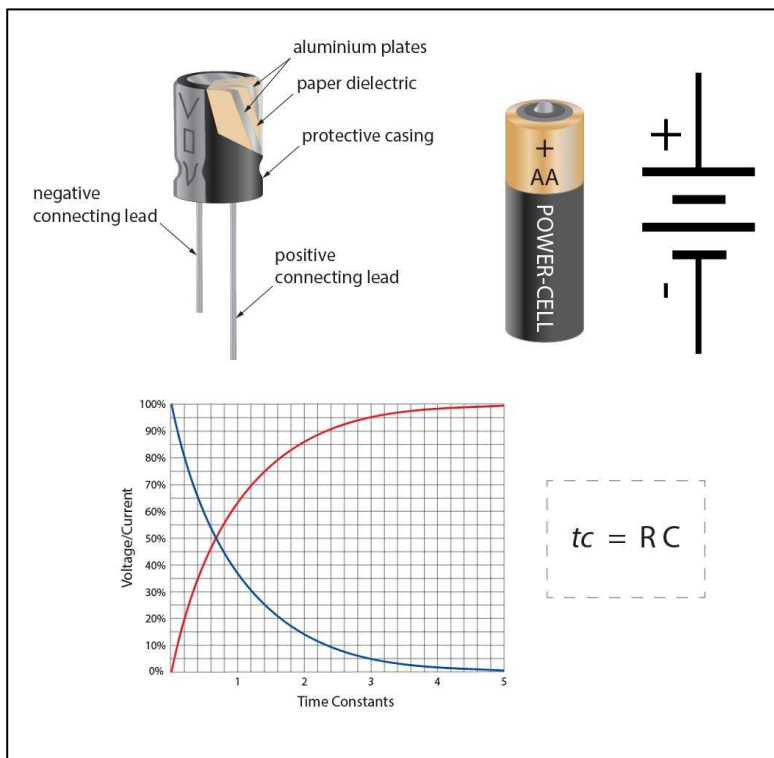


Unit Learning Plan

UEECD0044 – Solve problems in multiple path circuits



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	4
1 Parallel circuits	4
1.1 Introduction to Parallel Circuits	4
1.2 Characteristics and Operation of Parallel Circuits	4
2 Series/Parallel circuits	7
2.1 Introduction to Series/Parallel Circuits	7
2.2 Characteristics and Operation of Series/Parallel Circuits	7
3 Factors affecting resistance	9
3.1 Factors Affecting the Resistance of Conductors	9
4 Effects of meters in a circuit	11
4.1 Analogue and Digital Test Equipment	11
4.2 Characteristics of Test Equipment	11
4.3 Measuring Voltage and Current	12
5 Resistance measurement	14
5.1 Resistance Measurement Instruments	14
5.2 Measuring Resistance	14
6 Capacitors and Capacitance	17
6.1 Types of Capacitors	17
6.2 Factors Affecting Capacitance	17
6.3 Time Constant Relationship	18
7 Capacitors in Series and Parallel	20
7.1 Safe Handling and Storage of Capacitors	20
7.2 Capacitor Configuration and Testing	20

A. Overview		
Competency Standard Unit (CSU)	UEECD0044 Solve problems in multiple path circuits	
CSU Application	This unit involves the skills and knowledge required to solve problems in multiple path circuits. It includes working safely; applying problem-solving procedures, including the use of voltage, current and resistance measuring devices; and providing solutions derived from measurements and calculations to predictable problems in multiple path circuits. No licensing, legislative or certification requirements apply to this unit at the time of publication.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECD0044	Performance Criteria
	KE-UEECD0044	Knowledge Evidence
	PE-UEECD0044	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 7	36 hours
	Completion of Unit Knowledge Test	2 hours
	Completion of Unit Skills Test	2 hours
	Total duration of structured learning program	40 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0046 Solve problems in single path circuits	

B. Knowledge and Skills Delivery

1 Parallel circuits

Purpose:	In this topic you will learn about parallel circuits and the basic laws applicable to the parallel circuit. You will also learn about current dividers.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Introduction to Parallel Circuits					
Knowledge					
List the major components of a 'parallel' circuit including power supply, loads, connecting leads and switch	KE3.2	-	-	5	Topic 1 Content Quiz Topic 1.1 Learning Activity
List the applications where 'parallel' circuits are used in the Electrotechnology industry	KE3.3	-	-	5	
Skills					
Draw a schematic diagram of a single-source d.c. 'parallel' circuit	K3.1	1.1	PE12	5	Topic 1.1 Skills Practice
1.2 Characteristics and Operation of Parallel Circuits					
Knowledge					
Describe the characteristics of a 'parallel' circuit including load connection, current paths, voltage drops, power dissipation and the effects of an open circuit and short circuit in a 'parallel' circuit	KE3.4	-	-	5	Topic 1 Content Quiz Topic 1.2 Learning Activity
Describe the relationship between currents entering a junction and currents leaving a junction	KE3.5	-	-	5	

1 Parallel circuits					
Describe the relationship between branch currents and resistances in a two branch current divider network	KE3.6		-	5	
Explain the output voltage and current levels of connecting cells in parallel	KE3.11		-	5	
Skills		-	-		
Calculate the total voltage, current and resistance of a 'parallel' circuit	KE3.7.1, 3.7.2, 3.7.3	2.3, 2.6	PE3, 4, 13	5	Topic 1.2.1 Skills Practice Topic 1.2.2 Skills Practice
Calculate the individual branch currents and power dissipated in components of a 'parallel' circuit	KE3.7.2,	2.3, 2.6	PE3, 4, 13	5	
Set up and connect a single-source d.c. parallel circuit	KE3.8	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE5	5	
Take resistance, voltage and current measurements in a single-source parallel circuit	KE3.9	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE7	5	
Calculate the voltage, current, resistance and/or power dissipated from measured values of any of these quantities	KE3.10	2.3, 2.6	PE3, 4, 13	5	
Examine the effects of open circuits and short circuits	KE3.4	2.9	PE13	5	
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Phillips, P., Electrical Principles, Cengage Learning					
Equipment:					

1 Parallel circuits

- Selection of resistors of varying ohmic values and power ratings
- Insulated connecting leads
- Variable d.c. power supplies
- Batten holders
- Selection of d.c. bench ammeters
- Selection of d.c. bench voltmeters
- Selection of digital and analogue multimeters

2 Series/Parallel circuits					
Purpose:	In this topic you will learn about series/parallel circuits and the application of these circuits. You will also learn about bridge networks.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Introduction to Series/Parallel Circuits					
Knowledge					
List the major components of a 'series/parallel' circuit including power supply, loads, connecting leads and switch	KE2.2	-	-	5	Topic 2 Content Quiz Topic 2.1 Learning Activity
List the applications where 'series/parallel' circuits are used in the Electrotechnology industry	KE2.3	-	-	5	
Skills					
Draw a schematic diagram of a single-source d.c. series/ parallel circuit	KE2.1	1.1	PE12	5	Topic 2.1 Skills Practice
2.2 Characteristics and Operation of Series/Parallel Circuits					
Knowledge					
Describe the characteristics of a 'series/parallel' circuit including load connection, current paths, voltage drops, power dissipation, and effects of an open circuit and short circuit	KE2.4	-	-	5	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe the relationship between voltages, currents and resistances in a bridge network	KE2.5	-	-	5	
Skills					

2 Series/Parallel circuits					
Calculate the total voltage, current and resistance of a 'series/parallel' circuit	KE2.6.1, 2.6.2, 2.6.3	2.3, 2.6	PE3, 4, 13	5	Topic 2.2.1 Skills Practice Topic 2.2.2 Skills Practice
Calculate the total voltage and the individual voltage drops of a series/parallel circuit	K2.6.3	2.3, 2.6	PE3, 4, 13	5	
Calculate the individual branch currents and power dissipated in components of a 'series/parallel' circuit	KE2.6.2	2.3, 2.6	PE3, 4, 13	5	
Set up and connect a single-source d.c. series/parallel circuit	KE2.7	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE6	5	
Take resistance, voltage and current measurements in a single-source series/parallel circuit	K2.8	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE7	5	
Calculate the voltage, current, resistance and/or power dissipated from measured values of any of these quantities	K2.9	2.3, 2.6	PE3, 4, 13	5	
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Phillips, P., Electrical Principles, Cengage Learning Equipment: - Selection of resistors of varying ohmic values and power ratings. - Insulated connecting leads. - Variable d.c. power supplies. - Selection of d.c. bench ammeters - Selection of d.c. bench voltmeters					

2 Series/Parallel circuits

- Selection of digital and analogue multimeters.
- Selection of digital and analogue multimeters

3 Factors affecting resistance

Purpose: In this topic you will learn about the physical properties of a conductor that affect its resistance. You will also learn about the effect of this resistance has on cables current carrying capacity and voltage drop.

Duration: This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Factors Affecting the Resistance of Conductors					
Knowledge					
List the four factors that affect the resistance of a conductor (type of material, length, cross-sectional area and temperature).	KE1.1	1.2	-	3	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe the effects that material type has on the resistance of a conductor	KE1.2	-	-	3	
Describe the effects the change in 'length' has on the resistance of a conductor.	KE1.3	-	-	3	
Describe the effects the change in 'cross-sectional area' has on the resistance of a conductor.	KE1.4	-	-	3	
Describe the effects of temperature change on the resistance of various conducting materials.	KE1.5	-	-	3	
Describe the effects of resistance on the current-carrying capacity and voltage drop in cables.	KE1.6		-	3	

3 Factors affecting resistance

Skills					
Calculate the resistance of a conductor from factors such as conductor length, cross-sectional area, resistivity and changes in temperature.	KE1.7	2.3, 2.6	-	3	Topic 3.1 Skills Practice
Use digital and/or analogue ohmmeters to measure the change in resistance of different types of conductive materials (copper, aluminium, nichrome, tungsten) when those materials undergo a change in length, cross-sectional area and temperature.	KE1.8	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE8	3	

Reference Text:

- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Phillips, P., Electrical Principles, Cengage Learning

Equipment:

- Various types of conducting material – eg. copper, nichrome, tungsten, aluminium, etc.
- Analogue ohmmeter.
- Digital ohmmeter.
- Heat gun, portable LPG gas pack, etc.

4 Effects of meters in a circuit						
Purpose:	In this topic you will learn about the terms acceleration, force, work, power and energy and power dissipation in a d.c. circuit. You will also learn about power ratings of devices and methods used to calculate and measure power consumption.					
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Analogue and Digital Test Equipment						
Knowledge						
List the various types of voltmeters and ammeters used in the Electrotechnology industry.		KE4.1	-	-	5	Topic 4 Content Quiz Topic 4.1 Learning Activity
List the various types of voltage indicator testers (LED, neon, solenoid, volt-stick, series tester).		KE4.1	-	-	5	
4.2 Characteristics of Test Equipment						
Knowledge						
Explain the purpose and characteristics (internal resistance, range, loading effect and accuracy) of voltmeters and ammeters		KE4.2	-	-	5	Topic 4 Content Quiz Topic 4.2 Learning Activity
Explain the operation of various voltage indicator testers		KE4.5	-	-	5	
List the advantages and disadvantages of voltage indicator testers		KE4.2	-	-	5	
Explain and compare the operating characteristics of analogue and digital meters		KE4.1	-	-	5	
List the factors to consider when selecting meters for a given application (units to be measured, range, loading effect and accuracy)		KE4.4	-	-	5	

4 Effects of meters in a circuit					
Skills		-	-		
Select test equipment for given applications	KE4.3, KE4.5	1.6	-	5	Topic 4.3 Skills Practice
4.3 Measuring Voltage and Current					
Knowledge					
Explain the correct connection of a voltmeter into a circuit	KE4.4	-	-	5	Topic 4 Content Quiz Topic 4.3 Learning Activity
Explain the correct connection of an ammeter into a circuit	KE4.4	-	-	5	
Explain the 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 with the wrong polarity	KE4.5	-	-	5	
Explain and show the correct techniques to read the scale of an analogue meters and how to reduce the 'parallax' error	KE4.4	-	-	5	
Identify the hazards involved in using electrical instruments and the safety control measures that should be taken	KE4.3	-	-	5	
Skills					
Complete a Job Hazard Analysis when using electrical test instruments on a given testing task	KE4.3	1.2	PE1.1	5	Topic 4.3 Skills Practice
Connect an analogue/digital voltmeter into a circuit ensuring the polarities are correct and take various voltage readings	KE4.4	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	-	5	
Demonstrate the loading effect of various voltmeters when measuring voltage across various loads	KE4.6	1.2, 1.3, 1.5, 1.6, 2.1, 2.4,		5	

4 Effects of meters in a circuit

		2.5, 3.2			
Use a variety of voltage indicator testers to detect the presence of various voltage levels	KE4.4	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	-	5	
Connect an analogue/digital ammeter into a circuit ensuring the polarities are correct and take various current readings	KE4.4	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	-	5	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Phillips, P., Electrical Principles, Cengage Learning

Equipment:

- Selection of resistors of varying ohmic values and power ratings.
- Insulated connecting leads.
- Variable d.c. power supplies.
- Selection of d.c. bench ammeters
- Selection of d.c. bench voltmeters
- Selection of digital and analogue multimeters.
- Variable resistors.
- Simulated electrical installation.
- Selection of voltage indicator testers.

5 Resistance measurement						
Purpose:	In this topic you will learn about the various techniques used to measure resistance, including insulation resistance (IR).					
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 Resistance Measurement Instruments						
Knowledge						
Identify instruments used in the field to measure resistance (including insulation resistance) and the typical circumstances in which they are used		KE5.1	-	-	3	Topic 5 Content Quiz Topic 5.1 Learning Activity
Explain the purpose of an Insulation Resistance (IR) Tester		KE5.1	-	-	3	
Describe and explain the parts and functions of various analogue and digital IR Testers (selector range switch, zero ohms adjustment, battery check function, scale and connecting leads)		KE5.2	-	-	3	
Explain the purpose of regular IR tester calibration			-	-	3	
5.2 Measuring Resistance						
Knowledge						
Explain why the supply must be isolated prior to using IR/continuity testers		KE5.3	-	-	3	Topic 5 Content Quiz Topic 5.2 Learning Activity
Explain where and why a continuity test would be used		KE5.1, KE5.4	-	-	3	
Explain where and why an insulation resistance test would be used.		KE5.1, KE5.4	-	-	3	

5 Resistance measurement					
Explain 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.	KE5.5	-	-	3	
Discuss AS/NZS 3000 Wiring Rules requirements – Continuity test and Insulation resistance test	KE5.6	-	-	3	
Describe the correct methods of storing an IR tester after use	KE5.1	-	-	3	
Describe the volt-ammeter (short shunt and long shunt) methods of measuring resistance	KE5.8.3	-	-	3	
Skills					
Carry out a calibration check on a IR tester	KE5.7	-	-	3	Topic 5.2.1 Skills Practice Topic 5.2.2 Skills Practice
Measure low values of resistance using an IR tester continuity function	KE5.8.1	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE8	3	
Measure high values of resistance using an IR tester insulation resistance function	KE5.8.2	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE8	3	
Calculate resistance values using voltmeter and ammeter reading (long and short shunt connections)	KE5.8.3	2.3, 2.6	PE8	3	
Measure resistance using volt-ammeter methods	KE5.8.3	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE8	3	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education					

5 Resistance measurement

- Phillips, P., Electrical Principles, Cengage Learning

Equipment:

- Selection of resistors of varying ohmic values and power ratings
- Insulated connecting leads
- Variable d.c. power supplies
- Selection of d.c. desk-top ammeters
- Selection of d.c. desk-top voltmeters
- Selection of digital and analogue multimeters
- Variable resistors
- Selection of Insulation Resistance and Continuity testers
- Simulated electrical installation
- AS/NZS3000 Wiring Rules

6 Capacitors and Capacitance					
Purpose:	In this topic you will learn about the construction, types and application of capacitors and how to calculate the value of a capacitor from electrical values as well as physical dimensions. You will also learn about the effect of combining a resistor with a capacitor and how to determine the time constant that results.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Types of Capacitors					
Knowledge					
Describe the basic construction of a standard capacitor (plates, dielectric and connecting leads)	KE6.1	-	-	6	Topic 6 Content Quiz Topic 6.1 Learning Activity
List the different types of dielectric materials used in common capacitors, and each dielectric's relative permittivity	KE6.1	-	-	6	
Skills					
Identify the various types of fixed and variable capacitors commonly used in the Electrotechnology industry (stacked plate, rolled, electrolytic, ceramic, mica, tuning and trimmer)	KE6.1	-	-	6	Topic 6.2 Skill Practice
Identify the circuit symbol of various types of capacitors (standard, variable, trimmer and polarised)	KE6.2	-	-	6	
6.2 Factors Affecting Capacitance					
Knowledge					
Define the terms: "capacitance (C)", "electric charge (Q)" and "energy (W)"	KE6.3	-	-		Topic 6 Content Quiz Topic 6.2 Learning Activity

6 Capacitors and Capacitance					
List the units of capacitance (Farad), electric charge (Coulomb) and energy (Joule)	KE6.3	-	-	6	
Explain the 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	KE6.3	-	-	6	
Explain how a capacitor is charged in a d.c. circuit	KE6.4		-	6	
Skills					
Calculate voltage, capacitance and energy quantities from given information	KE6.5	2.3, 2.6	-	6	Topic 6.2 Skill Practice
6.3 Time Constant Relationship					
Knowledge					
Describe the behaviour of a series d.c. circuit containing resistive and capacitive components	KE6.4	-	-	6	Topic 6 Content Quiz Topic 6.3 Learning Activity
Explain the meaning of the term "time constant" and its relationship to the charging and discharging of a capacitor	KE6.4	-	-	6	
Skills					
Illustrate the charge and discharge curves for a series d.c. circuit containing resistive and capacitive components	KE6.6, 6.7	-	-	6	Topic 6.3 Skill Practice
Calculate the value of a single time constant, as well as the time taken to fully charge and discharge a given capacitor	KE6.6	2.3, 2.6	-	6	
Connect a series d.c. circuit containing capacitance and resistance and determine the time constant of the circuit	KE6.7	1.2, 1.3, 1.5, 1.6, 2.1, 2.4,	-	6	

6 Capacitors and Capacitance

2.5, 3.2

Reference Text:

- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Phillips, P., Electrical Principles, Cengage Learning

Equipment:

- Selection of capacitors of varying voltage/capacitance ratings.
- Selection of various capacitance and voltage rated electrolytic capacitors
- 1 x Galvanometer demonstration meter.
- Insulated connecting leads.
- Variable d.c. power supplies.
- Selection of d.c. bench ammeters and voltmeters.
- Selection of digital and analogue multimeters.
- Selection of various ohmic and power rated resistors.
- d.c. power supply.
- Single-throw, single-pole switch.

7 Capacitors in Series and Parallel						
Purpose:	In this topic you will learn how to determine the equivalent capacitance and voltage distribution for series and parallel-connected capacitors. You will also learn how to test capacitors for faults and serviceability.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
7.1 Safe Handling and Storage of Capacitors						
Knowledge						
List the applications for capacitors in the Electrotechnology industry	KE7.9	-	-	6	Topic 7 Content Quiz Topic 7.1 Learning Activity	
List the hazards associated with capacitors and the control measures that should be taken	KE7.1, KE7.2	-	-	6		
Describe the safe working procedures for handling and discharging capacitors	KE7.2	-	-	6		
Explain the dangers of a charged capacitor and describe the consequences of discharging a capacitor through a person	KE7.3	-	-	6		
7.2 Capacitor Configuration and Testing						
Knowledge						
Explain the effect of connecting capacitors in series and parallel on the total circuit capacitance	KE7.4, 7.5	-	-	6	Topic 7 Content Quiz Topic 7.2 Learning Activity	
Explain the procedure for testing a capacitor	KE7.8	-	-	6		
Describe common faults in capacitors	KE7.7	-	-	6		
Skills			-	-		
Draw capacitors connected in series (non-polarised and polarised)	KE7.6	-	-	6	Topic 7.2 Skills Practice	
Demonstrate safe working procedures when	KE7.2		-	6		

7 Capacitors in Series and Parallel					
working with capacitors					
Draw capacitors connected in parallel	KE7.6	-	-	6	
Calculate the total capacitance of a number of capacitors connected in series	KE7.5	2.3, 2.6	-	6	
Calculate the total capacitance of a number of capacitors connected in parallel	KE7.4	2.3, 2.6	-	6	
Connect capacitors in series and parallel configurations to achieve various capacitance values	KE7.6	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE9	6	
Determine through measurement whether a given capacitor is serviceable	KE7.8	1.2, 1.3, 1.5, 1.6, 2.1, 2.4, 2.5, 3.2	PE10	6	
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Phillips, P., Electrical Principles, Cengage Learning Equipment: - Selection of capacitors of varying voltage/capacitance ratings. - Insulated connecting leads. - Variable d.c. power supplies. - Selection of d.c. bench ammeters and voltmeters. - Selection of digital and analogue multimeters. - Selection of various ohmic and power rated resistors. - Single-throw, single-pole switch.					

Legend:

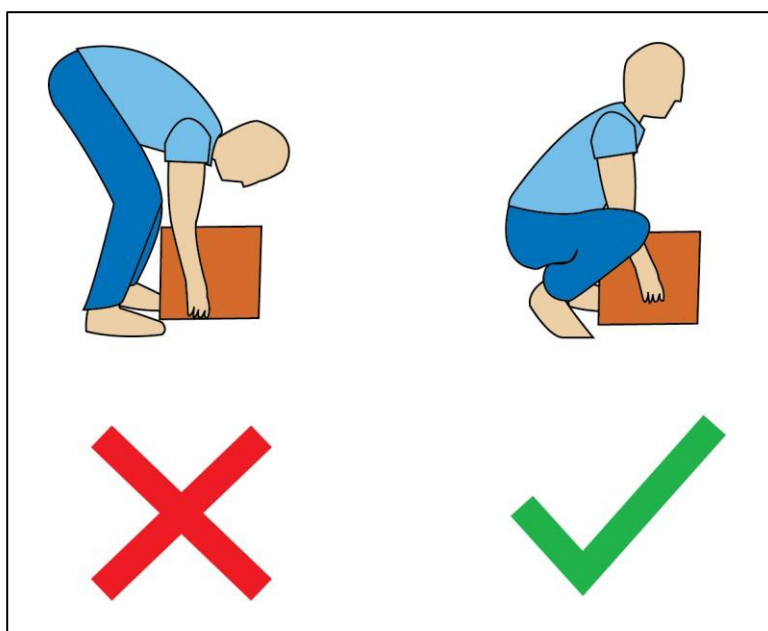
KE	Knowledge Evidence	PE	Performance Evidence

PC	Performance Criteria		

Unit Learning Plan

UEECD0007 – Apply work health and safety regulations, codes and practices in the workplace

April 2023
Release No. 1.1



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	4
1 Work Health and Safety Requirements	4
1.1 WHS Principles and Objectives	4
1.2 Roles and Responsibilities	4
1.3 Housekeeping and Potential Hazards	4
1.4 Personal Protective Equipment (PPE)	5
2 The Work Environment	6
2.1 Typical Hazards and Control Methods	6
2.2 Risk Assessment and Management	6
2.3 Workplace Safety	7
2.4 Standard Work Procedures	7
2.5 Fire Extinguishers	7
3 Manual Handling	9
3.1 Manual Handling Hazards	9
3.2 Manual Handling Techniques	9
4 Chemicals in the workplace	11
4.1 Classification and Identification	11
4.2 Handling and Storage	11
5 Working at Heights	13
5.1 Height Risk and Safety Equipment	13
5.2 Ladders	13
5.3 Scaffolds and Elevated Platforms	14
6 Confined Spaces	15
6.1 Confined Spaces	15
6.2 Hazards and Control Measures	15
7 Physical and Psychological Hazards	17
7.1 Physical Hazards	17
7.2 Hazardous Fibres and Gases	17
7.3 Psychological Hazards	18
8 Working Safely with Electricity	20
8.1 Causes and Effects of Electric Shock	20
8.2 Electric Shock Risk Control Measures	20
8.3 Electric Shock Rescue	21
9 Life Support – CPR in the Workplace	22
9.1 First Aid	22
9.2 Legal and Ethical Issues	22
9.3 Applying Emergency First Aid	22

A. Overview		
Competency Standard Unit (CSU)	UEECD0007 Apply work health and safety regulations, codes and practices in the workplace	
CSU Application	This unit involves the skills and knowledge required to apply work health and safety (WHS)/occupational health and safety (OHS) regulations and codes of practices in the electrotechnology workplace. It includes applying safe working practices, following workplace procedures for hazard identification and risk control. It also includes electrotechnology worker responsibilities and application for health and safety, risk management and adherence to safety practices as part of electrotechnology work functions when preparing to enter a work area. No licensing, legislative or certification requirements apply to this unit at the time of publication.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECD0007	Performance Criteria
	KE-UEECD0007	Knowledge Evidence
	PE-UEECD0007	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 9	17 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Unit Skills Test	2 hours
	Total duration of structured learning program	20 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • Nil	

B. Knowledge and Skills Delivery

1 Work Health and Safety Requirements

Purpose:	In this topic you will learn about workplace health and safety principles and requirements, legislative responsibilities of employers and employees, proper housekeeping and the selection of personal protective equipment.
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
1.1 WHS Principles and Objectives					
Knowledge					
State the underlying principles of workplace health and safety.	3.12	-	-	42	Topic 1 Content Quiz Topic 1.1 Learning Activity
List the general aims and objectives of the relevant state or territory legislation relating to workplace health and safety.	3.6, 3.11	-	-	42	
1.2 Roles and Responsibilities					
Knowledge					
Identify employer and employee responsibilities, rights and obligations.	3.4, 3.5, 3.11	-	-	42	Topic 1 Content Quiz Topic 1.2 Learning Activity
State the major functions of safety committees and representatives.	3.9	-	-	42	
List the powers given to workplace health and safety inspectors.	3.10	-	-	42	
1.3 Housekeeping and Potential Hazards					
Knowledge					
Define the term 'housekeeping'.	2.7, 3.8	-	-	43, 45	Topic 1 Content Quiz

1 Work Health and Safety Requirements					
List the potential hazards associated with improper housekeeping.	2.7, 3.8	-	-	43, 45	Topic 1.3 Learning Activity
1.4 Personal Protective Equipment (PPE)					
Knowledge					
List the types of personal protective equipment (PPE) commonly required to safely carry out typical electrotechnology work tasks.	3.1	-	-	43, 45	Topic 1 Content Quiz Topic 1.4 Learning Activity
Skills					
Select appropriate personal protective equipment (PPE) to carry out electrotechnology work tasks.	3.1	1.5, 3.1, 3.2, 3.3, 3.4	3	43, 45	Topic 1.4 Skill Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill, Seventh Edition, Volume 1, 2010 (Chapter 2) - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1) - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) Standards and codes: - AS 1470:1986 Health and safety at work - Principles and practices					

2 The Work Environment						
Purpose:	In this topic you will develop the ability to be able to identify hazards and risks in the workplace and document the hazards and control measures. It also covers emergency situations, standard work procedures and types of fire extinguishers.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping				Energy Space Resources
		KE	PC	PE	EPC	
2.1 Typical Hazards and Control Methods						
Knowledge						
Describe typical hazards associated with a range of worksites.		2.5, 3.7	-	-	44	Topic 2 Content Quiz Topic 2.1 Learning Activity
Describe the procedures used to control the risks associated with these hazards.		2.8	-	-	43, 44	
2.2 Risk Assessment and Management						
Knowledge						
Describe the principles of risk assessment / management and state the purpose of each.		3.3, 5.3	-	-	44	Topic 2 Content Quiz Topic 2.2 Learning Activity
List the hierarchy of OH&S hazard control measures.		5.2	-	-	44	
Describe the required documentation for risk assessment.		2.4, 5.3	-	-	44	
Skills						
Develop a job safety / hazard analysis (JSA/JHA) for a basic electrotechnology work task.		2.4, 2.7, 2.8, 3.3, 3.7, 3.8, 5.2, 5.3	3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.5, 3, 8	44	Topic 2.2 Skill Practice

2 The Work Environment					
2.3 Workplace Safety					
Knowledge					
List the safety signs commonly used in electrotechnology workplaces.	2.2	-	-	43, 45	Topic 2 Content Quiz Topic 2.3 Learning Activity
List the types of workplace emergencies that can require emergency evacuation of a workplace.	5.1	-	-	43, 45	
State the basic procedures for responding to workplace emergencies.	5.1	-	-	43, 45	
Skills					
Identify a range of commonly used workplace safety signs.	2.2	2.2, 3.4	2	43, 45	Topic 2 Content Quiz Topic 2.3 Learning Activity
2.4 Standard Work Procedures					
Knowledge					
Explain the concept of a 'standard work procedure'.	2.3	-	-	43, 44	Topic 2 Content Quiz Topic 2.4 Learning Activity
Explain the need for standard work procedures in electrotechnology work.	2.3	-	-	43, 44	
2.5 Fire Extinguishers					
Knowledge					
Match the fire extinguishers to the different types of fires.	2.1	-	-	43	Topic 2 Content Quiz Topic 2.5 Learning Activity
Explain the basic process of fighting a fire.	2.6	-	-	43	
Skills					
Select appropriate fire extinguishers for various types of fires.	2.1	2.2, 3.4	2	43	Topic 2 Content Quiz Topic 2.5 Learning Activity
Reference Text:					

2 The Work Environment

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill, Seventh Edition, Volume 1, 2010 (Chapter 2)
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1)
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1)

Standards and codes:

- AS 1470:1986 Health and safety at work - Principles and practices

3 Manual Handling					
Purpose:	In this topic you will learn about safe manual handling techniques.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 1 hour to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Manual Handling Hazards					
Knowledge					
Define the term manual handling.	6.7.2, 6.7.3	-	-	43, 45	Topic 3 Content Quiz Topic 3.1 Learning Activity
List typical manual handling injuries and the effect they have on lifestyle.	6.7.3	-	-	43, 45	
Skills					
Identify situations that may cause manual handling injuries.	6.7.2	3.1, 3.2	1.1	43, 45	Topic 3.2 Skill Practice
3.2 Manual Handling Techniques					
Knowledge					
Describe the correct procedures for lifting and carrying to prevent manual handling injuries.	6.7.1	-	-	43, 45	Topic 3 Content Quiz Topic 3.2 Learning Activity
Skills					
Develop a job safety / hazard analysis (JSA/JHA) for correctly lifting a heavy item from the floor to a bench.	2.4, 2.8, 3.3, 3.7, 5.2, 5.3, 6.7.1	3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.5, 8	43, 44, 45	Topic 3.2 Skill Practice
Demonstrate correct manual handling techniques to lift a weight from the floor to a bench.	6.7.1	2.1, 2.4	1.2, 1.4, 4	43, 45	

3 Manual Handling

Reference Text:

- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1)
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1)

4 Chemicals in the workplace					
Purpose:	In this topic you will learn about the safe handling of hazardous chemicals, labelling and storage of chemicals.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Classification and Identification					
Knowledge					
Describe the difference between hazardous substances and dangerous goods.	6.4.1	-	-	43, 45	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe the classification of hazardous substances and dangerous goods.	6.4.1	-	-	43, 45	
State the requirements for labelling chemicals in the workplace.	6.4.2	-	-	43, 45	
Skills					
Identify chemicals as hazardous substances and/or dangerous goods.	6.4.1	1.5, 3.1, 3.2	1.4	43, 45	Topic 4.2 Skill Practice
4.2 Handling and Storage					
Knowledge					
Describe safe storage procedures for chemicals.	6.4.2	-	-	43, 45	Topic 4 Content Quiz Topic 4.2 Learning Activity
Describe the purpose and interpretation of a safety data sheet (SDS).	6.4.3	-	-	43, 45	
Skills					
Interpret and extract information from a safety data sheet (SDS).	6.4.3	1.3, 1.5, 3.4	1.4	43, 45	Topic 4.2 Skill Practice
Reference Text:					

4 Chemicals in the workplace

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill, Seventh Edition, Volume 1, 2010 (Chapter 2)
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1)
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1)

5 Working at Heights					
Purpose:	In this topic you will learn about the hazards when working at heights and the safe use of ladders and mobile scaffolds.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Height Risk and Safety Equipment					
Knowledge					
List the hazards and risks associate with working on ladders and scaffolds.	6.8.1, 6.8.2	-	-	43, 45	Topic 5 Content Quiz Topic 5.1 Learning Activity
Skills					
Identify working at heights hazards and risks in a given work area.	6.8.1, 6.8.2	3.1, 3.2	1.1	43, 45	Topic 5.2 Skill Practice Topic 5.3 Skill Practice
Use appropriate safety equipment to control hazards and risks associated with working at heights.	6.8.1, 6.8.2	2.1, 2.3, 3.4	1.2, 1.4	43, 45	
5.2 Ladders					
Knowledge					
List the factors to consider when selecting a ladder for a given situation.	6.8.1, 6.8.2	-	-	43, 45	Topic 5 Content Quiz Topic 5.2 Learning Activity
List precautions that should be taken when ascending and working off a ladder.	6.8.1, 6.8.2	-	-	43, 45	
Skills					
Select an appropriate ladder for a given situation.	6.8.1, 6.8.2	1.5	7	43, 45	Topic 5.2 Skill Practice

5 Working at Heights					
Perform a basic pre-use safety check on a ladder.	6.8.1, 6.8.2	1.5, 3.4	7	43, 45	
5.3 Scaffolds and Elevated Platforms					
Knowledge					
List precautions that should be taken when working on and around a scaffold and elevated platform.	6.8.1, 6.8.2	-	-	43, 45	Topic 5 Content Quiz Topic 5.3 Learning Activity
Skills					
Develop a job safety / hazard analysis (JSA/JHA) for a work scenario requiring the use of a scaffold.	2.4, 2.8, 3.3, 3.7, 5.2, 5.3, 6.8.1, 6.8.2	1.5, 3.1, 3.2, 3.3 3.4	1.1, 1.2, 1.3, 1.5, 8	43, 45	Topic 5.3 Skill Practice
Reference Text: - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1) - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) - WorkCover NSW: Safety Guide No. 4503 February 1999: Portable Ladders					

6 Confined Spaces					
Purpose:	In this topic you will learn about confined spaces hazards and control measures when working in confined spaces.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 1 hour to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Confined Spaces					
Knowledge					
Define the term 'confined space'.	6.1	-	-	43, 45	Topic 6 Content Quiz Topic 6.1 Learning Activity
List typical workplace situations that would be classified as confined spaces.	6.2	-	-	43, 45	
Skills					
Identify confined spaces in a variety of workplace situations.	6.1, 6.2	3.1, 3.2	1.1	43, 45	Topic 6 Content Quiz Topic 6.1 Learning Activity
6.2 Hazards and Control Measures					
Knowledge					
State the hazards associated with working in a confined space.	6.1	-	-	43, 45	Topic 6 Content Quiz Topic 6.2 Learning Activity
State the control measures for working in a designated confined space.	6.3	-	-	43, 45	
Skills					
Develop a job safety / hazard analysis (JSA/JHA) for a work scenario involving work in a confined space.	2.4, 2.8, 3.3, 3.7, 5.2, 5.3, 6.5.1, 6.5.2,	1.5, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.5, 8	43, 44, 45	Topic 6.2 Skill Practice

6 Confined Spaces

6.5.3

Reference Text:

- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1)
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1)

Standards and codes:

- AS 2865:2009 Confined spaces

7 Physical and Psychological Hazards					
Purpose:	In this topic you will learn about physical and psychological workplace hazards and suitable methods for controlling them.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Physical Hazards					
Knowledge					
List the hazards, risks and control measures associated with industrial noise.	6.6	-	-	43, 45	Topic 7 Content Quiz Topic 7.1 Learning Activity
List the hazards, risks and control measures associated with vibration.	6.6	-	-	43, 45	
List the hazards, risks and control measures associated with excessive heat/cold.	6.6	-	-	43, 45	
List the hazards, risks and control measures associated with UV radiation.	6.6	-	-	43, 45	
List the hazards, risks and control measures associated with laser operated equipment and tools.	6.6	-	-	43, 45	
List the hazards, risks and control measures associated with occupational overuse syndrome (OOS).	6.6	-	-	43, 45	
7.2 Hazardous Fibres and Gases					
Knowledge					
List common types of asbestos containing materials (ACMs) and the methods by which asbestos fibres can be released.	3.2, 6.1.1	-	-	42, 43, 45	Topic 7 Content Quiz Topic 7.2 Learning Activity

7 Physical and Psychological Hazards					
List the hazards, risks and control measures associated with asbestos, including: - Effects on body - Warning signs - Requirement for reporting the presence of asbestos	3.2, 6.1.2, 6.1.3, 6.1.4	-	-	42, 43, 45	
List common types of building materials that contain crystalline silica and the methods by which silica dust can be released.	6.2.1, 6.2.2	-	-	42, 43, 45	
List the hazards, risks and control measures associated with silica, including: - Effects on body - Maximum exposure standards	6.2.3, 6.2.4	-	-	42, 43, 45	
List the hazards, risks and control measures associated with hazardous gases.	3.2, 6.3	-	-	42, 43, 45	
7.3 Psychological Hazards					
Knowledge					
List the factors that cause stress in the workplace and describe personal stress management techniques.	6.6	-	-	43, 45	Topic 7 Content Quiz Topic 7.3 Learning Activity
State the detrimental effects, dangers and consequences of drug and alcohol use in the workplace.	6.6	-	-	43, 45	
Reference Text: - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1) - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) Other useful references: - Stress, the Workplace and the Individual, WorkCover New South Wales, Sydney, 1996.					

7 Physical and Psychological Hazards

- The Management of Occupational Stress in Commonwealth Agencies: a joint ANAO/Comcare Better Practice Guide for Senior Managers, Comcare, Canberra, 1997.
- The Management of Occupational Stress in Commonwealth Agencies: implementing an occupational stress prevention program, Comcare, Canberra, 1997.
- Safety Management - A guide, (1997) NT WorkSafe, Darwin.

8 Working Safely with Electricity					
Purpose:	In this topic you will learn about working with electricity and the protective measures you can use to avoid electric shocks.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Causes and Effects of Electric Shock					
Knowledge					
State the effects that electric shock can cause to the human body.	6.9.1	-	-	43, 45	Topic 8 Content Quiz Topic 8.1 Learning Activity
Describe common causes of electrical accidents.	6.9.6	-	-	43, 45	
8.2 Electric Shock Risk Control Measures					
Knowledge					
Describe precautions that can minimise the chance of electric shock including earthing, extra low voltage, fuses, circuit breakers and residual current devices (RCDs).	6.9.5	-	-	43, 45	Topic 8 Content Quiz Topic 8.2 Learning Activity
Explain the protection offered by a residual current device (RCD).	6.9.2	-	-	43, 45	
State the need for ensuring the (safe) isolation of an electrical supply.	6.9.3	-	-	31, 43, 45	
Skills					
Develop a job safety / hazard analysis (JSA/JHA) for the safe isolation of an electrical supply for a given work task.	2.4, 2.8, 3.3, 3.7, 5.2, 5.3, 6.9.3	1.4, 1.5, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.5, 5, 8	31, 43, 44, 45	Topic 8.2 Skill Practice

8 Working Safely with Electricity					
Demonstrate the safe isolation of an electrical supply for a given task.	6.9.3	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.6, 3.1, 3.2 3.3, 3.4	5	31, 43, 45	
8.3 Electric Shock Rescue					
Knowledge					
Describe the process to safely remove an electric shock victim from a live electrical situation.	6.9.4	-	-	46	Topic 8 Content Quiz Topic 8.3 Learning Activity
Skills					
Demonstrate an appropriate method of removing an electric shock victim from a live electrical situation	6.9.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.5, 2.6, 3.1, 3.2 3.3, 3.4	6	46	Topic 8.3 Skill Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill, Seventh Edition, Volume 1, 2010 (Chapter 2) - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1) - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) Other useful references: - Butrej, P. and Douglas, G., Hazards at Work: A Guide to Health and Safety in Australian Workplaces, OTEN NSW 1990 - St John Ambulance Australia, Australian First Aid, Canberra, 4th Edition, 2006 Standards and Codes: - AS/NZS 4836 Safe working on or near low-voltage and extra-low voltage electrical installations and equipment					

9 Life Support – CPR in the Workplace					
Purpose:	In this topic you will learn about the procedures for providing emergency first aid.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
9.1 First Aid					
Knowledge					
Define 'First Aid'.	4.1	-	-	47	Topic 9 Content Quiz Topic 9.1 Learning Activity
Define the responsibilities of a First Aider.	4.2	-	-	47	
Describe the priorities of first aid management for any accident or injury.	4.3	-	-	47	
Explain the procedures required at an accident scene.	4.4	-	-	47	
9.2 Legal and Ethical Issues					
Knowledge					
Explain the legal and ethical issues of providing first aid.	4.5	-	-	47	Topic 9 Content Quiz Topic 9.2 Learning Activity
Explain the term 'Duty of Care'.	4.6	-	-	47	
9.3 Applying Emergency First Aid					
Knowledge					
Describe the effect of cardio pulmonary arrest on the body.	4.8	-	-	47	Topic 9 Content Quiz Topic 9.3 Learning Activity
Describe the signs and symptoms of shock.	4.13	-	-	47	

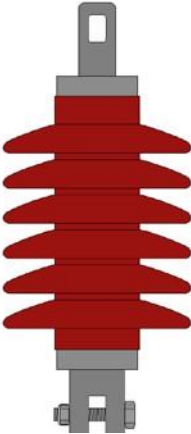
9 Life Support – CPR in the Workplace					
Skills					
Perform a simple examination of a casualty for injuries.	4.3, 4.4, 4.7	2.1, 2.2, 3.1, 3.2, 3.3, 3.4	2	47	Topic 9.3 Skill Practice
Manage the simulated conditions of airway obstruction, respiratory arrest and cardio pulmonary arrest.	4.3, 4.4, 4.9	2.1, 2.2, 3.1, 3.2, 3.3, 3.4	2	47	
Demonstrate single and two-person CPR.	4.4, 4.10	2.1, 2.2, 3.1, 3.2, 3.3, 3.4	2	47	
Demonstrate management by simulation of a casualty with an altered level of consciousness.	4.4, 4.12	2.1, 2.2, 3.1, 3.2, 3.3, 3.4	2	47	
Demonstrate management by simulation of a casualty in shock.	4.4, 4.14	2.1, 2.2, 3.1, 3.2, 3.3, 3.4	2	47	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill, Seventh Edition, Volume 1, 2010 (Chapter 2) - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education, Third Edition, 2011 (Section 1) - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) Equipment: - Practice mannequin for CPR					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEECD0016 – Document and apply measures to control WHS risks associated with electrotechnology work



	Likelihood		
Severity	Likely	Possible	Unlikely
Death or permanent disability	1	1	2
Serious injury or chronic illness	1	2	3
Minor injury requiring first aid	2	3	4

1 = Extreme risk
2 = High risk
3 = Medium risk
4 = Low risk

Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Risk Management	5
1.1 Risk Management Principles	5
1.2 Risk Assessment Processes	5
1.3 Hazard Identification	5
1.4 Risk Assessment Record Keeping	5
2 Degree of the Risk	7
2.1 Determining the Degree of the Risk	7
2.2 Using Control Measures	7
2.3 Monitoring and Review Processes	8
3 Construction Site Hazards and Risks	10
3.1 Hazards and Risks on Construction Sites	10
3.2 Construction Site Risk Management	10
4 Electrical Installation Hazards and Risks	12
4.1 Extra-Low Voltage Installations Risks	12
4.2 Low Voltage Installations Risks	12
5 High Voltage Hazards and Risks	14
5.1 High Voltage Terminology	14
5.2 High Voltage Installations	14
5.3 High Voltage Risk Management	14
6 Low Voltage Equipment Hazards and Risks	16
6.1 Working with LV Equipment	16
6.2 Control Measures for LV Equipment	16
6.3 Working on Energised LV Equipment	17
7 Harmful Materials Hazards and Risks	19
7.1 Harmful Devices	19
7.2 Harmful Materials	19
7.3 Harmful Airborne Particles	20

A. Overview		
Competency Standard Unit (CSU)	UEECD0016 Document and apply measures to control WHS risks associated with electrotechnology work	
CSU Application	This unit involves the skills and knowledge required to identify, document and apply work health and safety (WHS)/occupational health and safety (OHS) hazard and risk control measures associated with electrotechnology work. It includes identifying workplace hazards, assigning levels of risk, developing control measures to eliminate and/or mitigate risks, reviewing risk control measures and maintaining documentation of hazards, risk control measures and their application in accordance with compliance procedures. This unit addresses information, processes and techniques for the application of WHS/OHS, specific to working in the electrotechnology sector and is essential for workers without managerial or supervisory responsibilities. Typically, this unit will relate to the type of job being undertaken, electrical conditions, energy levels, radiation levels, toxic substances, airborne particles, pressure discharge, explosive atmosphere, worksite location, general worksite conditions, specific work location, moving parts, tools and equipment, workers competence and/or capacity and/or personal effects. No licensing, legislative or certification requirements apply to this unit at the time of publication.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECD0016	Performance Criteria
	KE-UEECD0016	Knowledge Evidence
	PE-UEECD0016	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 7	18 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Unit Skills Test	1 hour

	Total duration of structured learning program	20 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace	

B. Knowledge and Skills Delivery

1 Risk Management

Purpose:	In this topic you will learn about risk management and the various methods used for the assessment of risks.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Risk Management Principles					
Knowledge					
Explain the principles and purpose of risk management.	1.1	-	-	44	Topic 1 Content Quiz Topic 1.1 Learning Activity
1.2 Risk Assessment Processes					
Knowledge					
Describe the process of conducting a risk assessment.	1.2	-	-	44	Topic 1 Content Quiz Topic 1.2 Learning Activity
1.3 Hazard Identification					
Knowledge					
Describe how hazards are identified by a job analysis and work site inspection.	1.3	-	-	44	Topic 1 Content Quiz Topic 1.3 Learning Activity
Skills					
Conduct the Job Hazard Analysis (JHA) of a workplace and record identified hazards.	1.4	1.1, 1.2, 2.1, 3.1, 3.5	1.1, 1.2, 1.3, 1.4, 1.10	44	Topic 1.3 Skills Practice
1.4 Risk Assessment Record Keeping					
Knowledge					
Explain how to record hazards and assess the	1.4	-	-	44	Topic 1 Content Quiz

1 Risk Management					
risks.					Topic 1.4 Learning Activity
Skills					
Complete a workplace safety checklist to identify hazards, risks and required actions.	1.2, 1.3, 1.4	1.1, 1.2, 2.1	1.1, 1.2, 1.3, 1.4, 1.10	44	Topic 1.4 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - Codes of Practice – risk management					

2 Degree of the Risk					
Purpose:	In this topic you will learn about the methods in determining the degree of the risk and the monitoring and review of risk assessment methods used for continuous improvements.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Determining the Degree of the Risk					
Knowledge					
State the recognised levels of risk: • Extreme (imminent threat of death or permanent disability) • High (potential to kill or cause permanent disability) • Medium (potential to cause an injury or illness of a permanent nature) • Low (potential to cause a minor injury requiring first aid)	2.1, 2.2, 2.3, 2.4, 4.4	-	-	44	Topic 2 Content Quiz Topic 2.1 Learning Activity
State the difference between a hazard and a risk.	2.1, 2.2, 2.3	-	-	44	
Explain the concept of a risk matrix.	2.4, 2.5	-	-	44	
Skills					
Determine the risk level using a "risk priority" or "risk matrix" chart for a given task.	2.1, 2.2, 2.3, 2.4, 2.5, 4.4	1.2, 2.1	1.1, 1.2, 1.3, 1.4, 1.10	44	Topic 2 Content Quiz Topic 2.3 Skills Practice
2.2 Using Control Measures					
Knowledge					
Explain the hierarchy of control measures:	3.1	-	-	44	Topic 2 Content Quiz

2 Degree of the Risk					
• Elimination • Substitution • Isolation • Engineering controls • Administrative controls • Personal Protective Equipment (PPE)					Topic 2.2 Learning Activity
Explain what constitutes a 'reasonably practicable' in relation to risk control measures.	3.2, 4.4	-	-	44	
Describe how control measures are documented in Job Safety Analysis (JSAs), Safe Work Methods Statements (SWMS) and risk registers.	4.1, 4.2, 4.3, 4.4	-	-	43, 44	
Skills					
Develop a JSA or SWMS incorporating the hierarchy of control for a given work task.	3.1, 4.1, 4.2, 4.4	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.3, 3.5	1.1, 1.2, 1.3, 1.4, 1.7, 1.9, 1.10, 1.14	43, 44	Topic 2 Content Quiz Topic 2.3 Skills Practice
2.3 Monitoring and Review Processes					
Knowledge					
Describe the purpose of monitoring and reviewing the control measures.	3.3	-	-	44	Topic 2 Content Quiz Topic 2.3 Learning Activity
Describe the purpose of communicating the control measures to the work team.	3.3	-	-	44	
Describe the continuous improvement process to achieve best practice.	3.3	-	-	44	
Skills					
Engage in monitoring and reviewing processes to ensure control measures remain valid.	3.3	3.2, 3.4, 3.5	1.8, 1.11, 1.12, 1.13	44	Topic 2.3 Skills Practice
Conduct a safety meeting to review a JSA or SWM with a work group for a given task.	3.3	1.1, 1.2, 2.1, 2.2, 2.3, 2.4,	1.5, 1.6	44	

2 Degree of the Risk

3.1, 3.3

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- Codes of Practice – risk management

3 Construction Site Hazards and Risks					
Purpose:	In this topic you will learn about the various hazards and risks and the necessary control measures associated when working on construction sites.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Hazards and Risks on Construction Sites					
Knowledge					
List the various hazards that will be encountered on a construction site including: - Manual and mechanical handling - Working at heights - Working in confined spaces - Noise - Dusts, gases and chemicals	5.1, 5.2, 5.3, 5.4	-	-	44	Topic 3 Content Quiz Topic 3.1 Learning Activity
List the various risks posed by construction site hazards.	5.1, 5.2, 5.3, 5.4	-	-	44	
List the types of control measure typically used to reduce risks on construction sites.	5.1, 5.2, 5.3, 5.4	-	-	43, 44	
3.2 Construction Site Risk Management					
Knowledge					
State the relevant standards and codes of practice relevant to construction sites.	4.4	-	-	42, 44	Topic 3 Content Quiz Topic 3.2 Learning Activity
Skills					
Complete a Job Safety Analysis (JSAs) or Safe Work Methods (SWMs) to undertake electrical work in a construction site environment.	5.1, 5.2, 5.3, 5.4, 4.4	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3,	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9,	43, 44	Topic 3 Content Quiz Topic 3.2 Skills Practice

3 Construction Site Hazards and Risks

		3.4	1.10, 1.11, 1.12, 1.13, 1.14, 1.15		

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- Codes of Practice – construction work

4 Electrical Installation Hazards and Risks					
Purpose:	In this topic you will learn about the various hazards and risks and the necessary control measures associated when working on installations where high currents can be present operating at either extra-low voltage or low voltage.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Extra-Low Voltage Installations Risks					
Knowledge					
Explain the parts of an extra-low voltage electrical system and equipment where high currents are likely and describe the associated hazards.	8.2	-	-	44	Topic 4 Content Quiz Topic 4.1 Learning Activity
Explain the arrangement of power distribution and circuits in electrical installations operating at extra-low voltage.	8.1	-	-	44	
Skills					
Complete a Job Safety Analysis (JSAs) or Safe Work Methods (SWMs) to work on an extra low voltage, high current electrical installation.	8.2, 4.4	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14	44	Topic 4 Content Quiz Topic 4.1 Skills Practice
4.2 Low Voltage Installations Risks					
Knowledge					
Explain the parts of a low voltage electrical system and equipment where high currents are likely and describe the associated hazards.	8.2	-	-	44	Topic 4 Content Quiz Topic 4.2 Learning Activity

4 Electrical Installation Hazards and Risks					
Explain the arrangement of power distribution and circuits in electrical installations operating at low voltage.	8.1	-	-	44	
Explain the arrangement and relevant standards for safety services and alternate supplies within LV electrical installations.	4.4, 6.4, 7.5, 9.2	-	-	29, 55	
Skills					
Complete a Job Safety Analysis (JSAs) or Safe Work Methods (SWMs) to work on a low voltage, high current electrical installation.	8.2, 4.4	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.16	44	Topic 4 Content Quiz Topic 4.2 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - Codes of Practice – electrical risks					

5 High Voltage Hazards and Risks					
Purpose:	In this topic you will learn about the various hazards and risks and the necessary control measures associated when working on high voltage.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 High Voltage Terminology					
Knowledge					
Define the following concepts relating to high voltage: • Touch voltage • Step voltage • Induced voltage • Creepage	6.3	-	-	48	Topic 5 Content Quiz Topic 5.1 Learning Activity
5.2 High Voltage Installations					
Knowledge					
List the various parts of an electrical systems and equipment that operate at high voltage and describe the associated hazards and risks.	6.2	-	-	48	Topic 5 Content Quiz Topic 5.2 Learning Activity
Skills					
Identify the operating voltages of various high voltage systems and equipment.	6.2	-	-	48	Topic 5 Content Quiz Topic 5.2 Learning Activity
5.3 High Voltage Risk Management					
Knowledge					
Describe control measures used for dealing with hazards of high-voltage.	6.1	-	-	44, 48	Topic 5 Content Quiz

5 High Voltage Hazards and Risks					
State the relevant Australian Standards that apply to high voltage electrical installations.	4.4, 6.4	-	-	29, 48	Topic 5.3 Learning Activity
Describe the standard procedures for consultation, safe access and isolation of HV equipment for the purposes of undertaking electrical work.	4.4, 6.5	-	-	49	
Skills					
Complete a Job Safety Analysis (JSAs) or Safe Work Methods (SWMs) to work on a (simulated) high-voltage electrical installation.	4.4, 6.1, 6.3, 6.5	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.17	48, 44, 49	Topic 5 Content Quiz Topic 5.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - Codes of Practice – electrical risks					

6 Low Voltage Equipment Hazards and Risks					
Purpose:	In this topic you will learn about the various hazards and risks and the necessary control measures associated when working on low voltage.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Working with LV Equipment					
Knowledge					
Describe the associated hazards and risks that are present before, during and after modification, fault finding, maintenance and repair of low voltage equipment, including the presence of alternate supplies.	7.1, 7.5	-	-	44	Topic 6 Content Quiz Topic 6.1 Learning Activity
Skills					
Complete a Job Safety Analysis (JSAs) or Safe Work Methods (SWMs) to undertake modification, fault finding, maintenance and/or repair of low voltage equipment.	7.1	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.16	44	Topic 6 Content Quiz Topic 6.1 Skills Practice
6.2 Control Measures for LV Equipment					
Knowledge					
List the control measure for work before, while, and after workings on a low voltage electrical installations, circuits or equipment.	7.2, 4.4	-	-	44	Topic 6 Content Quiz Topic 6.2 Learning Activity
Describe and list the steps for safe isolation "lock out and tag out" (LOTO) procedures,	4.4, 7.3, 7.5, 9.1,	-	-	31, 55	

6 Low Voltage Equipment Hazards and Risks					
including precautions to ensure any alternate supplies are isolated.	9.2				
Skills					
Demonstrate the use of control measures to reduce the risks that are present before, during and after modification, fault finding, maintenance and repair of low voltage equipment.	4.4, 7.2	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.16	44	Topic 6 Content Quiz Topic 6.2 Skills Practice
Perform safe isolation and LOTO procedures.	4.4, 7.3, 9.1	-	-	31	
6.3 Working on Energised LV Equipment					
Knowledge					
Explain the hazards, risks and restrictions for working on “live” low voltage equipment.	4.4, 7.4	-	-	42, 44	Topic 6 Content Quiz Topic 6.3 Learning Activity
List the control measures for working on “live” low voltage equipment.	4.4, 7.4	-	-	44	
Skills					
Conduct an assessment to identify the risks and implement restrictions for working on “live” low voltage equipment.	4.4, 7.4	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.16	44	Topic 6 Content Quiz Topic 6.3 Skills Practice
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					
Standards and Codes:					

6 Low Voltage Equipment Hazards and Risks

- Codes of Practice – electrical risks

7 Harmful Materials Hazards and Risks					
Purpose:	In this topic you will learn about the various hazards and risks and the necessary control measures associated when working with harmful devices, materials, gases, dusts, and airborne contaminant.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Harmful Devices					
Knowledge					
List the hazards, risks and control measures associated with harmful devices, including: - Gas touches - Welding equipment - Laser equipped devices	4.4, 5.6	-	-	44	Topic 7 Content Quiz Topic 7.1 Learning Activity
Skills					
Conduct an assessment to identify harmful devices including gas torches, welding equipment, laser equipped devices and the like and apply control measures.	4.4, 5.6	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14	44	Topic 7 Content Quiz Topic 7.1 Skills Practice
7.2 Harmful Materials					
Knowledge					
List the hazards, risks and control measures associated with harmful materials, including: - Gases (refrigerants) - Industrial cleaning agents - Fibres of optical cable	4.4, 5.7	-	-	44	Topic 7 Content Quiz Topic 7.2 Learning Activity

7 Harmful Materials Hazards and Risks					
Thermal insulation					
Skills					
Conduct an assessment to identify harmful materials including gases (refrigerants), industrial cleaning agents, fibres of optical cable, and thermal insulation and apply control measures.	4.4, 5.7	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14	44	Topic 7 Content Quiz Topic 7.2 Skills Practice
7.3 Harmful Airborne Particles					
Knowledge					
List the hazards, risks and control measures associated with harmful airborne contaminants, including: - Fibres of thermal insulation - Fibres of optical cable - Fibrous cement materials - Asbestos	4.4, 5.5	-	-	44	Topic 7 Content Quiz Topic 7.3 Learning Activity
Skills					
Conduct an assessment to identify harmful airborne materials including fibres of thermal insulation, fibres of optical cable, fibrous cement, asbestos and other fibres in insulation materials and apply control measures.	4.4, 5.5	1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 3.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14	44	Topic 7 Content Quiz Topic 7.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					

7 Harmful Materials Hazards and Risks

Standards and Codes:

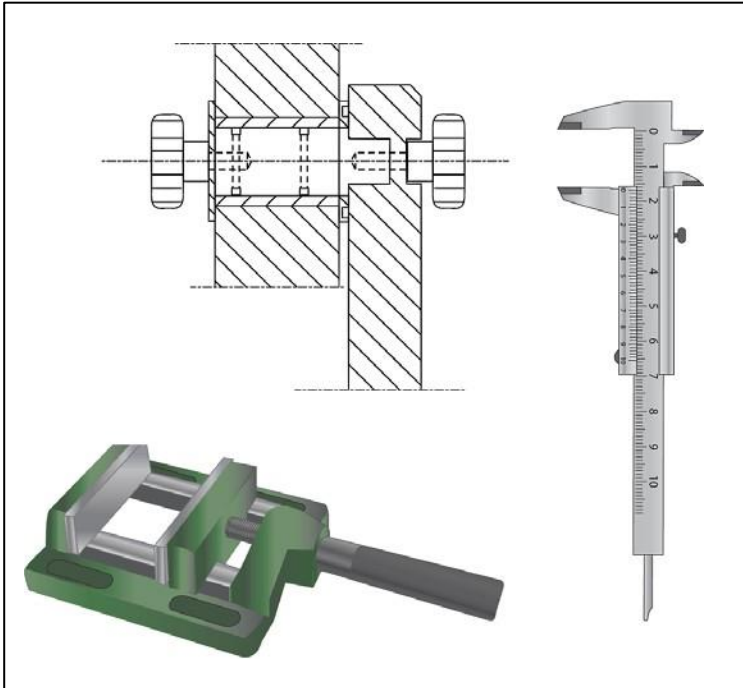
- Codes of Practice – asbestos, crystalline silica, chemicals, etc.

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEECD0019 – Fabricate, assemble and dismantle utilities industry components



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	4
1 Mechanical Drawings	4
1.1 Types of Mechanical Drawings	4
1.2 Standards and Conventions	4
1.3 Freehand Sketching	5
2 Workshop Planning and Materials	6
2.1 Safe Working Practices	6
2.2 Metallic and Non-Metallic Materials	6
2.3 Planning Process	7
3 Measuring and Marking Out	8
3.1 Measuring and Marking Out	8
3.2 Sustainable Work Practices	8
4 Holding and Cutting	10
4.1 Holding Tools	10
4.2 Cutting Tools	10
5 Drills and Drilling	12
5.1 Drill Bits	12
5.2 Drilling Machines	12
6 Tapping and Threading	14
6.1 Types of Threads	14
6.2 Tapping	14
6.3 Threading	14
7 General Hand Tools	16
7.1 Types of Hand Tools	16
7.2 Safe Use of Hand Tools	16
8 Joining Techniques	18
8.1 Machine Screws and Nuts	18
8.2 Soft Soldering	18
8.3 Welding, Brazing and Hard Soldering	19
9 Portable Power Tools	20
9.1 Types of Portable Power Tools	20
9.2 Safe Use of Portable Power Tools	20
10 Sheet Metal Work	22
10.1 Types of Sheet metals	22
10.2 Sheet Metal Fabrication	22
11 Low Tolerance Measurement	24
11.1 Tolerance	24
11.2 Vernier Callipers	24
11.3 Micrometers	24
12 Dismantling and Assembling Equipment	26
12.1 Dismantling Equipment	26
12.2 Assembling Equipment	27

A. Overview		
Competency Standard Unit (CSU)	UEECD0019 Fabricate, assemble and dismantle utilities industry components	
CSU Application	This unit involves the skills and knowledge required to fabricate, assemble and dismantle utilities industry components using fitting and metal fabrication techniques. It includes the safe use of hand tools, fixed and portable power tools; cutting, shaping, joining and fixing; using metallic and non-metallic materials; dismantling and assembling equipment; mechanical measurement and marking out; and, reading drawings/diagrams. No licensing, legislative or certification requirements apply to this unit at the time of publication.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECD0019	Performance Criteria
	KE-UEECD0019	Knowledge Evidence
	PE-UEECD0019	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 12	34 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Unit Skills Test	5 hours
	Total duration of structured learning program	40 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace	

B. Knowledge and Skills Delivery

1 Mechanical Drawings

Purpose:	In this topic you will learn how to use engineering drawings and the importance of standards and conventions used to allow the interpretation of the information they contain. You will also learn how to interpret and draw freehand objects in orthogonal and pictorial views.				
Duration:	This topic represents around 11% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Types of Mechanical Drawings					
Knowledge					
List the mechanical drawings that may typically be encountered in the electrotechnology industry (orthogonal projection, third angle - detail and assembly drawings, pictorial views).	1.3	-	13	-	Topic 1 Content Quiz Topic 1.1 Learning Activity
1.2 Standards and Conventions					
Knowledge					
Describe the drawing standards and conventions specified in AS1100.	1.1	-	13	-	Topic 1 Content Quiz Topic 1.2 Learning Activity
Explain the basic abbreviations and symbols used in drawing of mechanical components.	1.2	-	13	-	
Explain the layout of the mechanical components as per engineering drawing conventions.	1.4	-	13	-	
Skills					
Interpret and extract information from a standard mechanical engineering drawing.	1.3	1.4, 2.4, 3.4, 3.5	4, 6, 9, 10, 12, 13, 27	-	Topic 1.2 Learning Activity Topic 1.3 Skill Practice

1 Mechanical Drawings					
1.3 Freehand Sketching					
Knowledge					
Explain the information requirements for a freehand drawing so that others can interpret it.	1.5	-	-	-	Topic 1 Content Quiz Topic 1.3 Learning Activity
Skills					
Use freehand sketching techniques to draw a mechanical component showing all information needed for its manufacture/fabrication.	1.1, 1.2, 1.3, 1.4, 1.5	1.4	7, 10, 12, 15, 26, 27	-	Topic 1.3 Skill Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.4) - Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.1)					

2 Workshop Planning and Materials					
Purpose:	In this topic you will learn about required preparations prior to undertaking tasks in a workshop and some typical materials used in electrotechnology workshop situations.				
Duration:	This topic represents around 9% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Safe Working Practices					
Knowledge					
Describe the methods used to work safely in an industrial work environment.	2.1	-	-	44	Topic 2 Content Quiz Topic 2.1 Learning Activity
List typical non-electrical hazards in the workplace.	2.2	-	-	44	
Describe control measures for dealing with hazards identified.	2.3	-	-	44	
Skills					
Perform a risk assessment on a given work environment documenting and assessing the risks identified.	2.1, 2.2, 2.3	1.1, 1.2, 1.3	1, 3, 4, 6, 10, 12, 27	44	Topic 2.2 Skill Practice
2.2 Metallic and Non-Metallic Materials					
Knowledge					
List the types of metallic materials commonly used in the electrotechnology industry.	2.4	-	-	-	Topic 2 Content Quiz Topic 2.2 Learning Activity
List the types of non-metallic materials commonly used in the electrotechnology industry.	2.4	-	-	-	
List the applications for metallic and non-	2.4	-	-	-	

2 Workshop Planning and Materials					
metallic materials used in the electrotechnology industry.					
2.3 Planning Process					
Knowledge					
Describe the planning process for completing a mechanical workshop task.	2.5	-	-	44	Topic 2 Content Quiz Topic 2.3 Learning Activity
Skills					
Plan a mechanical workshop task (tools, materials, safe equipment and work methods)	2.5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7	1, 3, 4, 6, 9, 10, 12, 13, 18, 19, 26, 27	44	Unit Skills Project Topic 6.3 Skill Practice Topic 8.2 Skill Practice Topic 10.2 Skill Practice Topic 11.3 Skill Practice Topic 12.2 Skill Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.1 and 9.3-4) - Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.1)					

3 Measuring and Marking Out					
Purpose:	In this topic you will learn about common measuring and marking out tools and correct use of these tools.				
Duration:	This topic represents around 6% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Measuring and Marking Out					
Knowledge					
Explain the reasons of measuring and marking out.	3.1	-	-	-	Topic 3 Content Quiz Topic 3.1 Learning Activity
List the tools used for measuring.	14.6	-	-	45	
List the tools used for marking out.	14.6	-	-	45	
3.2 Sustainable Work Practices					
Knowledge					
Explain the methods used to reduce waste when measuring and marking out.	3.2	-	2	-	Topic 3 Content Quiz Topic 3.2 Learning Activity
Skills					
Measure and mark out a project accurately following correct procedures.	3.1, 3.2, 14.6	1.7, 3.4, 3.5	1, 2, 4, 6, 9, 10, 12, 13, 16, 17, 22, 26	44, 45	Unit Skills Project Topic 10.2 Skill Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.4) - Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.2) - Basic Training manuals – 16-4 Mechanical measuring					
Equipment:					

3 Measuring and Marking Out

- Working materials (i.e. sheet metal and mild steel bar)
- Callipers and Dividers
- Punches
- Scriber
- Square or combination set
- Steel ruler

4 Holding and Cutting					
Purpose:	In this topic you will learn about tools and techniques for holding and cutting materials used in the electrotechnology industry.				
Duration:	This topic represents around 6% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Holding Tools					
Knowledge					
List the types of holding tools used in electrotechnology work.	14.7	-	-	45	Topic 4 Content Quiz Topic 4.1 Learning Activity
Explain the applications for common holding tools.	14.7	-	-	45	
Skills					
Select holding tools to secure metallic and non-metallic materials.	14.7	1.7, 3.3	19	44, 45	Unit Skills Project Topic 6.3 Skill Practice Topic 10.2 Skill Practice
Demonstrate the use of safe working practices whilst using holding tools.	4.1, 4.2	3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10	1, 4, 6, 8.1, 9, 10, 11, 22, 26	44, 45	
4.2 Cutting Tools					
Knowledge					
List the types of cutting tools used in electrotechnology work.	14.7	-	-	45	Topic 4 Content Quiz Topic 4.2 Learning Activity
Explain the applications for common cutting tools used in electrotechnology work.	14.7	-	-	45	
Skills					

4 Holding and Cutting

Select tools for cutting, shaping, and finishing metallic and non-metallic materials.	14.7	1.7, 3.3	19	44, 45	Unit Skills Project Topic 6.3 Skill Practice Topic 10.2 Skill Practice
Demonstrate the use of safe working practices whilst using cutting tools.	4.1, 4.2	3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10	1, 2, 4, 6, 8.1, 9, 10, 11, 22, 26	44, 45	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.1 and 9.3-4)
- Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.1)
- Basic Training manuals - 16-9/10 Tools & equipment.

Equipment:

- Multi grips/Vice grips
- Cold chisels (various)
- Files (various)
- Hacksaw
- Pliers (various)
- Vice
- Steel sections (various)
- Brass sections (various)

5 Drills and Drilling					
Purpose:	In this topic you will learn about drill bits, drills and safe drilling techniques.				
Duration:	This topic represents around 6% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Drill Bits					
Knowledge					
List the types of drill bits commonly used in the electrotechnology industry.	5.1	-	-	45	Topic 5 Content Quiz Topic 5.1 Learning Activity
List the applications of the various types of drill bits used in the electrotechnology industry.	5.1	-	-	45	
Skills					
Select suitable drill bits for a range of applications.	5.1	1.7, 3.3	18	44, 45	Topic 5 Content Quiz Topic 5.1 Learning Activity
5.2 Drilling Machines					
Knowledge					
List the types of drilling machines commonly used in an electrotechnology workshop.	5.1	-	-	45	Topic 5 Content Quiz Topic 5.2 Learning Activity
List the applications of the various types of drilling machines used in an electrotechnology workshop.	5.1	-	-	45	
Describe the safe use of a pedestal/bench drill.	5.2, 5.3	-	-	45	
Skills					
Demonstrate the safe and accurate application of a pedestal/bench drill.	5.2, 5.3	3.1, 3.2, 3.3, 3.4, 3.5, 3.6,	1, 3, 4, 6, 8.1, 8.3, 9,	44, 45	Unit Skills Project

5 Drills and Drilling

		3.7, 3.8, 3.9, 3.10	10, 11, 12, 22, 24, 26		Topic 10.2 Skill Practice
Demonstrate the correct procedures when drilling metallic and non-metallic components.	5.2, 5.3	3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10	1, 3, 4, 6, 8.1, 8.6, 9, 10, 11, 12, 22, 24, 26	44, 45	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.6).
- Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.6).
- Metal Tool guides from various manufacturers
- Basic Training manual - 16-5

Equipment:

- Drills (range from 1 mm – 13 mm)
- Punches (various)
- Scribe
- Square/combination set and steel ruler
- Machine vice
- PPE – safety glasses, hair nets etc.
- Pedestal drill

6 Tapping and Threading					
Purpose:	In this topic you will learn about screw threads and suitable techniques for producing internal and external screw threads commonly used in the electrotechnology industry.				
Duration:	This topic represents around 6% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Types of Threads					
Knowledge					
List the common types and sizes of threads used in electrotechnology work.	6	-	-	-	Topic 6 Content Quiz Topic 6.1 Learning Activity
6.2 Tapping					
Knowledge					
List the various types of taps and tap wrenches used in electrotechnology work.	6, 14.1	-	-	45	Topic 6 Content Quiz Topic 6.2 Learning Activity
Describe the correct process to tap metallic and non-metallic materials.	6	-	-	45	
Skills					
Cut internal threads into metallic and non-metallic materials using suitable tapping tools, equipment and procedures.	6, 14.1	3.1, 3.2, 3.3, 3.6, 3.7, 3.8, 3.9, 3.10	1, 4, 6, 8.1, 8.2, 9, 10, 11, 12, 17, 19, 20, 22, 26	44, 45	Unit Skills Project
6.3 Threading					
Knowledge					
List the various types of stocks and dies used in electrotechnology work.	6, 14.1	-	-	45	Topic 6 Content Quiz

6 Tapping and Threading					
Describe the correct process to thread metallic and non-metallic materials.	6	-	-	45	Topic 6.3 Learning Activity
Skills					
Cut external threads onto metallic and non-metallic materials using suitable threading tools, equipment and procedures.	6, 14.1	3.1, 3.2, 3.3, 3.6, 3.7, 3.8, 3.9, 3.10	1, 4, 6, 8.1, 8.2, 9, 10, 11, 12, 17, 19, 20, 22, 26	44, 45	Topic 6.3 Skill Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.7). - Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.7). Equipment: - Stock and dies (various) - Taps and tap wrenches (various) - Round stock - Metallic conduit					

7 General Hand Tools					
Purpose:	In this topic you will learn about some of the hand tools commonly used in electrotechnology work.				
Duration:	This topic represents around 6% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Types of Hand Tools					
Knowledge					
List the types of hammers commonly used in electrotechnology work.	7, 14.2	-	-	45	Topic 7 Content Quiz Topic 7.1 Learning Activity
List the types of screwdrivers commonly used in electrotechnology work.	7, 14.2	-	-	45	
List the types of spanners and sockets commonly used in electrotechnology work.	7, 14.2	-	-	45	
List the types of pliers commonly used in electrotechnology work.	7, 14.2	-	-	45	
7.2 Safe Use of Hand Tools					
Knowledge					
Explain the safe working practices associated with using hammers, screwdrivers, spanners, sockets, and pliers.	7, 14.2	-	-	45	Topic 7 Content Quiz Topic 7.2 Learning Activity
Skills					
Select suitable hand tools to perform give work tasks.	7, 14.2	1.7, 2.3, 3.3	19	44, 45	Unit Skills Project Topic 8.2 Skill Practice Topic 10.2 Skill Practice Topic 12.2 Skill Practice
Demonstrate the safe use of a variety of hand tools.	7, 14.2	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.1, 2.2,	1, 2, 3, 4, 6, 9, 10, 19, 22, 26	44, 45	

7 General Hand Tools

		2.3, 2.4, 2.7, 2.8, 2.10, 2.11, 3.1, 3.2, 3.3, 3.6, 3.7, 3.9, 3.10			

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.2).
- Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.9).
- Basic Training manuals - 16-9/10 Tools & equipment 1, 2

Equipment:

- Allen keys (various)
- Hammer - engineers
- Hammer - soft headed (various)
- Pliers (various)
- Screw drivers (various)
- Sockets/spanners (various)

8 Joining Techniques					
Purpose:	In this topic you will learn about methods and practices for joining materials used in the electrotechnology industry.				
Duration:	This topic represents around 9% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Machine Screws and Nuts					
Knowledge					
List the various types of machine screws, nuts and washers used in electrotechnology work.	8.1	-	-	-	Topic 8 Content Quiz Topic 8.1 Learning Activity
Skills					
Use machine screws to join electrotechnology components.	8.1	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10	1, 3, 4, 6, 8.4, 8.5, 9, 10, 12, 14, 19, 22, 26	44, 45	Topic 12.2 Skill Practice
8.2 Soft Soldering					
Knowledge					
Explain the process of soft soldering.	8.2, 14.3	-	-	45	Topic 8 Content Quiz Topic 8.2 Learning Activity
List the safe working practises associated with soft soldering.	8.2	-	-	45	
Skills					
Join electrotechnology components using soft soldering techniques.	8.2, 14.3	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 3.1, 3.2, 3.3, 3.6, 3.7,	1, 2, 3, 4, 6, 9, 10, 12, 14, 22, 26	44, 45	Topic 8.2 Skill Practice

8 Joining Techniques					
		3.8, 3.9, 3.10			
8.3 Welding, Brazing and Hard Soldering					
Knowledge					
Describe the various forms of welding (Oxy-acetylene, arc welding, spot welding).	8.2, 14.3	-	-	45	Topic 8 Content Quiz Topic 8.3 Learning Activity
List the safe working practises associated with welding.	8.2	-	-	45	
Describe the various forms of brazing and hard soldering.	8.2, 14.3	-	-	45	
List the safe working practises associated with brazing and hard soldering.	8.2	-	-	45	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.8). • Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.10). Equipment: • Soldering irons • Soft solder • Printed circuit board • Electronic components					

9 Portable Power Tools					
Purpose:	In this topic you will learn about power tools that are commonly used in the electrotechnology industry.				
Duration:	This topic represents around 9% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
9.1 Types of Portable Power Tools					
Knowledge					
List the types of portable electric power tools commonly used in the electrotechnology work (grinders, drills, jigsaws, saws).	14.4	-	-	45	Topic 9 Content Quiz Topic 9.1 Learning Activity
List the types of compressed gas operated tools in electrotechnology work	10	-	-	45	
State typical applications for a variety of portable power tools.	9.1	-	-	45	
9.2 Safe Use of Portable Power Tools					
Knowledge					
Describe the safe working practices for the various portable power tools used in electrotechnology work (grinders, drills, jigsaws, saws).	9.2, 9.3	-	-	45	Topic 9 Content Quiz Topic 9.2 Learning Activity
Explain the requirement for portable power tools to be tested and tagged.	9.4	-	-		
Skills					
Fabricate electrotechnology components portable electric power tools.	9.2, 9.3	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 3.1, 3.2,	1, 2, 3, 4, 6, 9, 10, 12, 17, 18,	44, 45	Topic 10.2 Skill Practice

9 Portable Power Tools

		3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10	22, 26, 27		
Observe safe working practices whilst using portable electric power tools.	9.2, 9.3, 9.4	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 3.1, 3.2, 3.3, 3.6, 3.7, 3.8, 3.9, 3.10	1, 2, 3, 4, 6, 9, 10, 12, 17, 18, 22, 26, 27	44, 45	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.2 and 9.5-7).
- Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.8).

Equipment:

- PPE – safety glasses, gloves, hair nets etc.
- Portable grinder
- Portable drills

10 Sheet Metal Work					
Purpose:	In this topic you will learn about common types of sheet metal, sheet metal fabrication tools and techniques used in the electrotechnology industry.				
Duration:	This topic represents around 17% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
10.1 Types of Sheet metals					
Knowledge					
List the types of sheet metals used in electrotechnology work.	11.1	-	-	-	Topic 10 Content Quiz Topic 10.1 Learning Activity
State the common names and applications for various types of sheet metals.	11.2	-	-	-	
10.2 Sheet Metal Fabrication					
Knowledge					
Describe the techniques used in sheet metal fabrication work (cutting, bending, drilling/punching, joining, cutting mitres).	11.3, 11.4, 11.5	-	-	45	Topic 10 Content Quiz Topic 10.2 Learning Activity
Describe the safe working practices for handling sheet metals.	11.3	-	-	45	
List the tools used to work sheet metals (hacksaw, tinsnips, guillotines, punches, notching tools, folding machines).	14.8	-	-	45	
Skills					
Select appropriate tools for cutting, bending, drilling/punching holes, and joining sheet metals.	11.3, 11.4, 14.8	1.7, 3.3	18, 19	44, 45	Topic 10.2 Skill Practice

10 Sheet Metal Work

Use safe and sustainable working practices to fabricate electrotechnology components from sheet metal, including cutting, bending, drilling/punching holes, and joining.

11.3,
11.4,
11.5,
14.8

1.1, 1.2, 1.3,
1.4, 1.5, 1.6,
1.7, 3.1, 3.2,
3.3, 3.4, 3.5,
3.6, 3.7, 3.8,
3.9, 3.10

1, 2, 3, 4,
6, 8.1, 8.7,
9, 10, 11,
12, 13, 14,
16, 17, 18,
19, 22, 23,
26, 27

44, 45

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.3 and 9.5).
- Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.5).

Equipment:

- Pan brake bender, guillotine and notcher
- Tin snips (various)
- Callipers and dividers (various)
- Hammer – soft headed (various)
- Multi grips/Vice grips
- Punches (various)
- Scriber
- Combination set and steel ruler
- Pop riveter
- Nibbler
- Safety glasses
- Material: Aluminium, Galvanised steel, Copper and PVC.
- Miscellaneous fastenings

11 Low Tolerance Measurement					
Purpose:	In this topic you will learn how to use equipment for making measurements where a low tolerance is required.				
Duration:	This topic represents around 6% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
11.1 Tolerance					
Knowledge					
Explain what is meant by the term “tolerance” in relation to engineering measurements.	12.1	-	-	-	Topic 11 Content Quiz Topic 11.1 Learning Activity
List the tools typically used to take low tolerance measurements.	14.6	-	-	45	
11.2 Vernier Callipers					
Knowledge					
Describe the techniques for taking measurements with Vernier callipers.	12.2	-	-	45	Topic 11 Content Quiz Topic 11.2 Learning Activity
Skills					
Demonstrate the use of Vernier callipers to measure engineering components.	12.2, 14.6	2.1, 2.2, 2.3, 2.4, 2.5, 2.8, 2.9, 2.10, 2.11	1, 4, 6, 9, 10, 12, 22, 17, 21	44, 45	Topic 11.3 Skill Practice
11.3 Micrometers					
Knowledge					
Describe the techniques for taking measurements with a micrometer.	12.2	-	-	45	Topic 11 Content Quiz Topic 11.3 Learning

11 Low Tolerance Measurement					
					Activity
Skills					
Demonstrate the use of micrometers to measuring engineering components.	12.2, 14.6	2.1, 2.2, 2.3, 2.4, 2.5, 2.8, 2.9, 2.10, 2.11	1, 4, 6, 9, 10, 12, 17, 21, 22	44, 45	Topic 11.3 Skill Practice
Reference Text: • Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.3) • Basic Training manual – 16-4 Mechanical measuring Equipment: • Vernier callipers • Micrometers • Components to measure					

12 Dismantling and Assembling Equipment					
Purpose:	In this topic you will learn about using fitting techniques to dismantle and assemble commonly used equipment found in the electrotechnology industry.				
Duration:	This topic represents around 9% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
12.1 Dismantling Equipment					
Knowledge					
Describe the tools commonly used to dismantle electrotechnology equipment (soft-faced hammers, spanners, screwdrivers, bearing pullers, etc).	14.5	-	-	45	Topic 12 Content Quiz Topic 12.1 Learning Activity
Describe the safe working practices for dismantling electrotechnology equipment.	13	-	-	45	
Describe the techniques for dismantling electrotechnology equipment (documentation, sequence of steps, ensuring equipment is not damaged, cataloguing components).	13	-	-	45	
Skills					
Dismantle an electrical, electronic, instrumentation or refrigeration/air conditioning piece of equipment using safe working practices.	13, 14.5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11	1, 3, 4, 5, 6, 8.4, 9, 10, 12, 19, 22, 26, 27	44, 45	Topic 12.2 Skill Practice

12 Dismantling and Assembling Equipment					
12.2 Assembling Equipment					
Knowledge					
Describe the tools commonly used to assemble electrotechnology equipment.	14.5	-	-	45	Topic 12 Content Quiz Topic 12.2 Learning Activity
Describe the safe working practices for assembling electrotechnology equipment.	13	-	-	45	
Describe the techniques for assembling electrotechnology equipment. (documentation, sequence of steps, checking equipment for damage)	13	-	-	45	
Skills					
Assemble an electrical, electronic, instrumentation or refrigeration/air conditioning piece of equipment using safe working practices.	13, 14.5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.1, 2.2, 2.3, 2.4, 2.7, 2.8, 2.9, 2.10, 2.11	1, 3, 4, 5, 6, 8.5, 9, 10, 12, 19, 22, 26, 27	44, 45	Topic 12.2 Skill Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice – Volume 2. McGraw-Hill, Seventh Edition (eChapter 9.9). - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill, Sixth Edition, Volume 2 (Chapter 3.3). - Hampson, J., Electrotechnology Practical, Pearson Education, Third Edition, 2014 (Section 3.9). Equipment: - Allen keys (various) - Cold chisels (various) - Hammer- engineers - Hammer - soft headed (various) - Pliers – various - Multi grips/Vice grips					

12 Dismantling and Assembling Equipment

- Punches (various)
- Screw drivers Various
- Sockets/spanners various

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEECD0020 – Fix and secure electrotechnology equipment



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	4
1 Fixing to Hollow Walls	4
1.1 Hollow Wall Structures and Fixings	4
1.2 Hollow Wall Fixing Methods	5
2 Fixing to Solid Walls	6
2.1 Solid Wall Structures and Fixings	6
2.2 Solid Wall Fixing Methods	6
3 Fixing to Metal Structures	8
3.1 Metal Structures and Fixings	8
3.2 Metal Fixing Methods	9
4 Using Adhesives and Tapes	10
4.1 Types of Adhesives and Tapes	10
4.2 Fixing with Adhesives and Tapes	10

A. Overview		
Competency Standard Unit (CSU)	UEECD0020 Fix and secure electrotechnology equipment	
CSU Application	This unit involves the skills and knowledge required to fix, secure and mount electrotechnology equipment to hollow walls, solid walls and metal fixings. It includes the safe use of hand and portable tools/ power tools and the selection and safe application of fixing devices and supporting accessories/equipment. No licensing, legislative or certification requirements apply to this unit at the time of publication.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECD0020	Performance Criteria
	KE-UEECD0020	Knowledge Evidence
	PE-UEECD0020	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 4	18 hours
	Completion of Unit Knowledge Test	45 minutes
	Completion of Unit Skills Test	75 minutes
	Total duration of structured learning program	20 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace	

B. Knowledge and Skills Delivery

1 Fixing to Hollow Walls

Purpose:	In this topic you will learn about the various techniques and the fasteners and anchors available for use when securing and mounting accessories to hollow walls.				
Duration:	This topic represents around 25% of the knowledge and skills specification contents, and should take the learner approximately 5 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Hollow Wall Structures and Fixings					
Knowledge					
Describe the types of fixing devices used in the electrotechnology industry for fixing to hollow wall structures including: • Wood screws • Self-tapping screws • Coach bolts • Toggle devices • Wall mates • Hollow wall anchors • Plaster brackets • Wall boxes	1.1, 1.4, 1.6, 1.7, 4	1.6	12	34	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the types of tools used to install, tighten and loosen hollow wall fixings and supports.	1.1	1.8	-	34	
Skills					
Select suitable fixings for given hollow wall applications.	1.1, 1.4, 1.6, 1.7	1.6	11.1, 11.2, 12	34	Topic 1 Content Quiz Topic 1.1 Learning Activity Topic 1.2 Skills Practice

1 Fixing to Hollow Walls					
1.2 Hollow Wall Fixing Methods					
Knowledge					
Describe the methods and techniques for fixing and supporting electrotechnology accessories to hollow wall structures.	1.4, 1.6, 1.7, 7, 8	-	-	34	Topic 1 Content Quiz Topic 1.2 Learning Activity
Describe the hazards and safe working practices for installing hollow wall fixings.	2, 3, 5, 7	1.1, 1.2	-	34, 43, 44	
Skills					
Use a variety of hollow wall fixings to secure electrotechnology equipment to different types of hollow wall structures.	1.1, 1.4, 1.6, 1.7, 2, 3, 4, 5, 6, 7, 8	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 6, 8, 9, 10, 11.1, 11.2, 12, 14	34, 43, 44	Topic 1.2 Skills Practice
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill, Seventh Edition, 2010 (Chapter 5) • Hampson, J., Electrotechnology Practical, Pearson Education, Second Edition, 2011 (Section 3) • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) Equipment: • Frame structure lined with plasterboard • Masonry block structure • Hollow wall fixings – wall mates, screws, coach bolts, toggles, plasterboard clips, wall boxes, stud brackets etc. • Batten holder • Wall plate (e.g. socket outlet, switch plate, blank plate, telephone outlet etc.) • Brackets and mounting blocks • Tools – screwdrivers, plaster saw, tape measure, spirit level, HSS and masonry bits, battery / power drill, stud finder • PPE – safety glasses, ear plugs, dust masks					

2 Fixing to Solid Walls					
Purpose:	In this topic you will learn about the various techniques and the fasteners and anchors available for use when securing and mounting accessories to solid walls.				
Duration:	This topic represents around 25% of the knowledge and skills specification contents, and should take the learner approximately 5 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Solid Wall Structures and Fixings					
Knowledge					
Describe the types of fixing devices used in the electrotechnology industry for fixing to solid wall structures including: - Wall plugs - Expanding sleeve anchors - Concrete screws - Chemical anchors - Gas and powder actuated fixings	1.3, 1.4, 1.6, 1.7, 4	1.6	12	34	Topic 2 Content Quiz Topic 2.1 Learning Activity
Explain the regulatory requirements of using gas / powder actuated fixing tools.	2, 5			34	
Describe the types of tools used to install, tighten and loosen solid wall fixings and supports.	1.3	1.8	-	34	
Skills					
Select suitable fixings for given solid wall applications.	1.3, 1.4, 1.6, 1.7	1.6	11.1, 11.2, 11.3, 12	34	Topic 2 Content Quiz Topic 2.1 Learning Activity Topic 2.2 Skills Practice
2.2 Solid Wall Fixing Methods					
Knowledge					

2 Fixing to Solid Walls					
Describe the methods and techniques for fixing and supporting electrotechnology accessories to solid wall structures.	1.3, 1.4, 1.6, 1.7, 7, 8	-	-	34	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe the hazards and safe working practices for installing solid wall fixings.	2, 3, 5, 7	1.1, 1.2	-	34, 43, 44	
Skills					
Use a variety of solid wall fixings to secure electrotechnology equipment to different types of solid wall structures.	1.3, 1.4, 1.6, 1.7, 2, 3, 4, 5, 6, 7, 8	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 6, 8, 9, 10, 11.1, 11.2, 11.3, 12, 14	34, 43, 44	Topic 2.2 Skills Practice
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill, Seventh Edition, 2010 (Chapter 5) • Hampson, J., Electrotechnology Practical, Pearson Education, Second Edition, 2011 (Section 3) • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) Equipment: • Concrete structure • Brick structure • Solid wall fixings – wall/plastic plugs and screws, expanding sleeve anchors, loxins/dynasets etc. • Threaded rod • Brackets and mounting blocks • Tools – screwdrivers, spanners / sockets, tape measure, spirit level, masonry bits, hammer drill • PPE – safety glasses, ear plugs, dust masks					

3 Fixing to Metal Structures					
Purpose:	In this topic you will learn about the various techniques and the fasteners and anchors available for use when securing and mounting accessories to metal fixings.				
Duration:	This topic represents around 25% of the knowledge and skills specification contents, and should take the learner approximately 5 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Metal Structures and Fixings					
Knowledge					
Describe the types of fixing devices used in the electrotechnology industry for fixing and supporting accessories to metal structures including: - Self-tapping screws - Self-drilling screws - Machine screws - Nuts and bolts - Clips - Rivets	1.2, 1.4, 1.6, 1.7, 4	1.6	12	34	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe types of metal brackets and support systems commonly used in the electrotechnology industry.	1.2, 1.4, 1.6, 1.7, 4	1.7	12	34	
Describe the types of tools used to install, tighten and loosen metal fixings, brackets and supports.	1.2	1.8	-	34	
Skills					
Select suitable fixings for given metal structures applications.	1.2, 1.4, 1.6, 1.7	1.6	11.1, 11.2, 12	34	Topic 3 Content Quiz Topic 3.1 Learning Activity Topic 3.2 Skills Practice

3 Fixing to Metal Structures					
3.2 Metal Fixing Methods					
Knowledge					
Describe the methods and techniques for fixing and supporting electrotechnology accessories to metal structures.	1.2, 1.4, 1.6, 1.7, 7, 8	-	-	34	Topic 3 Content Quiz Topic 3.2 Learning Activity
Describe the hazards and safe working practices for installing metal fixings.	2, 3, 5, 7	1.1, 1.2	-	34, 43, 44	
Skills					
Install a fixing device and accessory capable of supporting up to 20 kg on a metal plate.	1.2, 1.4, 1.6, 1.7, 2, 3, 4, 5, 6, 7, 8	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.1, 11.2, 12, 14	34, 43, 44	Topic 3.2 Skills Practice
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill, Seventh Edition, 2010 (Chapter 5) • Hampson, J., Electrotechnology Practical, Pearson Education, Second Edition, 2011 (Section 3) • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) Equipment: • Metal enclosure (e.g. switchboard enclosure) • Metal cladding and metal plate • Metal or PVC sign / label • Conduit saddles and brackets • Metal fixings – rivets, self-drilling screws, nuts and bolts / screws etc. • Tools – screwdrivers, rivet gun, spanners / sockets, hand taps and wrench, tape measure, spirit level, HSS bits and drill • PPE – safety glasses, ear plugs, dust masks					

4 Using Adhesives and Tapes					
Purpose:	In this topic you will learn about the various fixing adhesives and tapes available for use when securing and mounting accessories used in electrotechnology activities.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Types of Adhesives and Tapes					
Knowledge					
Describe the types of adhesives commonly used in the electrotechnology industry including: - PVC pipe cement - Epoxy - Construction adhesives (e.g. liquid nails) - Chemical anchors	1.4, 1.5, 1.6, 1.7, 4	1.6	12	34	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe the types of tapes commonly used in the electrotechnology industry including: - Electrical tape - Double-sided tape - Duct tape	1.4, 1.5, 1.6, 1.7, 4	1.6	12	34	
Describe the types of tools used to prepare and apply adhesives and tapes.	1.5	1.8	-	34	
4.2 Fixing with Adhesives and Tapes					
Knowledge					
Describe the methods and techniques for applying adhesives and tapes to support electrotechnology accessories.	1.4, 1.5, 1.6, 1.7, 7, 8	-	-	34	Topic 4 Content Quiz Topic 4.2 Learning Activity
Describe the hazards and safe working practices	2, 3, 5,	1.1, 1.2	-	34, 43,	

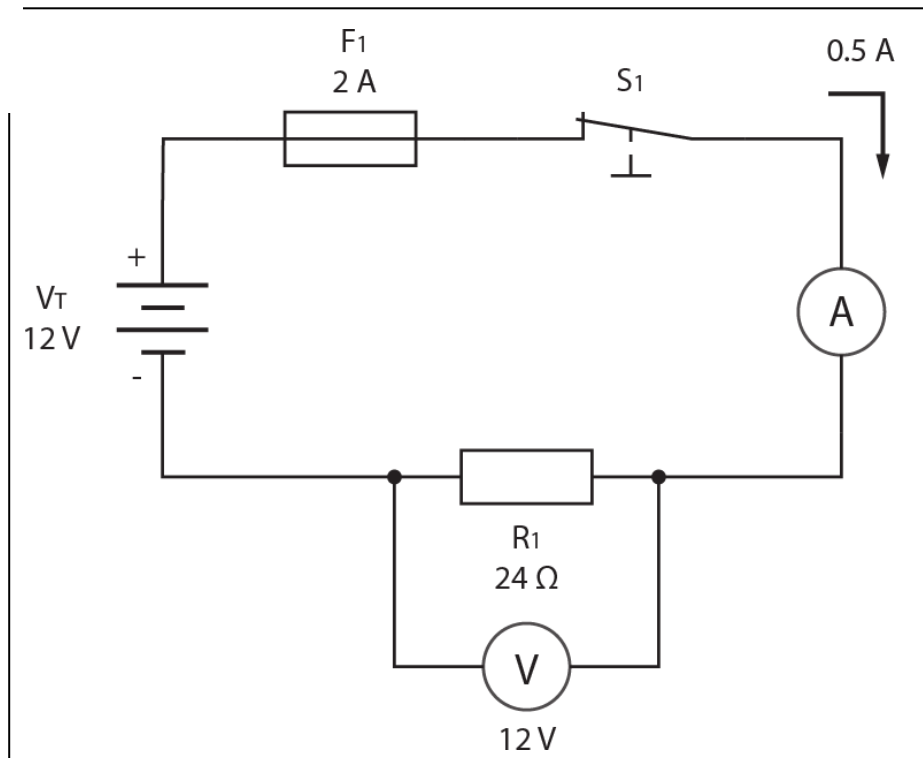
4 Using Adhesives and Tapes					
associated with the use of adhesives and tapes, including referencing safety data sheets (SDS).	6, 7			44	
Skills					
Fix PVC mini-duct onto a plasterboard wall using double-sided tape.	1.4, 1.5, 1.6, 1.7, 2, 3, 4, 5, 6, 7, 8	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.1, 12, 14	34, 43, 44	Topic 4.2 Skills Practice
Fix a small equipment box to a sheet metal panel using an epoxy adhesive.	1.4, 1.5, 1.6, 1.7, 2, 3, 4, 5, 6, 7, 8	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.1, 12, 14	34, 43, 44	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill, Seventh Edition, 2010 (Chapter 5) • Hampson, J., Electrotechnology Practical, Pearson Education, Second Edition, 2011 (Section 3) • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 1) Equipment: • Plasterboard and sheet metal surfaces • Double-sided tape and epoxy adhesive • PVC mini-duct and accessory for epoxy fixing (e.g. small equipment box, junction box, bracket or similar) • Tools – knife / scissors, tape measure, spirit level • PPE – safety glasses, ear plugs, masks, gloves					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEECD0046 – Solve problems in single path circuits



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	4
1 Basic electrical concepts	4
1.1 Electrotechnology Industry	4
1.2 Basic Concepts of Electricity	4
2 Basic electrical circuit	6
2.1 Circuit Symbols and Components	6
2.2 Multiple and Sub-Multiple Units	6
3 Ohm's Law	8
3.1 Basic Circuit Relationships	8
3.2 Basic Circuit Conditions	8
4 Electrical power	10
4.1 Force, Power, Work and Energy	10
4.2 Power Ratings of Devices	10
5 Effects of Electrical Current	12
5.1 Physiological Effects of Current	12
5.2 Heating, Magnetic and Chemical Effects of Current	12
5.3 Protection Against the Damaging Effects of Current	13
6 EMF Sources, energy sources and conversion of electrical energy	14
6.1 Sources of EMF	14
6.2 Primary, Secondary and Fuel Cells	14
6.3 Efficiency of Electrical Systems and Machines	14
7 Resistors	16
7.1 Fixed and Variable Resistors	16
7.2 Non-Linear Resistors	16
7.3 Selection of Resistors	17
8 Series circuits	18
8.1 Introduction to Series Circuits	18
8.2 Characteristics and Operation of Series Circuits	18

A. Overview		
Competency Standard Unit (CSU)	UEECD0046 Solve problems in single path circuits	
CSU Application	This unit involves the skills and knowledge required to solve problems in single path circuits. It includes working safely; applying problem-solving procedures, including the use of basic voltage, current and resistance measuring devices; and providing known solutions to predictable circuit problems. No licensing, legislative or certification requirements apply to this unit at the time of publication	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECD0046	Performance Criteria
	KE-UEECD0046	Knowledge Evidence
	PE-UEECD0046	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 8	36 hours
	Completion of Unit Knowledge Test	2 hours
	Completion of Unit Skills Test	2 hours
	Total duration of structured learning program	40 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace	

B. Knowledge and Skills Delivery

1 Basic electrical concepts

Purpose:	In this topic you will learn about the electrical energy generation, transmission and distribution, the properties of matter and the mechanisms of electric current flow. You also be introduced to some mechanical units and basic calculations.
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Electrotechnology Industry					
Knowledge					
Describe the electrotechnology industry in Australia	KE1.1	-	-	-	Topic 1 Content Quiz Topic 1.1 Learning Activity
List the methods of electricity production used in Australia from renewable and non-renewable sources	KE1.2	-	-	-	
Describe the transmission of electricity from the source of generation to the load	KE1.3	-	-	-	
Explain the utilisation of electricity by the various load types	KE1.4	-	-	-	
Skills					
Draw a single line diagram of an electrical supply system from source to load	KE1.4		-	-	Topic 1.1 Skills Practice
1.2 Basic Concepts of Electricity					
Knowledge					
Describe the concepts of static and current electricity	KE1.1	-	-	-	Topic 1 Content Quiz Topic 1.2 Learning Activity

1 Basic electrical concepts					
Explain “quantity of electricity”	KE1.5	-	-	-	
Skills		-	-		
Perform basic calculations to determine velocity and speed	KE1.5	-	-	-	Topic 1.1 Skills Practice
Perform basic calculations to determine quantity of electricity	KE1.5	-	-	-	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill, Seventh Edition, Volume 1, 2010 • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Third Edition, 2013 • Phillips, P., Electrical Principles, Cengage Learning, Second Edition, 2012					

2 Basic electrical circuit						
Purpose:	In this topic you will learn about electrical terminology, the basic electrical circuit and basic units associated with the electrical circuit. You will also learn how to connect a basic electrical circuit and how to use single range analogue bench meters to measure voltage and current.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
2.1 Circuit Symbols and Components						
Knowledge						
Explain the purpose of an electrical energy source, a load, a switch and a circuit protection device in a circuit		KE2.2	-	-	5	Topic 2 Content Quiz Topic 2.1 Learning Activity
Explain the arrangement of an electrical energy source, a load, a switch and a circuit protection device in a circuit		KE2.1	-	-	5	
Skills						
Draw the symbols used to represent an electrical energy source, a load, a switch and a circuit protection device in a circuit diagram		KE2.1	-	-	5	Topic 2.1 Skills Practice
Draw a single path d.c. circuit		KE2.1		-	5	
2.2 Multiple and Sub-Multiple Units						
Knowledge						
Explain how multiple and sub-multiple units are used in the electrotechnology industry		KE2.4	-	-	-	Topic 2 Content Quiz Topic 2.2 Learning Activity
Skills						

2 Basic electrical circuit

Calculate using multiple and sub-multiple units used in the electrotechnology industry

KE2.4

-

-

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Topic 2.1 Skills Practice

Reference Text:

- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill, Sixth Edition, Volume 1, 2011
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Second Edition, 2011
- Phillips, P., Electrical Principles, Cengage Learning, Second Edition, 2012

Equipment:

- Selection of resistors of varying ohmic values and power ratings
- Insulated connecting leads
- Variable d.c. power supplies
- 12/24 V globes
- Lamp holders and circuit protection device
- Switches
- Selection of d.c. bench ammeters
- Selection of d.c. bench voltmeters
- Selection of digital and analogue multimeters

3 Ohm’s Law						
Purpose:	In this topic you will learn about Ohm’s law as applied to a single resistor d.c. circuit. You will also learn how to use a digital multimeter to measure resistance.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
3.1 Basic Circuit Relationships						
Knowledge						
Describe the arrangement of a single path d.c. circuit		KE3.1	1.2	-	5	Topic 3 Content Quiz Topic 3.1 Learning Activity
State the relationship between voltage, currents and resistance in a single path d.c. circuit		KE3.2, KE3.4, KE3.6, KE3.7		-	5	
Skills						
Calculate voltage, current and resistance of a single path d.c. circuit		KE3.5		-	5	Topic 3.1 Skills Practice
Setup and connect an electrical energy source, a load, a switch and a circuit protection device to form a single path d.c. circuit		KE3.1		PE4	5	
Measure the voltage, current and resistance in a single path d.c. circuit		KE3.4, KE3.6		PE7	5	
3.2 Basic Circuit Conditions						
Knowledge						
Describe the effects of an open-circuit, a closed-circuit and a short-circuit on a d.c. single path circuit		KE2.3, KE3.3.1, KE3.3.2	-	-	5	Topic 3 Content Quiz Topic 3.2 Learning Activity

3 Ohm's Law

Skills					
Determine the effects of a short circuit and an open circuit in a single path d.c. circuit	KE2.3, KE3.3.1, KE3.3.2	-	-	5	Topic 3.1 Skills Practice
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill, Sixth Edition, Volume 1, 2011 - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Second Edition, 2011 - Phillips, P., Electrical Principles, Cengage Learning, Second Edition, 2012 Equipment: - Selection of resistors of varying ohmic values and power ratings - Insulated connecting leads - Variable d.c. power supplies - Selection of d.c. bench ammeters - Selection of d.c. bench voltmeters - Selection of digital and analogue multimeters					

4 Electrical power						
Purpose:	In this topic you will learn about the terms acceleration, force, work, power and energy and power dissipation in a d.c. circuit. You will also learn about power ratings of devices and methods used to calculate and measure power consumption.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Force, Power, Work and Energy						
Knowledge						
Explain the relationship between force, power, work and energy		KE4.1	-	-	1	Topic 4 Content Quiz Topic 4.1 Learning Activity
Explain the methods of determining the power dissipated in a circuit		KE4.2, KE4.4	-	-	5	
Skills						
Calculate the power dissipated in a d.c. circuit, from given voltage, current and resistance values		KE4.2	-	PE5	5	Topic 4.2 Skills Practice
Measure the electrical power in a d.c. circuit		KE4.4		-	5	
4.2 Power Ratings of Devices						
Knowledge						
Explain the power ratings of devices		KE4.3	-	-	5	Topic 4 Content Quiz Topic 4.2 Learning Activity
Describe the effects of power rating of various resistors		KE4.5	-	-	5	
Skills			-	-		
Calculate power ratings of d.c. circuit loads		KE4.3, KE4.5	-	-	5	Topic 4.2 Skills Practice
Reference Text:						

4 Electrical power

- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill, Sixth Edition, Volume 1, 2011
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Second Edition, 2011
- Phillips, P., Electrical Principles, Cengage Learning, Second Edition, 2012

Equipment:

- Selection of resistors of varying ohmic values and power ratings.
- Insulated connecting leads.
- Variable d.c. power supplies.
- Selection of d.c. bench ammeters
- Selection of d.c. bench voltmeters
- Selection of digital and analogue multimeters
- Wattmeter.

5 Effects of Electrical Current						
Purpose:	In this topic you will learn about the cause of electric current flow and its four effects. You will also learn how to protect equipment against the effects of current.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 Physiological Effects of Current						
Knowledge						
Describe the physiological effects of current.		KE5.1	-	-	2	Topic 5 Content Quiz Topic 5.1 Learning Activity
5.2 Heating, Magnetic and Chemical Effects of Current						
Knowledge						
Describe how electric current can result in the production of heat, magnetic fields and a chemical reaction.		KE5.2	-	-	2	Topic 5 Content Quiz Topic 5.2 Learning Activity
List the applications of the heating, magnetic and chemical effects of current.		KE5.3	-	-	2	
Skills						
Demonstrate the heating effects of an electric current.		KE5.2, KE5.3	-	-	2	Topic 5.2 Skills Practice
Demonstrate the magnetic effects of an electric current.		KE5.2, KE5.3		-	2	
Demonstrate the chemical effects of an electric current.		KE5.2, KE5.3		-	2	

5 Effects of Electrical Current					
5.3 Protection Against the Damaging Effects of Current					
Knowledge					
Describe the fundamental principles for protection against the damaging effects of current as required by AS/NZS 3000 (basics).	KE5.5	-	-	2	Topic 5 Content Quiz Topic 5.3 Learning Activity
Explain the mechanisms by which metals corrode.	KE5.4	-	-	2	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill, Seventh Edition, Volume 1, 2010 • Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill, Sixth Edition, Volume 1, 2011 • Hampson, J., Electrical Trade Principles a Practical Approach, Pearson Education, Second Edition, 2011 • Phillips, P., Electrical Principles, Cengage Learning, Second Edition, 2012 Equipment: • Selection of resistors of varying ohmic values and power ratings. • Variable d.c. power supplies and connecting leads. • Selection of d.c. bench ammeters • Selection of d.c. bench voltmeters • Selection of digital and analogue multimeters. • Devices to demonstrate the production of a magnetic field. • Devices to demonstrate the production of a chemical reaction.					

6 EMF Sources, energy sources and conversion of electrical energy						
Purpose:	In this topic you will learn about the different sources that produce an EMF, energy sources and the conversion of energy from one form to another. You will also learn how to determine the efficiency of energy transfer.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
6.1 Sources of EMF						
Knowledge						
Describe the principles of producing an EMF by electromagnetic induction, thermocouple effect, photoelectric effect and Piezo effect.		KE6.2.1, KE6.2.2, KE6.2.3, KE6.2.4	-	-	4	Topic 6 Content Quiz Topic 6.1 Learning Activity
6.2 Primary, Secondary and Fuel Cells						
Knowledge						
Describe the principles of producing an electric current from primary, secondary and fuel cells		KE6.3	-	-	4	Topic 6 Content Quiz Topic 6.2 Learning Activity
Skills						
Demonstrate the production of an EMF using electromagnetic induction, thermocouple effect and photoelectric effect		KE6.2.1, KE6.2.2, KE6.2.3, KE6.2.4		-	4	Topic 6.2 Skill Practice
6.3 Efficiency of Electrical Systems and Machines						
Knowledge						
Describe the input, output and efficiency of		KE6.1	-	-	-	Topic 6 Content Quiz

6 EMF Sources, energy sources and conversion of electrical energy					
electrical systems and machines.					Topic 6.3 Learning Activity
Describe the effect of losses in electrical wiring and machines.	KE6.1	-	-	-	
Describe the principle of energy conservation.	KE6.1	-	-	-	
Skills					
Demonstrate input, output, losses and efficiency of an electrical system	KE6.1		-	-	Topic 6.3 Skill Practice
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill, Sixth Edition, Volume 1, 2011 - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Second Edition, 2011 - Phillips, P., Electrical Principles, Cengage Learning, Second Edition, 2012 Equipment: - Insulated connecting leads. - Variable d.c. power supplies. - Selection of d.c. bench ammeters - Selection of d.c. bench voltmeters - Selection of digital and analogue multimeters. - Devices to demonstrate the production of an EMF using electromagnetic induction, thermocouple, solar and piezo effect.					

7 Resistors						
Purpose:	In this topic you will learn about the types of resistors available and the resistor colour code. You will also learn how to select resistors for a particular application.					
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
7.1 Fixed and Variable Resistors						
Knowledge						
Describe the features of various types of fixed and variable resistors		KE7.1, KE7.2	-	-	3	Topic 7 Content Quiz Topic 7.1 Learning Activity
List the typical applications of fixed and variable resistors (potentiometers and rheostats)		KE7.1, KE7.2	-	-	3	
Skills						
Identify fixed and variable resistors.		KE7.2	-	-	3	Topic 7.3 Skills Practice
7.2 Non-Linear Resistors						
Knowledge						
Explain the characteristics of temperature (NTC, PTC), voltage (VDR) and light dependent resistors (LDR).		KE7.3	-	-	3	Topic 7 Content Quiz Topic 7.2 Learning Activity
Explain the meaning of Positive Temperature Coefficient (PTC) and Negative Temperature Coefficient (NTC).		KE7.3	-	-	3	
List the typical applications for the various types of non-linear resistors.		KE7.3	-	-	3	
Skills			-	-		
Measure the resistance of temperature and light		KE7.3	-	-	3	Topic 7.3 Skills

7 Resistors					
dependent resistors under various temperature and light conditions.					Practice
7.3 Selection of Resistors					
Knowledge					
Describe the resistor colour code.	KE7.6		-	3	Topic 7 Content Quiz Topic 7.2 Learning Activity
Explain the power rating of resistors and the relationship of power loss (heat) in a circuit.	KE7.4, KE7.5		-	5	
Skills					
Apply the resistor colour code to determine the value of resistors and confirm value by measurement.	KE7.6		-	3, 5	Topic 7.3 Skills Practice
Select specific resistors for a particular application.	KE7.7		-	3, 5	
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill, Sixth Edition, Volume 1, 2011 - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Third Edition, 2013 - Phillips, P., Electrical Principles, Cengage Learning, Second Edition, 2012					
Equipment: - Selection of resistors of varying ohmic values. - Selection of temperature, voltage and light dependent resistors. - Selection of digital and analogue multimeters.					

8 Series circuits						
Purpose:	In this topic you will learn about series circuits and the basic laws applicable to the series circuit. You will also learn about voltage dividers.					
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
8.1 Introduction to Series Circuits						
Knowledge						
List the major components of a 'series' circuit including power supply, loads, connecting leads and switch		KE8.1	-	-	5	Topic 8 Content Quiz Topic 8.1 Learning Activity
List the applications where 'series' circuits are used in the Electrotechnology industry		KE8.1	-	-	5	
Skills						
Draw a schematic diagram of a single-source d.c. 'series' circuit		KE8.1	-	PE13	5	Topic 8.1 Skill Practice
8.2 Characteristics and Operation of Series Circuits						
Knowledge						
Describe the characteristics of a 'series' circuit including load connection, current paths, voltage drops, power dissipation and effects of an open and short circuit in a 'series' circuit		KE8.1, KE8.2, KE8.4, KE8.9	-	-	5	Topic 8 Content Quiz Topic 8.2 Learning Activity
Describe the relationship between voltage drops and resistance in a simple voltage divider network		KE8.6	-	-	5	
Explain the output voltage and current levels of connecting cells in series		KE8.1, KE8.3		-	5	

8 Series circuits

Skills					
Calculate the total voltage, current and resistances of a series circuit	KE8.4, KE8.5	-	PE3, PE4	5	Topic 8.2.1 Skill Practice
Calculate the individual voltage drops and power dissipated in components of a series circuit	KE8.4, KE8.5		PE3, PE4, PE5	5	Topic 8.2.2 Skill Practice
Set up and connect a single-source series d.c. circuits	KE8.7		PE2.1, PE6	5	
Take resistance, voltage and current measurements in a single source series circuit	KE8.8		PE7, PE8	5	
Calculate the voltage, current, resistances and/or power dissipated from measured or given values given any two of these quantities	KE8.4, KE8.5		PE3, PE4, PE5	5	
Examine the effects of open circuits and short circuits	KE8.4, KE8.9		PE3, PE11, PE12	5	

Reference Text:

- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill, Sixth Edition, Volume 1, 2011
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Third Edition, 2013
- Phillips, P., Electrical Principles, Cengage Learning, Second Edition, 2012

Equipment:

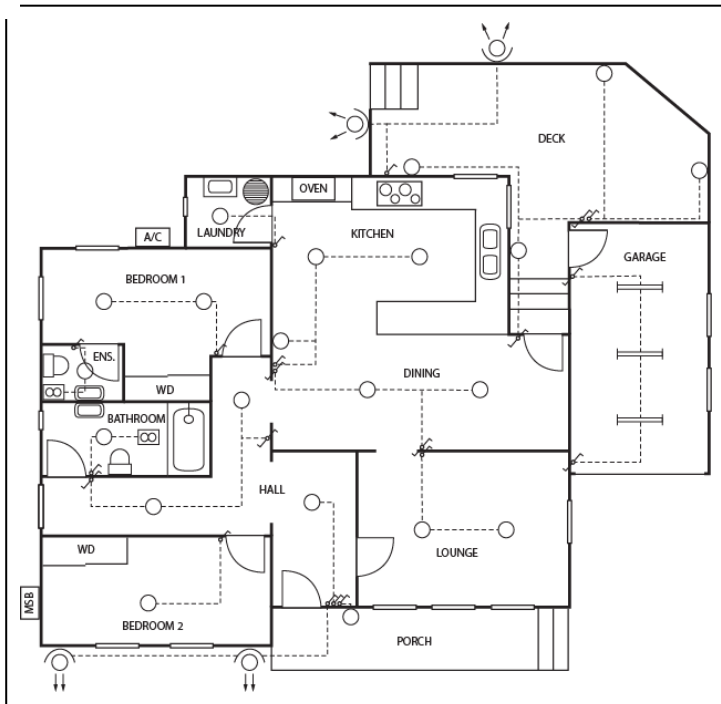
- Selection of resistors of varying ohmic values and power ratings
- Insulated connecting leads
- Variable d.c. power supplies
- Selection of d.c. bench ammeters
- Selection of d.c. bench voltmeters
- Selection of digital and analogue multimeters

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria		

Unit Learning Plan

UEECD0051 – Use drawings, diagrams, schedules, standards, codes and specifications



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	4
1 Architectural Drawings	4
1.1 Architectural Drawings	4
1.2 Floor Plans	4
1.3 Site Plans	5
2 Electrical Drawings	6
2.1 Types of Electrical Drawings	6
2.2 Cable Schedules	6
3 Circuit Diagrams	8
3.1 Circuit Diagrams	8
3.2 Switching Charts	8
4 Wiring Diagrams	10
4.1 Wiring Diagrams	10
5 Building Structures	12
5.1 Building Types	12
5.2 Building Sequence	12
5.3 Cable Routes	12
6 Regulation and Licensing	14
6.1 Electrical Licensing Requirements	14
6.2 Refrigerant Handling Licences	15
6.3 Cabling Registrations	15
7 Standards and Codes of Practice	17
7.1 Technical Standards	17
7.2 Australian Standards	17
7.3 Codes of Practice	18
8 Job Specifications	20
8.1 Job Specifications	20

A. Overview		
Competency Standard Unit (CSU)	UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications	
CSU Application	This unit involves the skills and knowledge required to use drawings, diagrams, cable schedules, industry standards, codes of practice and specifications as they apply to various electrotechnology work functions. It includes interpreting schematic, wiring and mechanical diagrams, equipment and cable/connection schedules and manuals; and the use and format of compliance standards, codes and job specifications used in the electrotechnology industry. It also includes the use of site and architectural drawings/plans to show the location of services, apparatus, plant and machinery. No licensing, legislative or certification requirements apply to this unit at the time of publication.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECD0051	Performance Criteria
	KE-UEECD0051	Knowledge Evidence
	PE-UEECD0051	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 8	36 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Unit Skills Test	3 hours
	Total duration of structured learning program	40 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: UEECD0007 Apply work health and safety regulations, codes and practices in the workplace	

B. Knowledge and Skills Delivery

1 Architectural Drawings

Purpose:	In this topic you will learn how to read and interpret architectural drawings for the locations of energy sector circuits, equipment, accessories and appliances.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Architectural Drawings					
Knowledge					
Describe the various types of architectural drawings: site plans, floor plans, detailed drawings and standard drawings.	1.1	1.2, 1.3	5.2	40	Topic 1 Content Quiz Topic 1.1 Learning Activity
Skills					
Demonstrate the use of standard drawing scales to determine the actual lengths represented by dimensions on an architectural drawing.	1.4	2.1, 2.2	5.3	40	Topic 1 Content Quiz Topic 1.1 Learning Activity Topic 1.1 Skills Practice
Perform the task of sketching/drawing given dimensions to scale.	1.4	3.1, 3.3	5.1, 5.7, 8.2	40	
Read and interpret architectural drawings to determine the location of the energy sector equipment.	1.1, 1.2, 1.3, 1.4, 1.5	1.2, 1.3, 2.1, 2.2, 2.3, 2.4	3, 4, 5.3, 8.3	40	
1.2 Floor Plans					
Knowledge					
Describe the purpose and the various layouts of architectural floor plans.	1.2	1.2, 1.3	5.2	40	Topic 1 Content Quiz Topic 1.2 Learning Activity
Skills					

1 Architectural Drawings					
Select and use architectural floor plans to determine the power and lighting or communications/audio/video layouts required in a domestic installation.	1.1, 1.2	1.2, 1.3, 2.1, 2.2, 2.3	5.3	40	Topic 1 Content Quiz Topic 1.2 Learning Activity Topic 1.2 Skills Practice
Determine the location of the electrical/communications/audio accessories and appliances by reading and interpreting a floor plan.	1.2, 1.4, 1.5	1.2, 1.3, 2.1, 2.2, 2.3, 2.4	3, 4, 5.3, 8.3	40	
Identify Australian standard symbols on a floor plan to show the location of the accessories and appliances as detailed in an electrical schedule.	1.5	2.1, 2.2, 2.3	3, 4, 5.3, 8.3	40	
1.3 Site Plans					
Knowledge					
Describe the purpose and the various layouts of architectural site plans.	1.3	1.2, 1.3	5.2	40	Topic 1 Content Quiz Topic 1.3 Learning Activity
Skills					
Identify the service point, consumer mains, communication services, main switchboard, distribution boards and/or builders supplies from a site plan.	1.3	1.2, 1.3, 2.1, 2.2, 2.3, 2.4	5.3	40	Topic 1 Content Quiz Topic 1.3 Learning Activity
Identify Australian standard symbols on site plans to show locations of the equipment and services.	1.3	2.1, 2.2, 2.3	5.3	40	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practical, Pearson Education					
Standards and Codes: AS/NZS 1102.8 Graphical Symbols for Electrotechnology, Location Symbols – Power Supply Systems and Electrical Services for Buildings and Sites					

2 Electrical Drawings						
Purpose:	In this topic you will learn about the major types of electrical diagrams used in the energy/electrotechnology industry along with their purpose, applications and uses.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
2.1 Types of Electrical Drawings						
Knowledge						
State the features, purpose and application of block, circuit, wiring and ladder diagrams.		4.1, 4.2	1.2, 1.3, 2.1, 2.4	5.2	40	Topic 2 Content Quiz Topic 2.1 Learning Activity
Explain why standard symbols are used to represent components on electrical diagrams.		4.3	2.1	5.2	40	
Skills						
Identify and distinguish between block, circuit, wiring and ladder diagrams.		4.1	1.2, 1.3	5.2	40	Topic 2 Content Quiz Topic 2.1 Learning Activity Topic 2.2 Skills Practice
2.2 Cable Schedules						
Knowledge						
Describe the conventions used in cable schedules.		4.5, 4.6	1.2, 1.3, 2.1, 2.4	5.2	40	Topic 2 Content Quiz Topic 2.2 Learning Activity
Skills						
Identify cable type, origin and route from a cable schedule.		4.5	1.2, 1.3, 2.1, 2.2, 2.3	4, 5.2, 5.3, 8.3	40	Topic 2 Content Quiz Topic 2.2 Learning Activity Topic 2.2 Skills Practice
Develop a cable schedule for a given installation.		4.6	3.1, 3.3	5.1, 5.7, 8.2	40	

2 Electrical Drawings

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 1102 Graphical Symbols for Electrotechnology documentation

3 Circuit Diagrams						
Purpose:	In this topic you will learn about the conventions used and techniques employed when sketching and using circuit diagrams as well as the concept and construction of switching charts.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
3.1 Circuit Diagrams						
Knowledge						
Describe the purpose of circuit diagrams in the energy/electrotechnology industries.		3.1	1.2, 1.3	5.2	40	Topic 3 Content Quiz Topic 3.1 Learning Activity
List the conventions used in and the features of circuit diagrams.		3.2, 3.3	1.2, 1.3, 2.1, 2.4	5.2	40	
Skills						
Identify a range of circuit diagram standard symbols.		3.3, 4.3	2.1	5.2, 5.3	40	Topic 3 Content Quiz Topic 3.1 Learning Activity Topic 3.1 Skills Practice
Sketch basic circuit diagrams.		3.2, 3.3	3.1, 3.2, 3.3	5.1, 5.7, 6	40	
Connect equipment according to a circuit diagram and confirm the operation of the circuit.		-	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4	1.1, 1.2, 2, 4, 5.2, 5.3, 8.1	40	
3.2 Switching Charts						
Knowledge						
Describe the purpose of switching charts.		4.1	1.2, 1.3	5.2	40	Topic 3 Content Quiz Topic 3.2 Learning Activity
Skills						
Use a continuity testing device to construct a		-	1.1, 3.1,	1.1, 1.2,	40	Topic 3.2 Skills Practice

3 Circuit Diagrams

switching chart to identify the terminals of various types of switches.

3.2, 3.3

2, 5.1,
5.7, 7

Reference Text:

- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 1102 Graphical Symbols for Electrotechnology documentation

Equipment:

- ELV a.c. power source
- Lamp Panel
- Switch Panel
- Fuse or circuit breaker panel
- Digital Multimeter
- Voltage Probe
- Continuity Tester

4 Wiring Diagrams						
Purpose:	In this topic you will learn about the conventions used and techniques employed when sketching and using wiring diagrams.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Wiring Diagrams						
Knowledge						
Describe the purpose of wiring diagrams in the energy/electrotechnology industries.		12.1	1.2, 1.3	5.2	40	Topic 4 Content Quiz Topic 4.1 Learning Activity
List the conventions used in and the features of wiring diagrams.		12.2	1.2, 1.3, 2.1, 2.4	5.2	40	
Skills						
Identify a range of wiring diagram standard symbols.		4.3, 12.3	2.1	5.3	40	Topic 4 Content Quiz Topic 4.1 Learning Activity Topic 4.1 Skills Practice 1 Topic 4.1 Skills Practice 2
Sketch basic wiring diagrams.		12.2, 12.3	3.1, 3.2, 3.3	5.1, 5.7, 8.2	40	
Convert a circuit diagram to a wiring diagram.		4.4	2.1, 2.2, 2.4, 3.1, 3.2, 3.3	5.1, 5.2, 5.3, 5.7, 8.2, 8.3	40	
Connect equipment according to a wiring diagram and confirm the operation of the circuit.		-	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4	1.1, 1.2, 2, 4, 5.2, 5.3, 8.1	40	
Reference Text: • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J. and Hanssen, S., Electrotechnology Practical, Pearson Education						

4 Wiring Diagrams

Standards and Codes:

- AS/NZS 1102 Graphical Symbols for Electrotechnology documentation

Equipment:

- ELV a.c. power source
- Mounting frame (Plywood or Masonite™)
- Batten Holder and globe (suitable 32 V a.c. bayonet or Edison Screw)
- 2 x SPDT lighting switch and integrated wall plate (Clipsal type 31HA)
- DPDT Intermediate lighting switch (E.g. Clipsal type 30M1)
- TPS cable 2-core + earth (1.5 mm²)
- TPS cable 2-core (1.5 mm²)
- Fuse-holder and fuse or a.c. circuit breaker (Rated at 10 amperes)
- Terminal block (3-way)
- Single-core double insulated cable (two individual colours required - 1.5 mm², colour coded for Active conductor)
- Multimeter

5 Building Structures					
Purpose:	In this topic you will learn about the ways that buildings and dwellings are constructed so that cabling and wiring can be routed in a manner that is safe and avoids damage to the premises or the cabling.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Building Types					
Knowledge					
List the different building types: timber frame, brick veneer, double brick and metal frame.	2.1	-	-	35	Topic 5 Content Quiz Topic 5.1 Learning Activity
Explain the different types of footings, floors, external walls, roofs and interior walls.	2.2	-	-	35	
5.2 Building Sequence					
Knowledge					
State the sequence of construction stages for brick, brick veneer and timber cottages.	2.4	-	-	35	Topic 5 Content Quiz Topic 5.2 Learning Activity
State the stages of electrical/communications (first and second fixing) that occurs in the sequence of construction of a building or dwelling.	2.5	-	-	35	
Explain the areas where cooperation is required between electrical/communications and other building trades.	2.6	-	-	35	
5.3 Cable Routes					
Knowledge					
Describe the typical cable and wiring routes through buildings.	2.3	-	-	35	Topic 5 Content Quiz

5 Building Structures					
Describe how cables and wiring can be routed post-construction through a building or dwelling in a manner that is non-obtrusive.	2.3	-	-	35	Topic 5.3 Learning Activity
Describe how cables can be retrofitted in existing buildings or dwellings.	2.3	-	-	35	
Skills					
Identify suitable cable routes through buildings and dwellings.	2.3	1.1, 3.1, 3.2, 3.3	1.1, 1.2, 2, 5.1, 8.2	35	Topic 5.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practical, Pearson Education					

6 Regulation and Licensing					
Purpose:	In this topic you will learn about the energy/electrotechnology industries regulators and the licensing/ registration/ accreditation/endorsement regime for those working in the industries.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Electrical Licensing Requirements					
Knowledge					
List the various types of electrical licences, including those required for undertaking: - Unsupervised electrical work - Electrical contracting - Restricted electrical work (disconnect-reconnect)	7	-	-	-	Topic 6 Content Quiz Topic 6.1 Learning Activity
Describe the criteria for obtaining each electrical license.	7	-	-	-	
Describe the scope of work covered by each electrical license.	7	-	-	-	
Describe the standard process to apply for an electrical license.	7	-	-	-	
State the legislative requirements for ensuring electrical and/or electronic equipment is safe i.e. compliance requirements of electrical installations.	6, 8	-	-	-	
Skills					
Identify applicable legislation and regulations covering your energy/electrotechnology discipline. (e.g. electrical, data communications,	6, 8	-	-	-	Topic 6.3 Skills Practice

6 Regulation and Licensing					
renewable/sustainable energy, refrigeration and air-conditioning, fire protection, gaming machines, security technology, TV Antenna installation, lineworkers, cable jointers).					
6.2 Refrigerant Handling Licences					
Knowledge					
List the various types of refrigerant handling licences, including: • RAC01 • AAC02 • RSS03 • RDR04	7	-	-	-	Topic 6 Content Quiz Topic 6.2 Learning Activity
Describe the criteria for obtaining each refrigerant handling license.	7	-	-	-	
Describe the scope of work covered by each refrigerant handling license.	7	-	-	-	
Describe the standard process to apply for a refrigerant handling license.	7	-	-	-	
6.3 Cabling Registrations					
Knowledge					
List the various types of cabling registrations, including: • Open • Restricted • Lift	7	-	-	-	Topic 6 Content Quiz Topic 6.3 Learning Activity
List the various types of endorsements that can be obtained on a cabling registration, including: • Structured cabling (S) • Coaxial cabling (C)	7	-	-	-	

6 Regulation and Licensing					
- Optical fibre (F) - Underground cabling (U) - Aerial cabling (A)					
Describe the criteria for obtaining each registration/endorsement.	7	-	-	-	
Describe the scope of work covered by each registration/endorsement.	7	-	-	-	
Describe the standard process to apply for a registration/endorsement.	7	-	-	-	
Skills					
Research and report on licensing in the electrotechnology sector.	7	-	-	-	Topic 6.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practical, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) Internet Websites: - Australian Apprenticeships and Traineeships Information Website: http://australianapprenticeships.gov.au/ - Electrical Regulatory Authorities Council (ERAC): http://www.erac.gov.au/ - E-Oz Energy Skills Australia: http://www.e-oz.com.au/ - My Future – Career paths: http://www.myfuture.edu.au Equipment: - Personal computer with access to the internet.					

7 Standards and Codes of Practice					
Purpose:	In this topic you will learn about Standards, Codes of Practice, and other similar documents that are used to provide guidance, advice and regulation about how work is done and the attainment of quality products and services.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Technical Standards					
Knowledge					
State the purpose of technical standards.	11.2	4.2	5.5	-	Topic 7 Content Quiz Topic 7.1 Learning Activity
Describe the process used to develop and amend industry standards.	11.2	4.2	5.5	-	
Explain the concept of a 'prescriptive' standard.	11.1	4.2	5.5	-	
Explain the concept of a 'performance' standard.	11.1	4.2	5.5	-	
Explain the role of standards Australia/New Zealand, International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC).	11.3	-	-	-	
7.2 Australian Standards					
Knowledge					
List the standards organisations appropriate to the electrotechnology industry in Australia.	11.3	-	-	-	Topic 7 Content Quiz Topic 7.2 Learning Activity
Describe the role of the identified standards organisations with reference to the Australian electrotechnology industry.	11.3	-	-	-	
List the Australian Standards that are applicable to the various discipline areas of the Australian electrotechnology industry.	11.7	-	-	-	

7 Standards and Codes of Practice					
List the content areas covered in an Australian Standard e.g. AS/NZS 3000 or AS/NZS 3760.	11.5, 11.6	4.2	5.5	-	
Describe how compliance of work performed to the standard is achieved.	11.4	4.2	5.5	-	
Skills					
Procure current electrotechnology Australian Standards using the internet.	11.5, 11.6	4.1	5.4	-	Topic 7.2 Skills Practice
Use a personal computer to view the contents of an Australian Standard.	11.5, 11.6	4.1, 4.2	5.4, 5.5	-	
Locate specific details of job specifications and requirements from within a nominated Australian Standard (e.g. AS/NZS 3000; low voltage wiring in wet areas).	11.5, 11.6	4.2	5.5	-	
Calculate or determine the material requirements for a given job/task where the applicable Standard specifies only the performance required.	11.5, 11.6	4.2	5.5	-	
7.3 Codes of Practice					
Knowledge					
Explain what a Code of Practice is and how it differs from a Standard.	11.9	4.2	5.5	-	Topic 7 Content Quiz Topic 7.3 Learning Activity
Explain the purpose of local service requirements (e.g. Service and Installation Rules).	11.8	4.2	5.5	-	
List the Codes of Practice that are applicable to the various discipline areas of the Australian energy/electrotechnology industries.	11.7, 11.9	4.2	5.5	-	
Explain the purpose of the Building Code of Australia (as applicable to persons working in electrotechnology industry).	11.9	4.2	5.5	-	

7 Standards and Codes of Practice

Skills					
Identify job/task requirements for a particular electrotechnology discipline from within a Code of Practice and/or local service requirements.	11.9	4.1, 4.2	5.4, 5.5	-	Topic 7.3 Skills Practice
Calculate or determine the material requirements for a given job/task where the applicable Code of Practice or local service requirement specifies only the performance required.	11.9	4.2	5.5	-	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 3000 Electrical installations (Wiring Rules)
- AS/NZS 3008 Electrical installations – Selection of cables
- AS/NZS 3012 Electrical installations - Construction and demolition sites
- AS/NZS 3017 Electrical installations – Verification
- AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays
- AS/NZS 3760 In-service inspection and testing of electrical equipment
- AS/NZS 4836 Safe working on or near low-voltage electrical installations
- AS 2067 Substations and HV installations exceeding 1 kV a.c.
- AS 2293 (Series) Emergency escape lighting and exit signs for buildings
- AS/CA S009 Installation requirements for customer cabling (Wiring Rules)

Equipment:

- Personal computer with access to the internet
- Licence to access Standards Australia materials

8 Job Specifications					
Purpose:	In this topic you will learn about job specifications that form part of the contract for supply of services and deliverables.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Job Specifications					
Knowledge					
Explain the purpose of job or project specifications that can form part of the contract for services.	5	4.3	5.6	40	Topic 8 Content Quiz Topic 8.1 Learning Activity
Describe the typical specifications used for common electrotechnology projects (e.g. domestic dwelling construction).	5	4.3	5.6	40	
Describe the typical format of job specifications used in the electrotechnology industry.	5	4.3	5.6	40	
Skills					
Interpret job requirements from a job specification which has been prepared based upon a NATSPEC template.	5	4.3	5.6	40	Topic 8 Content Quiz Topic 8.1 Learning Activity Topic 8.1 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practical, Pearson Education					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities



Unit Learning Plan

UEECO0017 – Source and purchase material/parts for installation
or service jobs



Contents

Contents

3B. Knowledge and Skills Delivery

Work Records and Communication	41.1
Communication in the Workplace	41.2
Customer Records and Communication	41.3
Supplier Records and Communication	51.4
Enterprise Records and Communication	52
Using Computer Systems	72.1
Basic Computer Use	72.2
Selecting Software	72.3
Using Software	82.4
Saving and Printing	83
Sourcing Parts and Materials	103.1
Sourcing Parts and Materials	104
Ordering and Receiving Procedures	124.1
Ordering Procedures	124.2
Receiving Procedures	12

2A. Overview

41

41.1

41.2

41.3

51.4

52

72.1

72.2

72.3

82.4

83

103.1

104

124.1

124.2

12

A. Overview

Competency Standard Unit (CSU)	UEECO0017 Source and purchase material/parts for installation or service jobs	
CSU Application	This unit involves the skills and knowledge required to source and purchase/order materials/parts for installation or service jobs. It includes determining job specifications, using manufacturer catalogues, making purchasing enquiries, selecting appropriate materials/parts and completing relevant purchasing documentation. In this unit, the value of materials for small installation jobs is limited to \$AUD20,000. No licensing, legislative or certification requirements apply to this unit at the time of publication.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECO0017	Performance Criteria
	KE-UEECO0017	Knowledge Evidence
	PE-UEECO0017	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 4	18 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Unit Skills Test	1 hour
	Total duration of structured learning program	20 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: Nil	

B. Knowledge and Skills Delivery

1 Work Records and Communication

Purpose:	In this topic you will learn about the methods and requirements for maintaining work records, and effective methods to communicate with customers, suppliers and other personnel in the electrotechnology industry.			
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Energy Space Resources
	KE	PC	PE	
1.1 Communication in the Workplace				
Knowledge				
Explain the need for communication in the workplace, including communicating with: • Work personnel • Customers/clients • Suppliers and wholesalers	9.1, 9.2, 9.3			Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the methods and effective techniques for communicating in the workplace, including: • Verbal communication • Written communication	9.4			
1.2 Customer Records and Communication				
Knowledge				
Describe the purpose and extent of electrotechnology customer records and communications, including: • Quotes and estimates • Testing/compliance certificates • Invoices	6.2, 6.3, 6.4			Topic 1 Content Quiz Topic 1.2 Learning Activity

Describe the methods of recording and maintaining customer work records.	6.1			
State the considerations for communicating effectively with customers.	9.1, 9.4			
1.3 Supplier Records and Communication				
Knowledge				
Describe the purpose and extent of electrotechnology supplier/wholesaler records and communications, including: • Purchase orders • Invoices	6.2, 6.4			Topic 1 Content Quiz Topic 1.3 Learning Activity
Describe the methods of recording and maintaining supplier/wholesaler records.	6.1			
State the considerations for communicating effectively with suppliers and wholesalers.	9.3, 9.4			
1.4 Enterprise Records and Communication				
Knowledge				
Describe the purpose and extent of electrotechnology enterprise work records, including: • Job Safety/Hazard Analysis (JSA/JHA) • Safe Work Method Statements (SWMS) • Timesheets • Job Cards/Service Reports • Apprentice Workplace Evidence • Inspection/Commissioning Records • Drawings/Plans	6.2, 6.3, 6.4			Topic 1 Content Quiz Topic 1.4 Learning Activity
Describe the methods of recording and maintaining enterprise work records.	6.1			

List the types of enterprise work records required by regulation in the electrotechnology industry.	6.3			
State the considerations for working and communicating effectively as a team.	9.2, 9.4			
Skills				
Complete work activity records typical of the electrotechnology industry.	6.1, 6.4	1.1, 1.2, 2.6	2, 3, 9	Topic 1.4 Skills Practice
Reference Text: - Communicating at Work, Alessandra, SIMON & SCHUSTER, 1993, ISBN:9780671788551 - Writing That Works; How to Communicate Effectively In Business, Kenneth Roman & Joel Raphaelson, Collins Reference; 3rd revised edition, 2000, (ISBN-13: 978-0060956431)				

2 Using Computer Systems

Purpose:	In this topic you will learn about the basic equipment that makes up a personal computer, and the procedures for starting up, logging in, logging off and shutting down a computer.
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Energy Space Resources
	KE	PC	PE	
2.1 Basic Computer Use				
Knowledge				
List the steps involved in starting up and logging in to a computer.	1.5			Topic 2 Content Quiz Topic 2.1 Learning Activity
Describe the basic features/layout of a computer desktop.	1.5			
List the steps involved in correctly logging off and shutting down a computer.	1.5			
2.2 Selecting Software				
Knowledge				
List at least four software packages used in the electrotechnology industry.	1.4			Topic 2 Content Quiz Topic 2.2 Learning Activity
Explain the applications for at least four software packages used in the electrotechnology industry.	1.4			
Skills				
Select suitable software to complete given electrotechnology engineering tasks.	1.4	1.1, 1.2, 2.6	2	Topic 2.2 Skills Practice
Identify the minimum system requirements of selected software.	1.4			

2.3 Using Software				
Knowledge				
Explain how to perform a basic search to locate files in a directory.	1.1			Topic 2 Content Quiz Topic 2.3 Learning Activity
Explain the methods of opening and using software applications.	1.1			
List the hazards to health and safety associated with using a computer and associated control measures.	4, 5			
Skills				
Use software to create new files, and to add, edit and delete information.	1.1, 4, 5	1.1, 1.2, 2.6	2	Topic 2.4 Skills Practice
2.4 Saving and Printing				
Knowledge				
Explain how to save files, including: • Concept of backing up data. • Importance of file naming conventions. • Use of shared directories and cloud-based file hosting services (e.g. Dropbox, Google Drive).	1.3			Topic 2 Content Quiz Topic 2.4 Learning Activity
List the types of print technologies used in the electrotechnology industry.	1.2			
Describe basic printer settings (single-sided, double-sided, paper size, print quality, colour/grey scale).	1.2			
Skills				
Save files to a given location observing enterprise naming conventions.	1.3	1.1, 1.2, 2.6	2	Topic 2.4 Skills Practice
Print a document to portable document format (.pdf).	1.2			
Reference Text: • Butler & Shallard, A Journey of Discovery Through How Computers Work. Australia: Prentice-Hall (ISBN 1-7400-9447-6)				

- Evans A, Martin K, Poatsy M, Technology in Action—Introduction. 2nd Ed. Prentice-Hall (ISBN 0-1314-8905-4)
- Price C and Wix J, Complete Certificate I IT Package. Software Publications (ISBN 1-8773-4482-6)
- Stephens, Ann, Operate a Personal Computer. ICAU1128A. Melbourne: Tertiary Press (ISBN 0-8645-8512-8)

3 Sourcing Parts and Materials

Purpose:	In this topic you will learn about the methods of sourcing parts and materials in the electrotechnology industry. You also learn about the considerations for making telephone inquiries to wholesalers and suppliers.
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Energy Space Resources
	KE	PC	PE	
3.1 Sourcing Parts and Materials				
Knowledge				
List the common methods of sourcing electrotechnology parts and materials.	8			Topic 3 Content Quiz Topic 3.1 Learning Activity
List the types of information needed to correctly source parts and materials, including: • Part numbers • Ratings • Features and dimensions • Colour, style/series etc.	2, 3			
Explain the factors to consider when sourcing parts and materials from a supplier, including: • Availability • Outlet location • Prices, discounts and taxes • Pick-up/delivery • Delivery times and costs	8			
Describe effective communication techniques for making telephone inquiries to suppliers.	9.3			
Skills				

Interpret job requirements to identify the parts and materials that need to be sourced.	2, 3	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2	1, 2, 4, 5, 6	Topic 3.1 Skills Practice
Locate outlets for the supply of identified parts and materials, and determine their availability and cost.	3, 8, 9.3			
Confirm the details of identified parts and materials with customer/supervisor (role play).	9.1, 9.2, 9.4			
Learning Resources: National VET Content: Dispatch Goods Toolbox				
Manufacturers/Suppliers Information: - Jaycar Electronics supplier - The Stove Connection – appliance parts - Lawrence & Hanson – Electrical wholesaler - John R. Turk - Electrical & data supplier - Actrol – Refrigeration wholesaler - Heatcraft – Refrigeration wholesaler				
Equipment: - Sample parts and components - Part catalogues				

4 Ordering and Receiving Procedures

Purpose:	In this topic you will learn about the procedures used to order parts and components from suppliers.			
Duration:	This topic represents around 30% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Energy Space Resources
	KE	PC	PE	
4.1 Ordering Procedures				
Knowledge				
Explain the need to gain customer/supervisor approval before parts and materials are ordered.	7.2, 7.3			Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe typical suppliers' requirements in relation to ordering parts and materials, including: • In-person purchasing • Use of purchase orders • Online purchasing systems	6.1,6.2,6.4, 7.3,7.4			
Describe typical enterprise requirements for ordering parts and materials, including: • Use of preferred suppliers • Enterprise accounts • Required approvals	7.1, 7.2			
Skills				
Complete an order/requisition form with the relevant information to order required parts and materials.	6.1, 6.4, 7.2, 7.3, 7.4, 9.3	1.1, 1.2, 2.1, 2.3, 2.4, 2.5, 3.1, 3.2	2, 4, 5, 8	Topic 4.1 Skills Practice
4.2 Receiving Procedures				

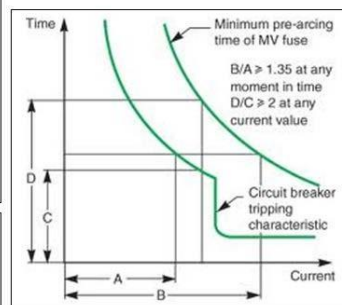
Knowledge				
Describe the procedures for safely receiving, handling and storing on-site deliveries.	4, 5, 7.3			Topic 4 Content Quiz Topic 4.2 Learning Activity
Skills				
Check the content of a received order against the invoice, identify any missing or incorrect items and forward documentation to approved personnel.	6.1, 6.4, 7.3, 9.2	1.1, 1.2, 3.1, 3.2	2, 7	Topic 4.2 Skills Practice
Learning Resources: - National VET Content: Dispatch Goods Toolbox Manufacturers/Suppliers Information: - Jaycar Electronics supplier - The Stove Connection – appliance parts - Lawrence & Hanson – Electrical wholesaler - John R. Turk - Electrical & data supplier - Actrol – Refrigeration wholesaler - Heatcraft – Refrigeration wholesaler Equipment: - Sample order forms				

Legend:

KE	Knowledge Evidence	PC	Elements and Performance Criteria
PE	Performance Evidence		

Unit Learning Plan

UEECO0023 – Participate in electrical work and competency development activities



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Competency Development Plans	5
1.1 Formal Training Agreements	5
1.2 Qualification Structure	5
1.3 Responsibilities of Parties to the Contract	6
1.4 Industry Customs and Practices	7
1.5 RTO Policies	7
1.6 Apprentice/Learner Discipline Policy	8
1.7 Attendance at the Training Centre	9
1.8 Fire and Emergency Procedures	9
1.9 Health and Safety at the Training Centre	9
1.10 Training Centre Tour	10
2 Monitoring Competency Development	11
2.1 Workplace Evidence	11
2.2 Monitoring Work Performance	11
3 Enterprise Policies and Procedures	14
3.1 Enterprise Policies and Procedures	14

A. Overview		
Competency Standard Unit (CSU)	UEECO0023 Participate in electrical work and competency development activities	
CSU Application	This unit involves the skills and knowledge required to participate in electrical work and related activities that contribute to the ongoing development of competency. It includes complying with electrical industry and organisational policies and procedures, undertaking work and related activities in accordance with a competency development plan, documenting and periodically reporting work activities, and participating in periodic reviews to monitor one's own competency development. Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations. Those holding an 'Unrestricted Electrician's Licence' or equivalent issued in an Australian state or territory meet the requirements of this unit.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEECO0023	Performance Criteria
	KE-UEECO0023	Knowledge Evidence
	PE-UEECO0023	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 3	6 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Induction/Orientation Record	30 minutes
	Work Performance Monitoring and Reporting	52.5 hours

	Total duration of structured learning program	60 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • Nil	

B. Knowledge and Skills Delivery

1 Competency Development Plans

Purpose:	In this topic you will undertake an induction/orientation program for the qualification you have undertaken.			
Duration:	This topic represents around 50% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the objectives.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Energy Space Resources
	KE	PC	PE	
1.1 Formal Training Agreements				
Knowledge				
State the relevant state/territories acts/regulations in relation to training plans.	1.1.1	1.1	-	Topic 1 Content Quiz Topic 1.1 Learning Activity
State the purpose of training contracts and training plans.	1.1, 1.2	1.1	-	
Describe the basic process and the parties involved in the development of a training plan.	1.2.1	1.1	-	
1.2 Qualification Structure				
Knowledge				
State the scope of work for the either the CIII in Electrotechnology Electrician, or CIII in Electrical Fitting qualification undertaken.	1.2.2	1.1	1.1	Topic 1 Content Quiz Topic 1.2.1 Learning Activity Topic 1.2.2 Learning Activity
State the structure of the either the CIII in Electrotechnology Electrician, or CIII in Electrical Fitting qualification.	1.2.2	1.1	1.1	
List the units of competency, which make up either the CIII in Electrotechnology Electrician, or CIII in Electrical Fitting qualification.	1.2.2	1.1	1.1	

1 Competency Development Plans				
State the nominal training period for either the CIII in Electrotechnology Electrician, or CIII in Electrical Fitting qualification.	1.2.3	1.1	1.1	
Describe the function and purpose of a unit of competency.	1.2.2	1.1	1.1	
Describe the key aspects of a unit of competency (performance criteria and assessment requirements).	1.2.2	1.1	1.1	
Explain the types of evidence commonly used to demonstrate competency.	1.2.2	1.1	1.1	
Skills				
Access the UEE Training Package using the internet to find the relevant qualification and competency standard units.	1.2.2	1.1	1.1	Topic 1.2 Skills Practice
1.3 Responsibilities of Parties to the Contract				
Knowledge				
List the obligations of employers under the National Code of Good Practice For Australian Apprenticeships for fulfilling a training contract, such as: • Provide opportunities to develop knowledge and skills. • Ensure records of training are maintained. • Provide supervision and support • Assist in overcoming areas requiring development by the apprentice/learner.	1.1.2	1.2	1.2	Topic 1 Content Quiz Topic 1.3 Learning Activity
List the responsibilities of the learner/apprentice under the National Code of Good Practice For Australian Apprenticeships for fulfilling a training	1.1.2	1.2	1.2	

1 Competency Development Plans				
contract.				
List the responsibilities of Registered Training Organisations (RTO) under the terms of registration for fulfilling a training contract.	1.1.2	1.2	1.2	
List the State Training Authorities (STA) responsibilities in relation to fulfilling a training contract.	1.1.2	1.2	1.2	
1.4 Industry Customs and Practices				
Knowledge				
List and describe the role of the Electrical Trades Union (ETU) in the electrotechnology industry.	2.1	-	-	Topic 1 Content Quiz Topic 1.4 Learning Activity
List and describe the role of employer associations in the electrotechnology industry, including: - National Electrical and Communications Association (NECA) - Master Electricians Australia (MEA)	2.2	-	-	
List and describe the role of electrotechnology regulatory bodies and networks, including: - State/Territory WHS/OHS regulators - State/Territory electrical regulators - Electrical Regulatory Authorities Council (ERAC)	2.3, 2.4	-	-	
1.5 RTO Policies				
Skills				
Identify the training practices, requirements, administration, costs, and support services at the nominated RTO.	3	1.1	-	Topic 1.5 Skills Practice
Identify the responsibilities of the learner in	3	1.1	-	

1 Competency Development Plans				
relation to completing assessments for the qualification at the nominated RTO.				
Identify the responsibilities of the teachers/trainers in relation to the delivery of the qualification at the nominated RTO.	3	1.1	-	
Identify the procedure learners need to follow in the event of being absent from an assessment event at the nominated RTO.	3	1.1	-	
Identify the off-job assessment requirements for the qualification at the nominated RTO.	3	1.1	-	
Identify the process that learners must follow to apply for RPL at the nominated RTO.	3	1.1	-	
Identify the process that learners must follow to apply for a review of their assessment results at the nominated RTO.	3	1.1	-	
1.6 Apprentice/Learner Discipline Policy				
Skills				
Identify the rights of learners undertaking the relevant qualification at the nominated RTO.	3	1.1	-	Topic 1.6 Skills Practice
Identify the responsibilities and standards of behaviour the learners must adhere to whilst undertaking the qualification at the nominated RTO.	3	1.1	-	
Identify the penalties for breach of discipline which apply to learners enrolled in the qualification at the nominated RTO.	3	1.1	-	
Identify the types of penalties which may be given by the RTO management when a breach of discipline occurs at the nominated RTO.	3	1.1	-	

1 Competency Development Plans				
1.7 Attendance at the Training Centre				
Skills				
Identify the importance of attending classes at the nominated RTO centre.	3	1.1	-	Topic 1.7 Skills Practice
Identify how attendance for each class is recorded and reported at the nominated RTO.	3	1.1	-	
Complete RTO attendance documentation.	3	1.1	-	
1.8 Fire and Emergency Procedures				
Skills				
Identify the procedure to follow in the event of a fire at the nominated RTO, including: - Designated fire and emergency exits - Evacuation of the nominated RTO building - Location of relevant assembly point(s)	3	1.1	-	Topic 1.8 Skills Practice
Undertake a simulated evacuation of the nominated RTO building.	3	1.1	-	
1.9 Health and Safety at the Training Centre				
Skills				
Identify the precautions required for using the wiring/workshop facilities at the nominated RTO, including: - Working near rotating machinery - Precautions for long hair and beards - Where eye protection and other PPE is required	3	1.1	-	Topic 1.9 Skills Practice
Identify the minimum dress regulations required at the nominated RTO facilities, including: Acceptable footwear	3	1.1	-	

1 Competency Development Plans				
• Acceptable types of clothing				
Identify the procedures if any personal injuries occur on the nominated RTO premises.	3	1.1	-	
Identify the policy for mobile phones and personal belongings on the nominated RTO premises.	3	1.1	-	
1.10 Training Centre Tour				
Skills				
Identify the layout of the nominated RTO college/skills centre.	3	1.1	-	Topic 1.10 Skills Practice
Identify the layout of the RTO building relevant to the selected qualification.	3	1.1	-	
Undertake a tour of the relevant building and nominated RTO college/skills centre.	3	1.1	-	
Equipment: • RTO Policies and Procedures Manual • Computer with internet access				

2 Monitoring Competency Development				
Purpose:	In this topic you will learn about the requirements and techniques for gathering workplace evidence, including evidence collection tools, roles and responsibilities, procedures for monitoring and review of workplace experience, and methods of addressing deficiencies in performance.			
Duration:	This topic represents around 33% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the objectives.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Energy Space Resources
	KE	PC	PE	
2.1 Workplace Evidence				
Knowledge				
Explain the workplace evidence requirements in particular units of the CIII in Electrotechnology Electrician and CIII in Electrical Fitting.	5.3	1.1, 1.2	1.1, 1.2	Topic 2 Content Quiz Topic 2.1 Learning Activity
List the acceptable methods of gathering workplace evidence in the Electrotechnology industry including paper based and electronic methods.	5.1	1.1	-	
State the aspects of workplace evidence relevant to competency, including: - Area and duration of work undertaken - Degree of participation - Range of equipment used - Level of supervision/support received	5.2.1, 5.2.2, 5.2.3, 5.2.4	1.1	-	
Skills				
Complete pseudo-profiling training records for three different work activities.	5.2.1, 5.2.2, 5.2.3, 5.2.4	1.1	-	Topic 2.2 Skills Practice
2.2 Monitoring Work Performance				
Knowledge				
Explain the learner's responsibilities in relation to	5.3	1.2	1.2	Topic 2 Content Quiz

2 Monitoring Competency Development				
workplace evidence, including: - Timely recording and reporting of activities - Participation in periodic reviews				Topic 2.2 Learning Activity
State the consequences of a learner failing to meet workplace evidence obligations.	5.3	1.2	1.2	
Explain the employer's responsibilities in relation to workplace evidence, including: - Providing the required scope of work - Verifying the accuracy of workplace records	5.4	1.2	1.2	
Explain the training organisation's responsibilities in relation to workplace evidence, including: - Monitoring learner participation and performance (periodic review/consultation) - Verifying the accuracy and authenticity of the evidence	5.5	1.2	1.2	
Explain the need for periodic review of workplace experience.	5.6	1.1	-	
Describe the basic procedures for periodic review of workplace evidence, including: - Methods and recommended intervals - Learner participation - Quality, authenticity and accuracy - Progress against unit benchmarks	5.6	1.1	-	
List the actions that will be taken when unsatisfactory progress by the individual apprentice/learner concerning workplace evidence collection.	5.7	1.1	-	
List the options for appeal or assistance from RTO or State Training Authority (STA).	5.7	1.1	-	

2 Monitoring Competency Development				
Skills				
Review the accuracy of information given in pseudo-profiling training records/reports.	5.6	1.1	-	Topic 2.2 Skills Practice
Equipment: • RTO Policies and Procedures Manual • Computer with internet access				

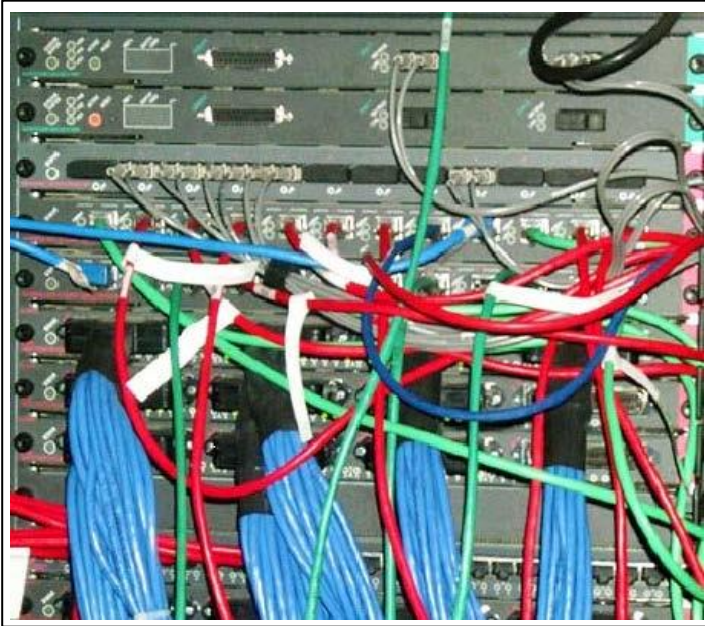
3 Enterprise Policies and Procedures				
Purpose:	In this topic you will learn about the enterprise work activities policies and procedures relevant to your workplace.			
Duration:	This topic represents around 17% of the knowledge and skills specification contents, and should take the learner approximately 1 hour to achieve the objectives.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Energy Space Resources
	KE	PC	PE	
3.1 Enterprise Policies and Procedures				
Knowledge				
State the need for policies and procedures in the workplace.	4	-	-	Topic 3 Content Quiz Topic 3.1 Learning Activity
Explain the general scope of enterprise policies and procedures, including those related to: • Workplace health and safety • Equal opportunity • Quality • Customer relations • Conflict resolution • Supervision • Competency development	4.1, 4.2, 4.3, 4.4, 4.5, 4.6	1.1	-	
Skills				
Identify and follow enterprise policies and procedures whilst undertaking electrical work.	4.1, 4.2, 4.3, 4.4, 4.5, 4.6	2.2	-	Topic 3.1 Skills Practice
Equipment: • RTO Policies and Procedures Manual • Computer with internet access				

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria		

Unit Learning Plan

UEEDV0005 – Install and maintain cabling for multiple access to telecommunication services



Contents

Contents	2
A. Overview	4
B. Knowledge and Skills Delivery	6
1 Cabling Work, Rules and Registration	6
1.1 Cabling Work and Regulations	6
1.2 Mandatory and Voluntary Requirements	6
1.3 Registration	7
2 General Installation Requirements	8
2.1 AS/CA S009 General Requirements	8
2.2 Hazards and Precautions	8
2.3 Customer Access Equipment (CAE)	9
3 Telecommunications Cables	10
3.1 Twisted Pair Cables	10
3.2 Cable Shielding and Interference	11
3.3 Optical Fibre and Coaxial Cables	11
3.4 Cable Preparation and Terminations	12
4 Telecommunications Installation Arrangements	14
4.1 Cabling Topology	14
4.2 Cabling Plans and Diagrams	14
5 Cable Distribution Devices	16
5.1 Network Boundary Distribution Devices	16
5.2 Cabling Distribution Devices	16
5.3 Distributor Records	17
6 Indoor Cabling	19
6.1 Indoor Cabling Installation Requirements	19
6.2 Damp Locations	20
6.3 Indoor Cable Supports and Enclosures	20
6.4 Indoor Cable Installation Practices	21
7 Underground Cabling	23
7.1 Underground Cabling Installation Requirements	23
7.2 Protection of Underground Cables	23
7.3 Underground Cable Installation Practices	24
8 Aerial Cabling	25
8.1 Aerial Cabling Installation Requirements	25
8.2 Catenary Systems and Requirements	25
8.3 Aerial Cable Installation Practices	26
9 Telecommunications Earthing Systems	27
9.1 MEN Earthing System	27
9.2 Earthing Systems	27
9.3 Earthing of Equipment	28
9.4 Earthing Installation and Testing	28
9.5 Earth Potential Rise	29
10 Surge Suppression Systems	31
10.1 Surge Suppression Systems and Devices	31
11 Miscellaneous Regulations	33
11.1 Cabling in Heritage Sites	33

11.2 Cabling in Public Places	33
11.3 Cabling in Hazardous Areas	33

A. Overview		
Competency Standard Unit (CSU)	UEEDV0005 Install and maintain cabling for multiple access to telecommunication services	
CSU Application	This unit involves the skills and knowledge required to install and maintain telecommunications cabling in buildings and premises. It includes working to relevant regulations, legislation, codes of practice and industry standards and to Australian Communications and Media Authority's (ACMA) Telecommunications Cabling Provider Rules; installing multiple telecommunication lines for multiple access to telecommunication services; terminating at telecommunication outlets, termination modules and distributors; testing for compliance and completing cabling documentation. This unit applies to customer cabling terminated on distributors and to the installation, maintenance and modification of indoor, external, underground cabling and customer cabling and may be used to connect devices for a range of applications, including telecommunications phones, data (video and multimedia) and security (alarms and fire protection). Work functions in the occupational areas where this unit may be used are subject to regulatory requirements. Refer to the UEE Electrotechnology Training Package Companion Volume Implementation Guide or the relevant regulator for specific guidance on requirements.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEDV0005	Performance Criteria
	KE-UEEDV0005	Knowledge Evidence
	PE-UEEDV0005	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 11	72 hours
	Completion of Unit Knowledge Test 1	1 hour 30 minutes
	Completion of Unit Knowledge Test 2	1 hour 30 minutes
	Completion of Unit Skills Test	5 hours
	Total duration of structured learning program	80 hours

	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications AND • UEECD0043 Solve problems in direct current circuits OR • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Cabling Work, Rules and Registration

Purpose:	In this topic you will interpret the Cabling Provider Rules AS/CA S009 and AS/CA S008 to facilitate correct installation of telecommunications wiring and associated equipment.			
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.			
Knowledge and Skills Content Areas	Unit Mapping			Exemplar Learning Resources
	KE	PC	PE	
1.1 Cabling Work and Regulations				
Knowledge				
State the responsibilities of the industry regulator – Australian Communications and Media Authority (ACMA) for customer premises cabling and cabling providers for WHS/OHS and network integrity.	2.1	-	-	Topic 1 Content Quiz Topic 1.1 Learning Activity
Explain the role of cabling registrars, cabling auditors and inspectors.	3.1	-	-	
Define the term 'network boundary'.	6.3	-	-	
State the scope of registered cabling work, and explain the limitations placed on registered cablers in relation to the network boundary.	2.1, 2.2, 2.4, 6.3	-	-	
1.2 Mandatory and Voluntary Requirements				
Knowledge				
Explain the role of the cabling provider rules and using ACMA certified components list.	2.1, 2.2, 2.3	-	-	Topic 1 Content Quiz Topic 1.2 Learning Activity
Outline the mandatory and voluntary registration requirements for internal, external, above ground or below ground installation cabling work.	2.1, 2.2, 2.4, 3.2	-	-	

1 Cabling Work, Rules and Registration				
Explain the role of the wiring rules, cabling record maintenance and the responsibilities and process for communicating the installation work under the cabling provider rules.	2.1, 2.2, 2.4, 3.2	-	-	
Explain the role of supervisors in implementing cabling provider rules.	2.1, 2.4, 3.2	-	-	
1.3 Registration				
Knowledge				
Describe the method of registration and the prerequisites for registration.	2.1, 3.1, 3.3	-	-	Topic 1 Content Quiz Topic 1.3 Learning Activity
Explain where security, data and fire alarm cabling are placed under cabling provider rules	2.1, 2.2, 3.3	-	-	
Reference Text • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. • Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. • Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.				
Standards and Codes • AS/CA S009 Installation requirements for customer cabling (Wiring Rules).				

2 General Installation Requirements				
Purpose:	In this topic you will examine the general requirements for telecommunications installations as stated in the Cabling Provider Rules AS/CA S009, customer access equipment (CAE) and hazards/precautions typically found in telecommunications systems.			
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.			
Knowledge and Skills Content Areas	Unit Mapping			Exemplar Learning Resources
	KE	PC	PE	
2.1 AS/CA S009 General Requirements				
Knowledge				
State the general installation requirements laid down by AS/CA S009.	3.2, 4.1	-	-	Topic 2 Content Quiz Topic 2.1 Learning Activity
Outline the requirements for joints in customer cables.	3.2, 4.1	-	-	
Outline the general requirements for ensuring safety and integrity of the telecommunications network.	2.4, 3.2, 4.1	-	-	
2.2 Hazards and Precautions				
Knowledge				
Describe the hazards encountered when working with electronic equipment.	21.1, 21.2, 21.3, 21.4, 21.5	-	-	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe precautions used to minimise damage to electronic components and circuits from: - Static discharge. - Chemical damage. - Mechanical damage. - Electromagnetic Interference.	21.1, 21.2, 21.3, 21.4, 21.5	-	-	

2 General Installation Requirements				
Skills				
Identify hazards associated with electronic components and printed board assemblies (PBAs).	21.1, 21.2, 21.3, 21.4, 21.5	1.2	1.1	Topic 2.2 Skills Practice
2.3 Customer Access Equipment (CAE)				
Knowledge				
Describe the basic functions of customer access equipment.	1	-	-	Topic 2 Content Quiz Topic 2.3 Learning Activity
Describe the basic operations of System Distribution Frames (SDF)	1	-	-	
Reference Text • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. • Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. • Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.				
Standards and Codes • AS/CA S009 Installation requirements for customer cabling (Wiring Rules).				

3 Telecommunications Cables				
Purpose:	In this topic you will develop an understanding of the types, characteristics and applications of various telecommunications cables. You will also practice your skills relating to the identification, preparation and termination of these cables using safe working practices.			
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.			
Knowledge and Skills Content Areas	Unit Mapping			Exemplar Learning Resources
	KE	PC	PE	
3.1 Twisted Pair Cables				
Knowledge				
Describe the various types of twisted pair cables.	14.1	-	-	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe the characteristics of UTP and STP indoor cable, underground pair and quad cable, aerial pair and quad cable and integral bearer wire.	14.1	-	-	
Explain the performance characteristics, bandwidth, and capacity of twisted pair cables.	14.2	-	-	
Describe the marking, identification and labelling of twisted pair cables, as required in AS/CA S008 and AS/CA S009.	4.1	-	-	
Describe the identification colour code for indoor and outdoor twisted pair cables up to and including 100 pairs.	14.1	-	-	
List the applications of the various types of twisted pair cables.	14.3	-	-	
Skills				
Identify twisted pair cables from their physical characteristics and manufacturers documentation.	14.1, 13.2, 16.2	-	-	Topic 3.3 Skills Practice

3 Telecommunications Cables				
3.2 Cable Shielding and Interference				
Knowledge				
Explain the principle of EMI/RFI.	19.1	-	-	Topic 3 Content Quiz Topic 3.2 Learning Activity
List EMI/RFI sources.	19.2	-	-	
Describe EMI/RFI reduction techniques.	19.3, 19.5	-	-	
State the reasons for earthing cable shields.	18.1, 19.4	-	-	
Skills				
Select cables having suitable shielding for given applications.	14.1, 13.2, 16.2	-	-	Topic 3.3 Skills Practice
3.3 Optical Fibre and Coaxial Cables				
Knowledge				
Describe the various types of optical fibre and coaxial cables.	14.1	-	-	Topic 3 Content Quiz Topic 3.3 Learning Activity
Explain the performance characteristics, bandwidth, and capacity of optical fibre and coaxial cables.	14.2	-	-	
Describe the marking, identification and labelling of optical fibre and coaxial cables, as required in AS/CA S008 and AS/CA S009.	3.2, 4.1, 4.4, 13.2, 16.2	-	-	
Describe the identification colour code for indoor and outdoor optical fibre and coaxial cables.	14.1	-	-	
List the applications of the various types of optical fibre and coaxial cables.	14.3	-	-	
Outline the general AS/CA S009 requirements for optical fibre and coaxial cabling systems.	3.2, 4.1, 4.4	-	-	
Skills				
Identify optical fibre and coaxial cables from their	14.1, 13.2,	-	-	Topic 3.3 Skills Practice

3 Telecommunications Cables				
physical characteristics and manufacturers documentation.	16.2			
3.4 Cable Preparation and Terminations				
Knowledge				
Describe the methods used for correct cabling stripping and fanning out to indicate relevant colour code.	16.1, 17.1	-	-	Topic 3 Content Quiz Topic 3.4 Learning Activity
Describe the precautions necessary to maintain pair integrity.	20.1	-	-	
List appropriate tools required for stripping and terminating cable safely.	17.1, 17.3	-	-	
List the hazards when stripping and terminating cable.	6.2, 15.1, 17.3, 17.4	-	-	
State the relevant regulations associated with cable preparation and termination.	3.2, 4.1, 6.1, 17.4	-	-	
Skills				
Identify the hazards associated with cable preparation and termination.	6.2, 15.1, 17.3, 17.4	1.1, 1.2, 1.3	1.1	Topic 3.4 Skills Practice
Demonstrate correct cabling stripping and fanning out to indicate relevant colour code.	16.1, 17.1	3.1, 3.2	1.1, 1.2, 5.3, 10	
Identify and check tools required for stripping cable safely.	17.1, 17.3	1.8	1.1, 1.2, 4	
Identify and prepare a range of cables including one larger cable (20 pair or greater) and terminate on a Krone block or other approved device.	6.1	1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 2.1, 2.6, 3.1, 3.2, 3.4, 3.13, 3.14, 4.1, 4.2	1.1, 1.2, 5.3, 10	
Identify and check tools for terminating insulation displacement (IDS) devices.	17.1, 17.3	1.8	1.1, 1.2, 4	

3 Telecommunications Cables

Reference Text

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education.
- Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements.
- Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.

Standards and Codes

- AS/CA S009 Installation requirements for customer cabling (Wiring Rules).

Equipment/Material

- Manufacturer's catalogues – telecommunications cables.
- Lengths of various telecommunications cables (at least 5).
- Multi-pair cable.
- Disconnect modules.
- 11-way frame.
- Cable stripping tools.
- Punch down tool.
- Cable ties.

4 Telecommunications Installation Arrangements				
Purpose:	In this topic you will develop your understanding of telecommunications installation layouts, identification, planning and documentation in accordance with relevant standards, codes and regulations.			
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
4.1 Cabling Topology				
Knowledge				
Describe the topology of telecommunications cables for a range of cable applications.	13.1	-	-	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe telecommunications distribution box layouts and systems including CD/BD, FD and LD.	13.1	-	-	
4.2 Cabling Plans and Diagrams				
Knowledge				
Describe the standard symbols and conventions used in telecommunications plans, cabling diagrams and schematic diagrams.	13.1, 13.2, 13.3	-	-	Topic 4 Content Quiz Topic 4.2 Learning Activity
Skills				
Interpret telecommunications plans, cabling diagrams and schematic diagrams to identify various types of cables and equipment used.	13.1, 13.2, 13.3	1.3	2	Topic 4.2 Skills Practice
Reference Text - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Third Edition, 2013. - Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. - Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.				

4 Telecommunications Installation Arrangements

Standards and Codes

- AS/CA S009 Installation requirements for customer cabling (Wiring Rules).
- AS 3085.1 Telecommunications installations – Administration of communications cabling systems.

5 Cable Distribution Devices				
Purpose:	In this topic you will expand your understanding of cabling distributors, including types, characteristics, AS/CA S009 requirements and records. You will also practice terminating, earthing and documenting cabling distribution devices.			
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
5.1 Network Boundary Distribution Devices				
Knowledge				
List the carrier's and licensed cable installer's responsibilities for the installation of the network boundary cable distribution device.	2.1, 2.2, 2.4, 3.2, 4.1, 6.1, 6.3, 15.8	-	-	Topic 5 Content Quiz Topic 5.1 Learning Activity
Explain the importance of maintaining segregation between cables of different systems.	5.2, 6.1, 6.3, 15.8	-	-	
State the AS/CA S009 requirements for the location and installation of the network boundary device.	6.1, 6.3, 15.8	-	-	
State the minimum clearances that apply to the network boundary cable distribution device.	6.3, 15.8	-	-	
Describe prohibited locations for installation of the network boundary cable distribution device.	6.3, 15.8	-	-	
Skills				
Apply AS/CA S009 to identify prohibited locations for network boundary cable distribution devices.	6.3, 15.8	-	-	Topic 5.2 Skills Practice
5.2 Cabling Distribution Devices				
Knowledge				
Describe the physical properties of common cable	5.1	-	-	Topic 5 Content Quiz

5 Cable Distribution Devices				
distribution devices.				Topic 5.2 Learning Activity
Explain the AS/CA S009 requirements for cable distribution devices, including: • Insulation • Terminations • Backmount earthing • Mechanical integrity • Link bar or strip insulation • Cross-connections • Records and fire resistance	3.2, 4.1, 5.1, 5.2, 5.3, 6.1, 6.3, 15.8, 16.1, 17.1, 17.2, 17.3, 17.4	-	-	
State the recommended access clearances required around MDFs and NTDs.	5.2, 5.3, 6.3, 15.8	-	-	
Describe the safety precautions required when soldering cables to distribution box terminals.	6.1, 6.2	-	-	
Skills				
Apply AS/CA S009 to plan the installation of cable distribution devices, ensuring minimum clearances are provided.	3.2, 4.1, 5.1, 5.2, 5.3, 6.2, 6.3, 13.3, 15.8	1.3	2	Topic 5.2 Skills Practice Topic 5.3 Skills Practice
Terminate boundaries and distribution devices using a range of methods, including: • Crimping (crushing/ insulation displacement). • Soldered connection.	6.1, 17.1, 17.2, 17.3, 17.4, 15.8	1.1, 1.2, 1.3, 1.6, 1.7, 1.8, 2.1, 2.6, 3.1, 3.2, 3.4, 3.13, 3.14, 4.1, 4.2	1.1, 1.2, 2, 4, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 10	
5.3 Distributor Records				
Knowledge				
Describe the minimum requirements for labelling and documentation associated with telecommunications systems, as specified in AS	13.3	-	-	Topic 5 Content Quiz Topic 5.3 Learning Activity

5 Cable Distribution Devices				
3085.1 for backbone cabling, horizontal cabling, indoor and outdoor cabling, and active communications equipment.				
Skills				
Update distributor records in accordance with industry standards and practices to reflect installed or altered cabling work.	13.3	4.3, 4.4	9	Topic 5.3 Skills Practice
Reference Text • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. • Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. • Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual. Standards and Codes • AS/CA S009 Installation requirements for customer cabling (Wiring Rules). Equipment/Material • Multi-pair cables (20-pair and 2-pair) and jumper wire. • 11-way frame and disconnect modules. • Cable stripping and punch down tools. • Wrap and solder tag block. • Distributor record sheets.				

6 Indoor Cabling				
Purpose:	In this topic you will develop your understanding and ability to install indoor customer cabling in accordance with AS/CA S009, safe work procedures and industry best practice.			
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
6.1 Indoor Cabling Installation Requirements				
Knowledge				
Describe the general conditions that apply to cable installation work.	3.2, 4.1, 7.1	-	-	Topic 6 Content Quiz Topic 6.1 Learning Activity
Describe the AS/CA S009 requirements for the installation of indoor grade customer cables.	3.2, 4.1, 7.1	-	-	
State the minimum separations required between indoor customer cables and other services.	3.2, 4.1, 7.2	-	-	
State the minimum separations required between the indoor customer cable terminations and other services.	3.2, 4.1, 7.2	-	-	
Describe the restrictions placed on cables installed in lift and hoist shafts.	3.2, 4.1, 7.4	-	-	
Describe the Building Code requirements that affect the installation of indoor customer cabling (fire safety, health and amenity etc.)	3.2	-	-	
Skills				
Apply AS/CA S009 to plan compliant indoor customer cabling installations.	3.2, 4.1, 7.1, 7.2	1.3, 1.4	2, 3, 5.6	Topic 6.2 Skills Practice
Apply AS/CA S009 to determine the minimum separations required between indoor customer	3.2, 4.1, 7.2	1.3	-	

6 Indoor Cabling				
cabling/terminations from other services.				
Apply AS/CA S009 to determine the restrictions on indoor customer cabling and equipment installed in lift and hoist shafts.	3.2, 4.1, 7.4	1.3	-	
6.2 Damp Locations				
Knowledge				
Delineate restricted zones within damp situations.	3.2, 4.1, 7.3	-	-	Topic 6 Content Quiz Topic 6.2 Learning Activity
List suitable customer equipment for installation within damp situation restricted zones.	7.3	-	-	
Skills				
Use Cabler Wiring Rules to determine the various standards for indoor telecommunications cabling and equipment in damp situations.	3.2, 4.1, 7.3	1.3	-	Topic 6.2 Skills Practice
6.3 Indoor Cable Supports and Enclosures				
Knowledge				
List the various types of cable supports, fixings and enclosures used to support indoor cabling (tray, basket, conduit, trunking, catenary, hooks).	4.5, 15.5, 15.6, 16.5	-	-	Topic 6 Content Quiz Topic 6.3 Learning Activity
List the various methods of securing indoor cabling to supports (Velcro ties etc.).	15.5, 15.6, 16.5	-	-	
Describe the AS/CA S009 requirements applicable to indoor cable supports and enclosures, including catenary systems and conduits.	3.2, 4.1, 4.3, 4.5, 15.4, 15.7	-	-	
Skills				
Identify the various types of cable enclosures utilised in telecommunication cabling installations.	4.5, 15.4	1.3	-	Topic 6 Content Quiz Topic 6.3 Learning Activity Topic 6.4 Skills Practice

6 Indoor Cabling				
6.4 Indoor Cable Installation Practices				
Knowledge				Topic 6 Content Quiz Topic 6.4 Learning Activity
Describe the various cable installation/hauling methods and equipment used to install indoor customer cabling.	15.2, 15.3, 16.1, 16.2, 16.3, 20.2	-	-	
Describe the various cable dispensers such as, cable drums and cable spools.	15.3	-	-	
Define the precautions needed to prevent damage when hauling indoor customer cabling (e.g. kinking, stretching, burning, crushing, bending radius, and sheath damage).	15.2, 16.4	-	-	
State the WHS/OHS risks and precautions needed when installing indoor customer cabling (e.g. lifting and rolling drums, hauling cables etc.).	15.1, 15.7	-	-	
Skills				
Install, test and fault find indoor customer cabling and equipment in accordance with AS/CA S009, safe work procedures and industry best practice.	7.1, 7.2, 15.1, 15.2, 15.3, 15.4, 15.5, 15.6, 15.7, 16.1, 16.2, 16.3, 16.4, 16.5, 20.1, 20.2	1.1, 1.2, 1.3, 1.4, 1.6, 1.7, 1.8, 2.1, 2.2, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.13, 2.14, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.12, 3.13, 3.14, 4.1, 4.2, 4.3, 4.4	1.1, 1.2, 2, 3, 4, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 9, 10	Topic 6.4 Skills Practice
Reference Text				
• Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. • Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements.				

6 Indoor Cabling

- Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.

Standards and Codes

- AS/CA S009 Installation requirements for customer cabling (Wiring Rules).

Equipment/Material

- Multi-pair cables (20-pair recommended).
- 11-way frame and disconnect modules.
- 20 pair cable blocks.
- Distributor record sheets.
- Cable stripping and punch down tools.
- Cable supports and fixings (cable tray / duct / trunking).
- Digital multimeter.
- Cable ties.
- Hand tools.
- PPE.

7 Underground Cabling					
Purpose:	In this topic you will develop your understanding and ability to install underground customer cabling in accordance with AS/CA S009, safe work procedures and industry best practice.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas		Unit Mapping ¹			Exemplar Learning Resources
		KE	PC	PE	
7.1 Underground Cabling Installation Requirements					
Knowledge					
Describe the AS/CA S009 requirements for the installation of underground customer cables.		3.2, 4.1, 8.1	-	-	Topic 7 Content Quiz Topic 7.1 Learning Activity
State the minimum separations required between underground customer cables and other services.		3.2, 4.1, 8.1, 8.4	-	-	
7.2 Protection of Underground Cables					
Knowledge					
Outline the precautions used to protect underground customer cabling.		3.2, 4.1, 8.1, 8.3	-	-	Topic 7 Content Quiz Topic 7.2 Learning Activity
List the AS/CA S009 requirements for underground conduits.		3.2, 4.1, 4.5, 8.1, 15.4	-	-	
State the minimum installation depths for underground customer cabling.		3.2, 4.1, 8.1, 8.2	-	-	
Skills					
Apply AS/CA S009 to plan compliant underground customer cabling installations.		3.2, 4.1, 8.1, 8.2, 8.3, 8.4	1.3, 1.4	2, 3, 5.6	Topic 7.2 Skills Practice

7 Underground Cabling				
7.3 Underground Cable Installation Practices				
Knowledge				
Describe the various cable installation/hauling methods and equipment used to install underground customer cabling.	15.2, 15.3	-	-	Topic 7 Content Quiz Topic 7.3 Learning Activity
Define the precautions needed to prevent damage when hauling underground customer cabling.	15.2	-	-	
State the WHS/OHS risks and precautions needed when installing underground customer cabling.	15.1, 15.7	-	-	
Skills				
Draw in underground customer cabling in accordance with AS/CA S009, safe working procedures and industry best practice.	3.2, 4.1, 8.1, 8.2, 8.3, 8.4, 15.1, 15.2, 15.3, 15.4, 15.5, 15.6, 15.7, 16.1, 16.2, 16.4, 16.6	1.1, 1.2, 1.3, 1.4, 1.6, 1.7, 1.8, 2.1, 2.2, 2.5, 2.6, 2.7, 2.8, 2.10, 2.13, 2.14, 4.1, 4.2	1.1, 1.2, 2, 3, 4, 5.1, 5.3, 5.4, 5.6, 9	Topic 7.3 Skills Practice
Reference Text - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. - Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. - Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual. Standards and Codes - AS/CA S009 Installation requirements for customer cabling (Wiring Rules).				

8 Aerial Cabling				
Purpose:	In this topic you will develop your understanding and ability to install aerial customer cabling in accordance with AS/CA S009, safe work procedures and industry best practice.			
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
8.1 Aerial Cabling Installation Requirements				
Knowledge				
Describe the AS/CA S009 requirements for the installation of aerial customer cables.	3.2, 4.1, 9.1	-	-	Topic 8 Content Quiz Topic 8.1 Learning Activity
Outline the precautions required to protect aerial customer cabling.	15.2, 16.6	-	-	
State the minimum ground clearances for aerial customer cabling.	3.2, 4.1, 9.2	-	-	
State the minimum separations required between aerial cabling and aerial electrical services.	3.2, 4.1, 9.3	-	-	
8.2 Catenary Systems and Requirements				
Knowledge				
Describe the various components of catenary cabling systems.	4.3	-	-	Topic 8 Content Quiz Topic 8.2 Learning Activity
Outline the general requirements for catenary cabling systems.	3.2, 4.1, 4.3, 9.1, 9.2, 9.3	-	-	
Skills				
Apply AS/CA S009 to plan compliant aerial and/or catenary supported customer cabling installations.	3.2, 4.1, 4.3 9.1, 9.2, 9.3	1.3, 1.4	2, 3, 5.6	Topic 8.2 Skills Practice

8 Aerial Cabling				
8.3 Aerial Cable Installation Practices				
Knowledge				
Describe the various cable installation/hauling methods and equipment used to install aerial customer cabling.	15.2, 15.3, 16.6	-	-	Topic 8 Content Quiz Topic 8.3 Learning Activity
Define the precautions needed to prevent damage when installing aerial customer cabling.	15.2, 16.6	-	-	
State the WHS/OHS risks and precautions needed when installing aerial customer cabling.	15.1, 15.7	-	-	
Skills				
Install, terminate and test aerial customer cabling in accordance with AS/CA S009, including identification and rectification of any faults or problems.	3.2, 4.1, 4.3, 9.1, 9.2, 9.3, 15.1, 15.2, 15.3, 15.4, 15.5, 15.6, 15.7, 16.1, 16.2, 16.4, 16.5, 16.6, 20.1, 20.2	1.1, 1.2, 1.3, 1.4, 1.6, 1.7, 1.8, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.13, 2.14, 3.1, 3.12, 4.1, 4.2	1.1, 1.2, 2, 3, 4, 5.1, 5.3, 5.4, 5.5, 5.6, 9, 10	Topic 8.3 Skills Practice
Reference Text - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. - Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. - Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual. Standards and Codes - AS/CA S009 Installation requirements for customer cabling (Wiring Rules).				

9 Telecommunications Earthing Systems				
Purpose:	In this topic you will learn about the various arrangements and AS/CA S009 requirements for telecommunications earthing systems and components. You will also learn about the hazards and requirements associated with earth potential rise and low frequency induction.			
Duration:	This topic represents around 12.5% of the knowledge and skills specification contents, and should take the learner approximately 10 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PE	PC	
9.1 MEN Earthing System				
Knowledge				
Describe the Multiple Earthed Neutral (MEN) system of earthing.	10.5	-	-	Topic 9 Content Quiz Topic 9.1 Learning Activity
9.2 Earthing Systems				
Knowledge				
Explain the three types of telecommunications earthing systems and where they are used.	10.5	-	-	Topic 9 Content Quiz Topic 9.2 Learning Activity
Explain the arrangement of the Telecommunication Reference Conductor (TRC) and Communications Earthing System (CES) as laid down by AS/CA S009.	10.1	-	-	
Describe the purpose of the Telecommunication Reference Conductor (TRC) in single and multi-storey buildings.	10.2, 10.3	-	-	
Explain the function of the telecommunications functional earth electrode.	10.2	-	-	
Skills				
Identify component parts of the basic	10.5	1.5	6	Topic 9.4 Skills Practice

9 Telecommunications Earthing Systems				
telecommunications earthing systems.				
9.3 Earthing of Equipment				
Knowledge				
Explain the purpose and regulatory requirements for earthing of cable shields and drain wires.	10.6, 18.1	-	-	Topic 9 Content Quiz Topic 9.3 Learning Activity
List the regulatory requirements for earthing of metallic frames, backmounts, enclosures, trays, conduits and ducts.	10.6, 18.3	-	-	
Describe the purpose of protective earth barriers for segregation on cable tray, duct and metal equipment enclosures.	10.6	-	-	
Explain regulatory requirements for equipotential bonding.	10.1, 10.6, 10.7	-	-	
Skills				
Use Cabler Wiring Rules to determine the requirements for equipotential bonding in a telecommunication installation.	10.6, 10.7	1.5	6	Topic 9.4 Skills Practice
9.4 Earthing Installation and Testing				
Knowledge				
List the AS/CA S009 requirements for the installation of TRC and CES earthing systems.	10.4	-	-	Topic 9 Content Quiz Topic 9.4 Learning Activity
Describe the use of line taps.	10.4	-	-	
Explain the purpose of earth testing instruments and the parameters that are to be met.	10.4, 18.2, 18.4, 18.7	-	-	
Describe the procedure and requirements for testing telecommunications earthing systems.	10.4, 18.2, 18.6	-	-	

9 Telecommunications Earthing Systems				
Skills				
Install the TRC and CES earthing systems as laid down by AS/CA S009, including: • Correct selection of earthing conductors • Installing line taps. • Terminating earthing conductors at earth bars using lugs and tunnel connectors. • Correct labelling of cables and components.	10.4	1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 2.1, 2.12, 2.13, 2.14, 3.1, 3.2, 3.8, 3.9, 3.11, 3.13, 3.14, 4.1, 4.2	1.1, 1.2, 2, 3, 4, 6, 7, 10	Topic 9.4 Skills Practice
Test installed TRC and CES earthing for compliance with requirements, including: • TRC conductor resistance. • Accidental bonding. • CES resistance. • Recording and interpreting test results.	10.4, 18.2, 18.6, 18.7, 20.3	1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 3.1, 3.10, 3.12, 3.14, 4.1, 4.3	1.1, 1.2, 4, 9, 11	
9.5 Earth Potential Rise				
Knowledge				
Explain the conditions that can lead to Earth Potential Rise (EPR) and Low Frequency Induction (LFI) hazards.	3.2, 4.2, 18.5	-	-	Topic 9 Content Quiz Topic 9.5 Learning Activity
Explain the potential effects of EPR and LFI.	3.2, 4.2, 18.5	-	-	
Outline the requirements and considerations for the installation of customer cabling and equipment within an EPR zone.	3.2, 4.1, 4.2, 18.5	-	-	
Outline the requirements and considerations for the installation of customer cabling and equipment within a LFI zone.	3.2, 4.1, 4.2, 18.5	-	-	
List the requirements for power/earth feeding.	3.2, 4.1, 4.2, 18.5	-	-	

9 Telecommunications Earthing Systems

Reference Text

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Third Edition, 2013.
- Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements.
- Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.

Standards and Codes

- AS/CA S009 Installation requirements for customer cabling (Wiring Rules).

Equipment

- Multipair cable.
- Selection of earth cables (including 6mm² green/yellow earth cable).
- Selection of crimp lugs (including 6mm² crimp lugs).
- Communications earth terminal (CET).
- 2 x 11-way profile frames + earth bars.
- 2 x disconnection modules
- Line taps.
- Digital multimeter.
- Crimp tool and punch down tool.
- Hand tools.
- Small cable ties.
- PPE.

10 Surge Suppression Systems				
Purpose:	In this topic you will gain knowledge and develop skills in the different types and ratings of surge suppression devices approved by AS/CA S009 for telecommunication installations.			
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping¹			Exemplar Learning Resources
	KE	PC	PE	
10.1 Surge Suppression Systems and Devices				
Knowledge				
Describe the purpose of overvoltage protection devices (surge suppression).	11	-	-	Topic 10 Content Quiz Topic 10.1 Learning Activity
Describe the operation of various types of overvoltage protection devices.	11	-	-	
Describe the different types and ratings of surge suppression devices approved by AS/CA S009 for telecommunication installations.	11	-	-	
Explain the installation techniques for overvoltage protection systems.	11	-	-	
List the regulatory requirements for connecting surge suppression devices to the protective earth.	11, 20.3	-	-	
Explain the earthing requirement for each type of overvoltage protection device.	11, 20.3	-	-	
List the hazards associated with non-complying earths used in overvoltage and surge/spike suppression systems, and the possible solutions.	11, 20.3	-	-	

10 Surge Suppression Systems

Skills

Select and install a surge suppression device for a given scenario.

11

1.1, 1.2, 1.3,
1.6, 1.7, 1.8,
2.1, 2.11, 2.14

1.1, 1.2, 4,
8

Topic 10.1 Skills Practice

Reference Text

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education.
- Standards Australia Communications Cabling Manual HFB243 Module 1 Australian Regulatory Arrangements.
- Standards Australia Communications Cabling Manual HB29 Module 2 Communications Cabling Manual.

Standards and Codes

- AS/CA S009 Installation requirements for customer cabling (Wiring Rules).

Equipment/Material

- Manufacturer's catalogues – surge suppression devices.

11 Miscellaneous Regulations				
Purpose:	In this topic you will learn about the relevant regulations and standards affecting cabling installations in heritage buildings and sites, public places and hazardous areas.			
Duration:	This topic represents around 2.5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
11.1 Cabling in Heritage Sites				
Knowledge				
State the regulatory requirements and cabling techniques to carry out work in heritage buildings.	12.1	-	-	Topic 11 Content Quiz Topic 11.1 Learning Activity
Skills				
Identify the regulations for telecommunications installation in heritage buildings.	12.1	1.3	-	Topic 11.3 Skills Practice
11.2 Cabling in Public Places				
Knowledge				
List the approvals required and procedures involved in road and pavement openings for underground and aerial cable erection in a public place.	12.2	-	-	Topic 11 Content Quiz Topic 11.2 Learning Activity
Skills				
Identify the regulations for telecommunications installation in public places.	12.2	1.3	-	Topic 11.3 Skills Practice
11.3 Cabling in Hazardous Areas				
Knowledge				
Describe hazardous areas in relation to cabling	12.3	-	-	Topic 11 Content Quiz

11 Miscellaneous Regulations				
installations and procedures and techniques required for cabling in such areas.				Topic 11.3 Learning Activity
State the requirements for installing customer cabling in explosive atmospheres.	12.3	-	-	
Skills				
Identify the regulations for telecommunications installation in hazardous areas.	12.3	1.3	-	Topic 11.3 Skills Practice
Reference Text • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Third Edition, 2013. • Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. • Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual. Standards and Codes • Australian standard AS/CA S009 Installation requirements for customer cabling (Wiring Rules).				

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria		

Unit Learning Plan

UEEDV0008 – Install, modify and verify coaxial and structured communication copper cabling



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Structured Cables and Hardware	5
1.1 Types of Structured Cables	5
1.2 Structured Cabling Hardware	5
1.3 Structured Cabling Terminations	6
2 Local Area Networks	7
2.1 Local Area Networks	7
2.2 Cabling Requirements for LANs	7
3 Installation Planning	8
3.1 Installation Requirements	8
3.2 Structured Cabling Equipment Selection	8
3.3 Structured Cabling Identification	9
4 Structured Cabling Installation	10
4.1 Site Survey and Assessment	10
4.2 Structured Cable Installation	11
4.3 Racks and Hardware Installation	11
5 Testing Structured Cabling Systems	13
5.1 Testing Structured Cables	13
5.2 Fault Diagnosis	13
6 Coaxial Cables and Hardware	15
6.1 Types of Coaxial Cables	15
6.2 Coaxial Cabling Hardware	15
7 Coaxial Cable Installation and Testing	17
7.1 Coaxial Cabling Installation	17
7.2 Coaxial Testing and Documentation	17

A. Overview		
Competency Standard Unit (CSU)	UEEDV0008 Install, modify and verify coaxial and structured communication copper cabling	
CSU Application	This unit involves the skills and knowledge required to install, modify and verify coaxial and structured communication copper cabling in buildings and premises intended for connection to a telecommunications network as permitted by the Australian Communications and Media Authority (ACMA). It includes working safely to industry standards; installing generic, structured twisted pair cabling (category 5 and above) and coaxial cabling that terminate at distributors, termination modules and telecommunication outlets; testing for compliance; and completing cabling documentation. Work functions in the occupational areas where this unit may be used are subject to regulatory requirements. Refer to the UEE Electrotechnology Training Package Companion Volume Implementation Guide or the relevant regulator for specific guidance on requirements.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEDV0008	Performance Criteria
	KE-UEEDV0008	Knowledge Evidence
	PE-UEEDV0008	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 7	36 hours
	Completion of Unit Knowledge Test	1 hour 30 minutes
	Completion of Unit Skills Test	2 hours 30 minutes
	Total duration of structured learning program	40 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	

Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEDV0005 Install and maintain cabling for multiple access to telecommunication services AND • UEECD0043 Solve problems in direct current circuits OR • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Structured Cables and Hardware

Purpose:	In this topic you will gain knowledge of the various types, characteristics and applications of structured cables, the associated enclosures and hardware, and termination tools and techniques.			
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
1.1 Types of Structured Cables				
Knowledge				
Describe the construction, performance characteristics and applications of structured cables, including Category 5, 5e, 6, 6A and 7 cables.	1.1, 1.2, 1.3, 7	-	-	Topic 1 Content Quiz Topic 1.1 Learning Activity
List the conventions and requirements for labelling and identification of structured cables.	2.2	-	-	
List the Australian Standards applicable to structured cables.	7	-	-	
Skills				
Identify different types of structured cables, including UTP, FTP, and STP.	1.1, 7	1.7	2	Topic 1 Content Quiz Topic 1.1 Learning Activity Topic 1.3 Skills Practice
1.2 Structured Cabling Hardware				
Knowledge				
Describe the types of connectors and termination devices (sockets, patch panels etc.) used in different structured cabling systems.	8.3	-	-	Topic 1 Content Quiz Topic 1.2 Learning Activity
Describe the types of racks, cabinets and back	4.1, 4.3	-	-	

1 Structured Cables and Hardware				
mounts used in structured cabling systems.				
Skills				
Identify different types of structured cabling connectors and termination devices.	4.1, 4.3, 8.3	1.7	2	Topic 1 Content Quiz Topic 1.2 Learning Activity Topic 1.3 Skills Practice
1.3 Structured Cabling Terminations				
Knowledge				
List the types of tools used for stripping and terminating structured cables.	5, 8.4	-	-	Topic 1 Content Quiz Topic 1.3 Learning Activity
Describe the techniques for stripping and terminating structured cables.	5, 8.1	-	-	
Skills				
Terminate structured cables at sockets and patch panels.	4.3, 5, 8.1, 8.2, 8.4	1.1, 1.2, 1.3, 1.4, 1.6, 1.7, 1.8, 1.9, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7, 3.10, 3.11, 4.1, 4.2, 4.4	1, 2, 3, 4, 6.3, 6.5, 6.6	Topic 1.3 Skills Practice
Reference Text: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. - Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. - Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual. Standards and Codes: - AS/CA S009 Installation requirements for customer cabling (Wiring Rules). - AS/NZS 3080 Telecommunications installations – Generic cabling for commercial premises.				

2 Local Area Networks					
Purpose:	In this topic you will gain knowledge of the purpose and layout of local area networks (LAN) and the use of structural cabling systems.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas		Unit Mapping ¹			Exemplar Learning Resources
		KE	PC	PE	
2.1 Local Area Networks					
Knowledge					
Describe the general principle of Local Area Network (LAN).		6.2, 6.3	-	-	Topic 2 Content Quiz Topic 2.1 Learning Activity
List and describe the different types of networks such as peer-to-peer and server-client types.		6.1, 6.2, 6.3	-	-	
2.2 Cabling Requirements for LANs					
Knowledge					
Explain the cabling and termination arrangements for a LAN system.		6.1, 6.2, 6.3	-	-	Topic 2 Content Quiz Topic 2.2 Learning Activity
List the hardware requirements for a typical LAN system.		6.1, 6.2, 6.3	-	-	
Reference Text: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. - Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. - Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.					
Standards and Codes: - AS/CA S009 Installation requirements for customer cabling (Wiring Rules). - AS/NZS 3080 Telecommunications installations – Generic cabling for commercial premises.					

3 Installation Planning				
Purpose:	In this topic you will gain knowledge and skills related to planning out basic structured cabling installations, including the interpretation of relevant drawings, and the factors affecting cable and equipment selection.			
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
3.1 Installation Requirements				
Knowledge				
Describe the types of cable routes used for structured cabling in domestic and commercial buildings.	10	-	-	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe the types of cable supports and enclosures used with structured cabling (e.g. tray, conduit, trunking, catenary, hooks).	10	-	-	
State the general AS/CA S009 installation requirements applicable to structured customer cabling.	10	-	-	
State the requirements and cabling techniques to carry out work in heritage buildings.	10	-	-	
3.2 Structured Cabling Equipment Selection				
Knowledge				
State the basic design principles for structured cabling systems.	6.1	-	-	Topic 3 Content Quiz Topic 3.2 Learning Activity
List the factors/characteristics that will affect the selection of structured cables and hardware for a given system.	6.2, 6.3	-	-	

3 Installation Planning				
Skills				
Select structured cables and associated hardware to suit given installation specifications/customer requirements.	2.1, 2.3, 6.1, 6.2, 6.3	1.4, 1.5, 1.6, 1.7, 1.8, 1.9	6.2, 7	Topic 3 Content Quiz Topic 3.2 Learning Activity Topic 3.3 Skills Practice
3.3 Structured Cabling Identification				
Knowledge				
Describe the symbols and conventions used in structured cabling plans, drawings and schematics.	2.1	-	-	Topic 3 Content Quiz Topic 3.3 Learning Activity
List the documentation requirements for structured cable identification.	2.3	-	-	
Skills				
Interpret structured cabling plans, drawings and schematics.	2.1	1.4	6.1, 7	Topic 3.3 Skills Practice
Reference Text: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. Standards and Codes: - AS/CA S009 Installation requirements for customer cabling (Wiring Rules). - AS/NZS 3080 Telecommunications installations – Generic cabling for commercial premises. - AS/NZS 3085 Telecommunications installations – Administration of communications cabling systems.				

4 Structured Cabling Installation				
Purpose:	In this topic you will gain knowledge and skills for the installation of telecommunications structured cabling systems.			
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
4.1 Site Survey and Assessment				
Knowledge				
List factors, issues and requirements to be discussed and confirmed with the customer prior to commencing installation work.	10	-	-	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe the Australian Standards for structured cabling installations.	4.2	-	-	
List the types of hazards risks and control measures commonly associated with coaxial cable and radio frequency (RF) based systems.	3.1, 8.2	-	-	
Describe the techniques for risk management as applicable to coaxial installation work.	3.1, 8.2	-	-	
Skills				
Apply Australian Standards to the installation of structured cabling.	4.2, 5, 8.2	1.4, 1.5, 1.9, 2.2, 3.3, 3.4, 3.5, 3.6	6.2, 6.3	Topic 4.3 Skills Practice
Undertake a risk assessment for structured cabling installation work.	3.1, 8.2	1.1, 1.2	1	
Confirm key information with customer (teacher/trainer) regarding the proposed installation work.	10	1.3, 1.6, 1.9	1	

4 Structured Cabling Installation				
4.2 Structured Cable Installation				
Knowledge				
List the various cable dispensing and hauling methods used for structured cabling.	3.3	-	-	Topic 4 Content Quiz Topic 4.2 Learning Activity
List the approved practices for installing structured cabling including separation and segregation requirements.	8.1, 10	-	-	
Describe the precautions that should be implemented to prevent cable damage.	3.2	-	-	
List the types of cable ties and precautions used for structured cabling systems.	3.2	-	-	
List the hazards that may be encountered during the installation of structured cabling.	3.1	-	-	
Skills				
Draw in and secure structured cabling.	3.1, 3.2, 3.3, 8.1, 10	2.1, 2.2, 2.3	1, 2, 3, 4, 6.1, 6.2, 6.4	Topic 4.3 Skills Practice
4.3 Racks and Hardware Installation				
Knowledge				
List the considerations for installing racks, cabinets and sockets to ensure cabling and equipment is not damaged.	4.1, 4.2, 4.3	-	-	Topic 4 Content Quiz Topic 4.3 Learning Activity
List the various fixing devices used for securing structured cabling supports and hardware.	8.1	-	-	
Skills				
Install and terminate a structured cabling system to a given specification.	2.1, 2.3, 5, 8.1	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.1, 2.2, 2.3,	1, 2, 3, 4, 6.1, 6.2, 6.3, 6.4,	Topic 4.3 Skills Practice

4 Structured Cabling Installation

		3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.10, 3.11, 4.1, 4.2, 4.4	6.5, 6.6, 6.7, 6.8, 7	

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education.

Standards and Codes:

- AS/CA S009 Installation requirements for customer cabling (Wiring Rules).
- AS/NZS 3080 Telecommunications installations – Generic cabling for commercial premises.

Equipment/Material:

- 4 RU wall mounted cabinet.
- 24 port Cat 6 patch panel.
- Cat 6 cable and sockets.
- 2 gang wall plate.
- 6 mm² green/yellow earth wire.
- Cable supports and fixings (e.g. tray, duct, trunking, Velcro ties etc.)
- Hand tools and PPE, including stripping and punch down tools.

5 Testing Structured Cabling Systems				
Purpose:	In this topic you will you gain knowledge and skills needed to successfully test and diagnose faults in structured cabling systems.			
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Exemplar Learning Resources
	KE	PC	PE	
5.1 Testing Structured Cables				
Knowledge				
List the tools and test equipment required to test structured cable installations.	8.1, 9	-	-	Topic 5 Content Quiz Topic 5.1 Learning Activity
Describe the correct testing procedures for Category 5, 5e, 6, 6A and 7 cabling including: • Attenuation to crosstalk ratio (ACR) • Near End crosstalk (NEXT) • Return loss • Propagation delay • Attenuation • Earthing	1.2, 8.1, 8.2, 8.5, 9	-	-	
Describe the recording process for the results of the test in accordance with requirements.	2.3, 8.7	-	-	
5.2 Fault Diagnosis				
Knowledge				
List the types of faults that can occur in structured cabling systems.	8.6, 11	-	-	Topic 5 Content Quiz Topic 5.2 Learning Activity
Describe the test procedures for locating and diagnosing faults in structured cabling.	8.6, 11	-	-	

5 Testing Structured Cabling Systems

Skills				
Carry out tests on structured cabling systems to ensure performance specifications are met and document results.	1.2, 2.3, 8.1, 8.2, 8.5, 8.6, 8.7, 9, 11	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 3.1, 3.8, 3.9, 4.1, 4.2, 4.4	1, 2, 3, 6.8, 7	Topic 5.2 Skills Practice

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education.
- Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements.
- Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.

Standards and Codes:

- AS/CA S009 Installation requirements for customer cabling (Wiring Rules).
- AS/NZS 3080 Telecommunications installations – Generic cabling for commercial premises

Equipment/Material:

- Four to six Cat 6 cables, each terminated at both ends (several cables to contain a fault, e.g. open circuit, poor termination, damaged/kinked cable, wrong socket).
- Cable certifier.

6 Coaxial Cables and Hardware				
Purpose:	In this topic you will learn about the different types of coaxial cables, termination hardware and associated tools.			
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.			
Knowledge and Skills Specification Content Areas	Unit Mapping			Exemplar Learning Resources
	KE	PC	PE	
6.1 Types of Coaxial Cables				
Knowledge				
Describe the basic construction and characteristics of coaxial cable.	1.1, 1.2, 7	-	-	Topic 6 Content Quiz Topic 6.1 Learning Activity
Describe the construction and features of quad-shield, tri-shield and hard-line coaxial cables.	1.1, 1.2, 7	-	-	
List the conventions and requirements for labelling and identification of coaxial cables.	2.2	-	-	
List the applications of the different types of coaxial cables.	1.3, 7	-	-	
Skills				
Identify different types of coaxial cables from cable markings/features.	2.2	1.7	2	Topic 6 Content Quiz Topic 6.1 Learning Activity Topic 6.2 Skill Practice
Select appropriate coaxial cable types for given applications.	1.3, 7	1.7	2	
6.2 Coaxial Cabling Hardware				
Knowledge				
List the different types of coaxial cable connectors and termination devices, including compression and crimp types.	5, 8.3	-	-	Topic 6 Content Quiz Topic 6.2 Learning Activity

6 Coaxial Cables and Hardware				
List the types of terminating tools that are suitable for coaxial cables.	5, 8.4	-	-	
Describe the techniques and safe methods for terminating coaxial cables.	5, 8.1	-	-	
Explain the purpose of overvoltage protection devices used in coaxial cabling installations.	5, 8.2	-	-	
Skills				
Identify different types of coaxial connectors.	8.3	1.7	2	Topic 6 Content Quiz Topic 6.2 Learning Activity Topic 6.2 Skills Practice Topic 7.1 Skills Practice Topic 7.2 Skills Practice
Select the correct terminating tool and connectors for given applications.	8.4	1.7	2	
Terminate RG6 quad-shield coaxial cable correctly and safely using approved practices.	5, 8.1	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 3.1, 3.2, 3.3, 3.10, 3.11, 4.1, 4.2, 4.4	1, 2, 3, 5, 6.1, 6.3	
Fit over voltage protection device to coaxial cable.	5, 8.2	3.1, 3.4, 3.5	1, 6.6, 6.7	
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. • Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. • Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.				
Standards and Codes: • AS/CA S009 Installation requirements for customer cabling (Wiring Rules). • AS/NZS 1367 Coaxial cable and optical fibre systems for the RF distribution of digital television, radio and in-house analog television signals in single and multiple dwelling installations.				

7 Coaxial Cable Installation and Testing					
Purpose:	In this topic you will learn about the hazards, safe working procedures and quality considerations for installing and terminating coaxial cabling. You will also learn about the requirements and approved methods for testing coaxial cabling and completing associated installation documentation.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas		Unit Mapping			Exemplar Learning Resources
		KE	PC	PE	
7.1 Coaxial Cabling Installation					
Knowledge					
Describe the Australian Standards for coaxial cabling installations.		10	-	-	Topic 7 Content Quiz Topic 7.1 Learning Activity
List the approved practices for installing coaxial cabling including separation and segregation requirements.		8.1, 10	-	-	
Describe the specific considerations for hauling coaxial cables to prevent cable damage.		3.2, 3.3	-	-	
Skills					
Install RG6 quad-shield coaxial cabling according to a given specification using approved practices.		2.1, 2.3, 3.2, 3.3, 8.1, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.10, 3.11, 4.1, 4.2, 4.4	1, 2, 3, 5, 6.1, 6.2, 6.3, 6.4, 6.6, 6.7, 7	Topic 7.1 Skills Practice Topic 7.2 Skills Practice
7.2 Coaxial Testing and Documentation					
Knowledge					
Describe the tools and test equipment required to test coaxial cable installations.		8.1, 9	-	-	Topic 7 Content Quiz

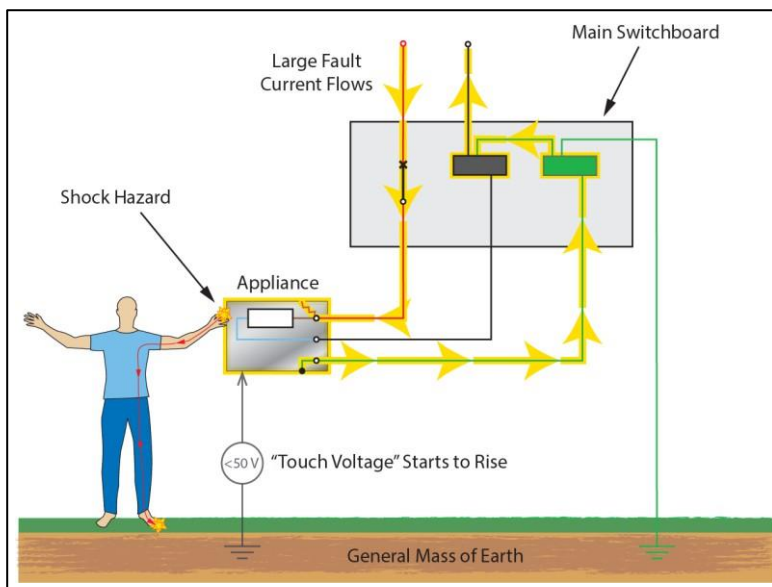
7 Coaxial Cable Installation and Testing				
Describe the methods of testing coaxial cabling installations to confirm signal levels are within required limits.	1.2, 8.1, 8.2, 8.5, 9	-	-	Topic 7.2 Learning Activity
List the types of faults that can occur in coaxial cabling systems.	8.6, 11	-	-	
Describe the test procedures for locating and diagnosing faults in coaxial cabling.	8.6, 11	-	-	
Skills				
Select tools and test equipment to test coaxial cable installations.	8.1, 9	1.7	2	Topic 7.2 Skills Practice
Carry out tests on coaxial cabling systems to ensure performance specifications are met.	1.2, 8.1, 8.2, 8.5, 8.6, 9, 11	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 3.1, 3.8, 3.9, 4.1, 4.2, 4.4	1, 2, 3, 5, 6.8	
Complete required coaxial cabling installation and reporting documentation.	2.3, 8.7	4.3	7	
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education. • Standards Australia Communications Cabling Manual HB243 Module 1 Australian Regulatory arrangements. • Standards Australia Communications Cabling Manual HB29 Module 2 Communications cabling Manual.				
Standards and Codes: • AS/CA S009 Installation requirements for customer cabling (Wiring Rules). • AS/NZS 1367 Coaxial cable and optical fibre systems for the RF distribution of digital television, radio and in-house analog television signals in single and multiple dwelling installations.				

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Elements and Performance Criteria		

Unit Learning Plan

UEEEL0003 – Arrange circuits, control and protection for electrical installations



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Fundamental Safety Principles	5
1.1 Safety Principles	5
1.2 Methods of Compliance	5
1.3 Installation Design and Equipment	6
2 Circuits and Control Arrangements	7
2.1 Electrical Installation Circuits	7
2.2 Electrical Circuit Design	7
2.3 Special Circuit Arrangements	8
3 Electrical Installation Hazards and Risks	9
3.1 Electric Current Effects on the Body	9
3.2 Ignition Risk	9
3.3 Risk of Injury	9
3.4 Protection Against Direct Contact	10
4 Fault Protection	11
4.1 Protection Against Indirect Contact	11
4.2 Fault Protection Methods	11
4.3 Damp Situations	12
5 Earthing	13
5.1 Earthing Concepts	13
5.2 MEN Earthing Systems	14
6 Overcurrent Protection	16
6.1 Overload and Short-Circuit Protection	16
6.2 Protection Arrangements	16
7 Devices for Automatic Disconnection of Supply	18
7.1 Circuit Breakers	18
7.2 Fuses	18
7.3 Residual Current Devices (RCDs)	19
7.4 Earth Fault Loop Impedance	20
8 Abnormal Voltage Protection	21
8.1 Overvoltage Protection	21
8.2 Undervoltage Protection	21
9 Electrical Installation Control	23
9.1 Switch Types	23
9.2 Switching Requirements	23
9.3 Control Arrangements	23
10 Switchboard Arrangements	25
10.1 Switchboards and Distribution Boards	25
10.2 Metering	25
10.3 Switchboard Layouts	25

A. Overview		
Competency Standard Unit (CSU)	UEEEL0003 Arrange circuits, control and protection for electrical installations	
CSU Application	This unit involves the skills and knowledge required to select, arrange and terminate circuits, control and protection devices and systems for electrical installations operating at low voltage (LV). It includes protection of persons and property, correct functioning, ensuring compatibility with the supply, arranging installation into circuits, selecting and arranging switchgear/control gear and protective devices to meet compliance requirements, and documenting arrangement decisions. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0003	Performance Criteria
	KE-UEEEL0003	Knowledge Evidence
	PE-UEEEL0003	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 10	36 hours
	Completion of Unit Knowledge Test	1.5 hours
	Completion of Unit Skills Test	2.5 hours

	Total duration of structured learning program	40 hours
	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits Based on the requirement for learners to select protection devices to operate in island mode, it is strongly recommended that this unit is undertaken concurrently* with the following Competency Standard Unit or equivalent: • UEEEL0047 Identify, shut down and restart systems with alternate supplies *Note that UEEEL0003 is a pre-requisite to UEEEL0047	

B. Knowledge and Skills Delivery

1 Fundamental Safety Principles

Purpose:	In this topic you will learn about the safety principles associated with electrical systems in buildings and premises, the various methods of compliance to provide protection and the design requirements.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Safety Principles					
Knowledge					
State the safety principles given in Part 1 (Section 1) of the Wiring Rules AS/NZS 3000 with deemed-to-comply requirements given in Sections 2 to 8.	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10	-	-	10	Topic 1 Content Quiz Topic 1.1 Learning Activity
1.2 Methods of Compliance					
Knowledge					
List compliance methods for providing protection against: • Direct contact. • Indirect contact. • Thermal effects. • Unwanted voltages. • Over current. • Fault currents. • Overload. • Overvoltage. • Injury from mechanical movements.	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10	-	-	10	Topic 1 Content Quiz Topic 1.2 Learning Activity

1 Fundamental Safety Principles					
1.3 Installation Design and Equipment					
Knowledge					
Explain the requirements for installation design and selection of equipment including: • Compliant protection arrangements. • Functioning, compatibility with supply. • Estimation of maximum demand. • Voltage drop and arrangement of circuits.	1.11, 1.13.1, 1.13.2, 1.13.3, 1.14	-	-	10	Topic 1 Content Quiz Topic 1.3 Learning Activity
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: • AS/NZS 3000 Wiring Rules					

2 Circuits and Control Arrangements					
Purpose:	In this topic you will learn about the reasons and factors to consider in the arrangement of circuits to provide safe electrical operations of the installation.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Electrical Installation Circuits					
Knowledge					
Explain the reasons for dividing electrical installations into specific circuits.	1.14, 2.1	-	-	10	Topic 2 Content Quiz Topic 2.1 Learning Activity
List the factors that shall be considered when determining the number and type of circuits in an installation.	1.14, 2.2	-	-	10	
2.2 Electrical Circuit Design					
Knowledge					
Describe the daily and seasonal requirements of lighting, power, heating and other loads in a given installation.	2.3	-	-	10	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe the methods used to determine the number and type of circuits required for a particular installation.	1.14, 2.4, 14	-	-	10	
Describe the use of diagrams and schedules for circuits in a given installation.	2.5, 13	-	-	10, 40	
Skills					
Determine the number and type of circuits required for a particular installation.	1.14, 2.2, 2.4, 13, 14	1.1, 1.2, 1.3, 2.1, 3.2, 3.3	1, 2, 5, 11, 12, 19, 25	10	Topic 2.2 Skills Practice

2 Circuits and Control Arrangements					
2.3 Special Circuit Arrangements					
Knowledge					
List the applications and arrangements of separated extra low voltage (SELV) circuits.	2.6	-	-	10, 20, 23	Topic 2 Content Quiz Topic 2.3 Learning Activity
List the applications and arrangements of protected extra low voltage (PELV) circuits.	2.6	-	-	10, 20, 23	
List the applications and arrangements of an isolated supply.	2.7	-	-	10, 23	
Skills					
Draw an electrical extra low voltage circuit including all components to provide protection against direct contact with live parts.	2.6	1.1, 2.1	2, 5, 12, 25	10, 20, 23	Topic 2.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules					

3 Electrical Installation Hazards and Risks					
Purpose:	In this topic you will learn about the various hazards and risks encountered in an electrical installation.				
Duration:	This topic represents around 7.5% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Electric Current Effects on the Body					
Knowledge					
List the effects on the human body of various levels of a.c. and d.c. current and include the duration of current flow for the various current paths.	3.1, 12	1.2	-	2	Topic 3 Content Quiz Topic 3.1 Learning Activity
3.2 Ignition Risk					
Knowledge					
Explain the risk of ignition of flammable materials due to the thermal effects of current and electric arcs.	3.2, 12	1.2	-	10	Topic 3 Content Quiz Topic 3.2 Learning Activity
3.3 Risk of Injury					
Knowledge					
Describe the hazards and associated risks of injury posed by the mechanical movement of electrically actuated equipment.	3.3, 12	1.2	-	10	Topic 3 Content Quiz Topic 3.3 Learning Activity
Skills					
Evaluate and document the hazards and associated risks posed by a given electrical installation, and select control measures to reduce the identified risks.	3.1, 3.2, 3.3, 12, 13, 14	1.1, 1.2	1, 4, 5, 6, 9, 25	10, 44	Topic 3.3 Skills Practice

3 Electrical Installation Hazards and Risks					
3.4 Protection Against Direct Contact					
Knowledge					
List the acceptable methods of providing protection against direct contact with live parts of an electrical installation.	3.4, 3.5	-	-	10, 20, 23	Topic 3 Content Quiz Topic 3.4 Learning Activity
Explain the use of extra-low voltage (ELV) as a method of providing protection against direct contact with live parts of an electrical installation.	3.6	-	-	10, 20, 23	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules					

4 Fault Protection						
Purpose:	In this topic you will learn about indirect contact, acceptable methods and requirements for fault protection (protection against indirect contact), and additional requirements necessary in damp situations.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Protection Against Indirect Contact						
Knowledge						
Explain the term “indirect” contact with live parts of an electrical installation.		4.1	-	-	10	Topic 4 Content Quiz Topic 4.1 Learning Activity
List the acceptable methods of providing protection against indirect contact with live parts of an electrical installation.		1.12	-	-	10, 23	
Define the terms touch voltage and touch current.		4.3	-	-	10	
Describe the current path when a short circuit fault occurs to exposed conductive parts of an appliance.		4.4	-	-	10, 23	
4.2 Fault Protection Methods						
Knowledge						
Describe the automatic disconnection of supply method of providing protection.		4.2	-	-	10, 23	Topic 4 Content Quiz Topic 4.1 Learning Activity
Explain the use of Class II equipment.		4.5	-	-	10, 23	
Explain the term “electrical separation”.		4.7	-	-	10, 23	
List the uses of a Residual Current Device (RCDs).		4.6	-	-	10, 23	
Describe protection provided by the use of extra-low voltage and electrical separation.		4.7	-	-	20	

4 Fault Protection					
Skills					
Draw a single phase electrical installation using RCDs to provide protection against indirect contact.	4.6, 13	1.1, 2.1	1, 2, 5, 12, 17, 25	10, 20, 23	Topic 4.2 Skills Practice
4.3 Damp Situations					
Knowledge					
State the requirements for providing protection in damp situations.	4.8	-	-	25	Topic 4 Content Quiz Topic 4.3 Learning Activity
Skills					
Apply AS/NZS 3000 to select equipment for given damp situations.	4.8	1.1, 2.1	1, 5, 18, 20, 25	25	Topic 4 Content Quiz Topic 4.3 Learning Activity
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules					

5 Earthing					
Purpose:	In this topic you will learn about the various terms, arrangements and requirements regarding earthing in an electrical installation.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Earthing Concepts					
Knowledge					
Define the following earthing terms according to the Wiring Rules: • Earthed • Earthed situation • Earth electrode • Equipotential bonding • Multiple earthed neutral (MEN) systems • Protective earth neutral (PEN) conductor • Main earthing conductor • Protective earthing (PE) conductor • Functional earthing • MEN link	5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.10	-	-	16, 17	Topic 5 Content Quiz Topic 5.1 Learning Activity
Describe the basic arrangement and application of the various different types of earthing systems, including: • TN-C system • TN-S system • TN-C-S (MEN) system • TT system • IT system	5.4	-	-	16, 17	

5 Earthing					
5.2 MEN Earthing Systems					
Knowledge					
List the parts of a MEN earthing system and the purpose of each.	5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.10	-	-	16, 17	Topic 5 Content Quiz Topic 5.2 Learning Activity
Describe the compliant arrangement of a MEN earthing system and associated protective earthing conductors, including arrangements for outbuildings.	5.2, 5.3	-	-	16, 17	
List the requirements for equipotential bonding in a range of installations situations.	6	-	-	16, 17	
Explain the method to determine the minimum size earthing conductor for a range of active conductor sizes and materials.	14	-	-	16, 17	
Skills					
Draw a single phase electrical installation using a “multiple earthed neutral” system.	5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.10, 5.2, 6, 13	2.1, 2.2	1, 3, 5, 25	16, 17	Topic 5 Content Quiz Topic 5.2 Learning Activity Topic 5.2 Skills Practice
Select minimum earthing conductor sizes for given active conductor sizes and materials.	5.2	2.1, 2.2	1, 5, 14	16, 17	
Install and test a MEN earthing system for a single phase installation.	5.1.3, 5.1.4, 5.1.5, 5.1.6, 5.1.7, 5.1.8, 5.1.9, 5.1.10, 5.2,	1.1, 1.2, 2.1, 2.2, 3.2, 3.3	1, 3, 4, 5, 6, 9, 18, 25	16, 17	

5 Earthing

6, 12, 13, 14

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

6 Overcurrent Protection					
Purpose:	In this topic you will learn about the terms, causes and effects of overload and short circuit currents. It also covers protection against these adverse conditions in electrical installations.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Overload and Short-Circuit Protection					
Knowledge					
Explain the terms overload current or fault currents with regard to an electrical installation.	7.1	-	-	10	Topic 6 Content Quiz Topic 6.1 Learning Activity
Describe the equivalent circuit of an earth fault-loop.	7.3	-	-	16	
Describe the level of fault current possible at a given point in an installation from the fault-loop impedance and electricity distributor data.	7.4	-	-	16, 23	
List the methods and devices that comply with the Wiring Rules for providing protection against overload and fault current.	7.6	-	-	23	
Explain the issues posed by the operation of multimode inverters in island mode.	7.2	-	-	23	
Skills					
Calculate the prospective fault current at different points within a given electrical installation.	7.4, 14	-	7	16, 23	Topic 6 Content Quiz Topic 6.1 Learning Activity
6.2 Protection Arrangements					
Knowledge					
List the requirements for the coordination between protection devices and conductors.	7.5	-	21	23	Topic 6 Content Quiz

6 Overcurrent Protection					
List the requirements for discrimination between protection devices and back up protection.	7.5	-	10	23	Topic 6.2 Learning Activity
Skills					
Develop compliant overcurrent protection arrangements for a single phase electrical installation including: • Coordination of protection devices and circuit wiring • Selective coordination of protection devices for discrimination and back up protection	7.5, 7.6	1.1, 1.2, 1.3, 2.1, 2.3, 3.1, 3.2, 3.3	1, 10, 21	23	Topic 7.3 Skills Practice 1
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: • AS/NZS 3000 Wiring Rules					

7 Devices for Automatic Disconnection of Supply					
Purpose:	In this topic you will learn about the various protection devices such as circuit breakers, fuses and residual current devices used for the automatic disconnection of the electrical supply causes by fault conditions.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Circuit Breakers					
Knowledge					
Describe the operating principles of thermal/magnetic circuit breakers.	8.1	-	-	23	Topic 7 Content Quiz Topic 7.1 Learning Activity
Explain the time/current tripping characteristic curves of various types of circuit breakers that comply with the requirements of the Wiring Rules.	8.2	-	-	23	
Explain the considerations for selecting circuit breakers to operate in island mode.	7.2, 8.2	-	-	23	
Skills					
Select circuit breakers for given electrical installations, including circuit breakers to operate when an installation is in island mode.	8.1, 8.2, 13, 14	1.1, 1.2, 1.3, 2.1, 2.3, 3.1, 3.2, 3.3	1, 2, 5, 12, 13, 15, 18, 22, 23, 25	23	Topic 7.4 Skills Practice
7.2 Fuses					
Knowledge					
Describe the operating principles of common types of fuses.	8.1	-	-	23	Topic 7 Content Quiz Topic 7.2 Learning Activity
Explain the time/current curves fusing characteristics of various types of fuses that	8.3	-	-	23	

7 Devices for Automatic Disconnection of Supply					
comply with the requirements of the Wiring Rules.					
Explain the use of fuses as fault current limiting protection.	8.1, 8.3	-	-	23	
Skills					
Select the fuse type and size for fault current limiting protection for a given single phase electrical installation.	8.1, 8.3, 13, 14	1.1, 1.2, 1.3, 2.1, 2.3, 3.1, 3.2, 3.3	1, 2, 5, 12, 13, 18, 22, 23, 24, 25	23	Topic 7.4 Skills Practice
7.3 Residual Current Devices (RCDs)					
Knowledge					
Describe the operating principles of residual current devices (RCDs).	8.1	-	-	23	Topic 7 Content Quiz Topic 7.3 Learning Activity
Explain the time/current curves tripping characteristics of various types of RCDs that comply with the requirements of the Wiring Rules.	8.4	-	-	23	
State the acceptable RCDs Types for use with inverter systems that may operate in island mode (i.e. Type A, Type B).	8.1, 8.4	-	-	23	
Skills					
Select RCDs/RCBOs for given electrical installations, including RCDs/RCBOs to operate when an installation is in island mode.	8.1, 8.4, 13, 14	1.1, 1.2, 1.3, 2.1, 2.4, 3.1, 3.2, 3.3	1, 2, 5, 12, 13, 16, 18, 22, 23, 25	23	Topic 7 Content Quiz Topic 7.3 Learning Activity Topic 7.3 Skills Practice Topic 7.4 Skills Practice
Draw a switchboard with wiring arrangements to include 2-pole RCDs, 4-pole RCDs and combination RCD/MCBs.	4.6, 13, 14	1.1, 1.2, 1.3, 2.1	1, 2, 5, 12, 17, 25	23	

7 Devices for Automatic Disconnection of Supply					
7.4 Earth Fault Loop Impedance					
Knowledge					
List the factors that will affect the impedance of an earth fault loop.	8.5	-	-	16	Topic 7 Content Quiz Topic 7.4 Learning Activity
State the maximum impedance of an earth fault-loop to ensure the operation of the protection device.	8.6	-	-	16	
Skills					
Calculate the earth fault-loop impedance of various circuits.	8.5, 8.6, 14	-	8	16	Topic 7 Content Quiz Topic 7.4 Learning Activity Topic 7.4 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules					

8 Abnormal Voltage Protection					
Purpose:	In this topic you will learn about the effects of over voltage and under voltage and the methods used to protect circuits against over voltage and under voltage conditions.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Overvoltage Protection					
Knowledge					
Define an overvoltage condition.	9.1	-	-	23	Topic 8 Content Quiz Topic 8.1 Learning Activity
List the causes of overvoltage and how this may affect the electrical system.	9.1	-	-	23	
Describe the methods for protection against overvoltage.	9.2	-	-	23	
Skills					
Determine the circuits in an electrical installation that require overvoltage protection.	9.1, 9.2	1.1, 1.2, 2.1, 3.2, 3.3	1, 2, 5, 12	23	Topic 8.1 Skills Practice Topic 8.2 Skills Practice
Test an electrical installation where overvoltage devices are fitted.	9.2, 14	1.1, 1.2	-	30	
8.2 Undervoltage Protection					
Knowledge					
Define an undervoltage condition.	9.1	-	-	23	Topic 8 Content Quiz Topic 8.2 Learning Activity
List the causes of undervoltage and how this may affect the electrical system.	9.1	-	-	23	
Explain the methods of protection against undervoltage.	9.2	-	-	23	

8 Abnormal Voltage Protection					
Skills					
Determine the circuits in an electrical installation that require undervoltage protection.	9.1, 9.2	1.1, 1.2, 2.1, 3.2, 3.3	1, 2, 5, 12	23	Topic 8.2 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules					

9 Electrical Installation Control

Purpose:	In this topic you will learn about the switch types, switching arrangements and control arrangements required to control an electrical installation and circuits.
Duration:	This topic represents around 7.5% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
9.1 Switch Types					
Knowledge					
Describe the switch types including current, voltage and IP ratings, and their applications.	10.1	-	-	23	Topic 9 Content Quiz Topic 9.1 Learning Activity
9.2 Switching Requirements					
Knowledge					
State the switching requirements for isolation, emergency, mechanical maintenance and functional control.	10.2	-	-	23	Topic 9 Content Quiz Topic 9.2 Learning Activity
9.3 Control Arrangements					
Knowledge					
Explain the control arrangements for installations without safety services or alternate supplies.	10.3	-	-	23	Topic 9 Content Quiz Topic 9.3 Learning Activity
Explain the control arrangements for installations with safety services and alternate supplies, including consideration relating to: - d.c. polarity - d.c. ratings	10.3.1, 10.3.2	-	-	23	
Describe the switchgear types, ratings, characteristics and applications related to alternate supplies.	11.4	-	-	23	

9 Electrical Installation Control					
Skills					
Select control devices, including the switch type, current, voltage and IP ratings, for given single phase electrical installations.	10.1, 10.2, 10.3.1, 10.3.2, 11.4, 14	1.1, 1.2, 1.3, 2.1, 2.5, 3.1, 3.2, 3.3	1, 2, 5, 6, 9, 12, 18, 22, 23, 25	23	Topic 9.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules					

10 Switchboard Arrangements					
Purpose:	In this topic you will learn about the requirements of electrical switchboards and distribution boards, metering arrangements and the layout of switchboard/distribution board's equipment.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
10.1 Switchboards and Distribution Boards					
Knowledge					
List the purpose, types and applications of electrical switchboards and distribution boards.	11.1	-	-	24	Topic 10 Content Quiz Topic 10.1 Learning Activity
10.2 Metering					
Knowledge					
Explain the physical and circuit arrangements for whole current metering.	11.2	-	-	24	Topic 10 Content Quiz Topic 10.2 Learning Activity
Explain the physical and circuit arrangements for CT metering.	11.2	-	-	24	
10.3 Switchboard Layouts					
Knowledge					
Explain the physical and circuit arrangements of: - Main switches. - Circuit protection devices. - Fault-current limiters and metering equipment. - Other distributor equipment.	11.3	-	-	24	Topic 10 Content Quiz Topic 10.3 Learning Activity
Describe the compliance requirements including: Location and access.	11.5.1, 11.5.2,	-	-	24	

10 Switchboard Arrangements					
• Arc fault protection. • Identification. • Construction suitability. • Equipment marking and wiring. • Fire protection. • Arc-fault protection.	11.5.3, 11.5.4, 11.5.5, 11.5.6, 11.5.7				
Skills					
Draw switchboard layouts, including the main switches, circuit protection devices, fault-current limiters and metering equipment, and other distributor equipment, for given electrical installations.	11.2, 11.3, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.6, 11.5.7	1.1, 1.2, 1.3, 2.1, 2.6, 3.3	1, 2, 5, 6, 9, 12, 25	24	Topic 10.3 Skills Practice
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: • AS/NZS 3000 Wiring Rules • Local Service and Installation Rules (SIR)					

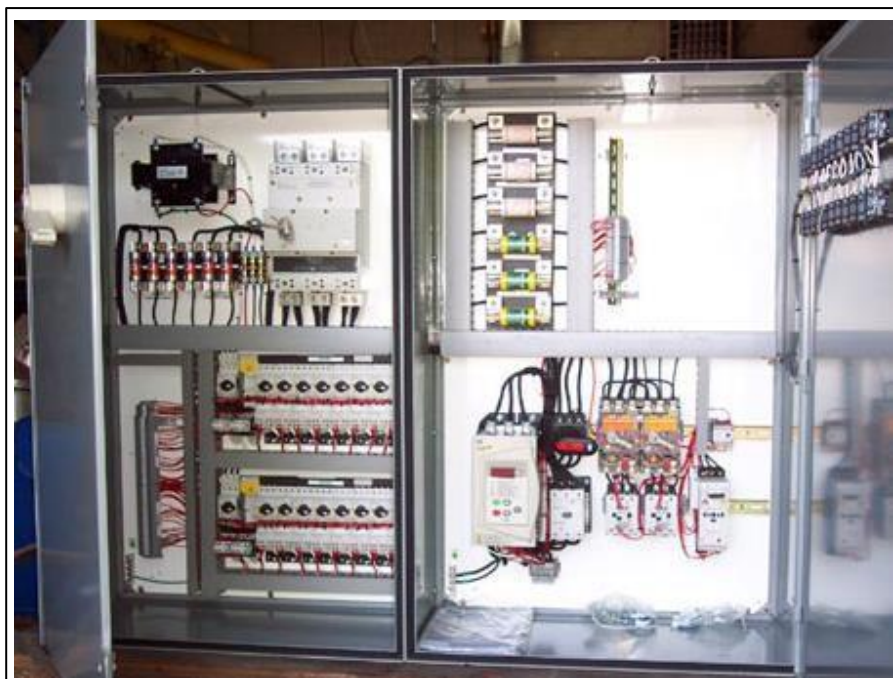
Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities



Unit Learning Plan

UEEEL0005 Develop and connect electrical control circuits



Contents

Contents	2
A. Overview	4
B. Knowledge and Skills Delivery	6
1 Relay Circuits and Drawing Conventions	6
1.1 Circuit Diagrams	6
1.2 Control Relays	6
1.3 Pushbuttons	7
1.4 Circuit Development, Connections and Testing	7
2 Remote Stop-Start Control and Electrical Interlocking	9
2.1 Remote Stop-Start Stations	9
2.2 Interlocking Circuits	9
2.3 Circuit Development, Connections and Testing	9
3 Time Delay Relays	12
3.1 Timers	12
3.2 Circuit Development, Connections and Testing	12
4 Circuits Using Contactors	14
4.1 Contactors	14
4.2 Thermal Overloads	14
4.3 Circuit Development, Connections and Testing	15
5 Jogging and Interlocking Circuits	17
5.1 Jogging Control Circuits	17
5.2 Circuit Development, Connections and Testing	17
6 Control Devices	19
6.1 Light Sensors	19
6.2 Proximity Sensors	19
6.3 Other Sensors	20
6.4 Circuit Development, Connections and Testing	21
7 Programmable Relays	23
7.1 Programmable Relays	23
7.2 Programmable Relay Connections	23
7.3 Programmable Relay Programming	24
7.4 Operation of Programmable Relays	24
7.5 Circuit Development Using Programmable Relays	25
8 Three Phase Induction Motor Starters	27
8.1 Motor Starters	27
8.2 DOL Motor Starters	27
8.3 Electronic Soft Starters	28
9 Three Phase Induction Motor Starters – Reduced Voltage	30
9.1 Star Delta Starters	30
9.2 Primary Resistance Starters	30
9.3 Autotransformer Starters	31
9.4 Secondary Resistance Starters	32
10 Three Phase Induction Motor Braking	34
10.1 Motor Reversing and Motor Braking	34
10.2 Plug Braking	34
10.3 Dynamic Braking	35

10.4 Regenerative Braking	35
10.5 Eddy Current Braking	36
10.6 Mechanical Braking	36
11 Three Phase Induction Motor Speed Control	38
11.1 Three Phase Induction Motor Speed Control	38
11.2 Pole Changing Methods	38
11.3 Variable Frequency Drives	38
11.4 Slip Ring Induction Motor Speed Control	39

A. Overview		
Competency Standard Unit (CSU)	UEEEL0005 Develop and connect electrical control circuits	
CSU Application	This unit involves the skills and knowledge required to develop, connect and functionally test electrical power and control circuits that perform specific control functions. It includes working safely, developing schematic diagrams and converting them to wiring diagrams, selecting and connecting contactors and control devices to perform a specific function. It also includes testing electrical control circuits and completing circuit development activities documentation. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0005	Performance Criteria
	KE-UEEEL0005	Knowledge Evidence
	PE-UEEEL0005	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 11	72 hours
	Completion of Unit Knowledge Tests	3 hours
	Completion of Unit Skills Tests	5 hours
	Total duration of structured learning program	80 hours

	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0003 Arrange circuits, control and protection for electrical installations • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0024 Test and connect alternating current (a.c.) rotating machines • UEEEL0025 Test and connect transformers and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Relay Circuits and Drawing Conventions

Purpose: In this topic you will learn about circuit diagram drawing conventions, conductor numbering systems, control relays, pushbuttons, development of control circuits from a written description and the connection and testing of control circuits incorporating stop, start stations, latching circuits and pilot lights.

Duration: This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Circuit Diagrams					
Knowledge					
Explain circuit diagram drawing conventions.	2.4	-	-	40, 41	Topic 1 Content Quiz Topic 1.1 Learning Activity
Explain the reasons for the need to label wires and terminals using a numbering system.	2.2	-	-	41	
Explain the operation of the components represented by circuit diagrams (schematic) symbols.	2.2	-	-	40, 41	
Skills					
Identify given circuit diagrams (schematic) symbols.	2.2, 2.4	1.4	5	40, 41	Topic 1.1 Skills Practice
1.2 Control Relays					
Knowledge					
List the types of control relays.	1.1	-	-	7	Topic 1 Content Quiz Topic 1.2 Learning Activity
Describe the circuit diagram symbols used for electrical control relays.	2.2	-	-	7	
Describe the control relay operating principles.	1.1	-	-	7	
Describe the control relay basic contact	1.1	-	-	7	

1 Relay Circuits and Drawing Conventions					
configurations and identification.					
List the control relay common applications.	1.1	-	-	7	
Skills					
Select control relays from manufacturers' catalogues for specified applications.	1.1, 13	1.6	3.4	7	Topic 1.3 Skills Practice
1.3 Pushbuttons					
Knowledge					
List the types of commonly used pushbuttons.	2.3	-	-	40	Topic 1 Content Quiz Topic 1.3 Learning Activity
Describe the circuit diagram symbols used for electrical pushbuttons.	2.3, 6.2	-	-	40	
Describe the pushbutton operating principles.	2.3, 6.2	-	-	40	
Describe the various switching configurations.	2.3	-	-	40	
List pushbutton common applications.	2.3	-	-	40	
Skills					
Select pushbuttons/pilot lamps from manufacturers' catalogues for specific applications.	2.3, 13	1.6	3.3	40	Topic 1.3 Skills Practice
1.4 Circuit Development, Connections and Testing					
Knowledge					
Describe circuit development of an electrical control circuit in accordance with a written description (specification) and sequence of operation of a circuit.	2.4	-	-	40, 41	Topic 1 Content Quiz Topic 1.4 Learning Activity
Skills					
Develop a simple stop-start relay circuit that incorporates pilot lights and latching circuits from a written description.	2.4	1.2, 1.3, 1.4	7.3	40, 41	Topic 1.4 Skills Practice

1 Relay Circuits and Drawing Conventions

Connect a stop-start relay circuit that incorporates pilot lights and latching circuits from developed circuit diagrams.	2.1, 2.2	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	2, 9.6	40, 41	
Label wires and terminals using number systems.	2.2	2.4	4	40, 41	
Apply safe work practices when testing an electrical control circuit.	3.2	2.5, 2.6, 2.8, 3.1, 3.2, 3.3	1, 10	40, 41	

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Standards and Codes:

- AS/NZS 1102 (Series) Graphical symbols for electrotechnical documentation

Equipment/Material:

- Manufacturer's catalogues
- Relays
- Pushbuttons
- Indicator lamps
- Power supplies
- Fuse/protective device
- Wiring panels
- Multimeter

2 Remote Stop-Start Control and Electrical Interlocking					
Purpose:	In this topic you will learn about remote Stop-Start control and electrical/mechanical interlocking circuits.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Remote Stop-Start Stations					
Knowledge					
Describe the operation of a local and remote stop-start control of relays.	3.1.1	-	-	40, 41	Topic 2 Content Quiz Topic 2.1 Learning Activity
Skills					
Select stop-start stations from manufacturers' catalogues for specific applications.	3.1.1, 13	1.6	3.3	40, 41	Topic 2.2 Skills Practice
2.2 Interlocking Circuits					
Knowledge					
Describe the operation of a mechanical interlocked device.	6.1.2	-	-	40, 41	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe the operation of an electrical interlocked relay circuit.	3.1.2, 6.1.2	-	-	40, 41	
Skills					
Select electrical and mechanical interlocking equipment from manufacturers' catalogues for specific applications.	6.1.2, 13	1.6	3.1	40, 41	Topic 2.3 Skills Practice
2.3 Circuit Development, Connections and Testing					

2 Remote Stop-Start Control and Electrical Interlocking					
Knowledge					
Explain the development of a relay circuit incorporating local and remote start and stop buttons and electrical interlocking from a written description.	2.4	-	-	40, 41	Topic 2 Content Quiz Topic 2.3 Learning Activity
Skills					
Develop a relay circuit incorporating local and remote start and stop buttons and electrical interlocking from a written description.	2.3, 2.4	1.2, 1.3, 1.4	7.2	40, 41	Topic 2.3 Skills Practice
Connect electrical circuits with local and remote start-stop control and with electrical and mechanical interlocking.	2.1, 2.4	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	2, 9.6	40, 41	
Demonstrate circuit checking and testing techniques on an electrical circuit.	2.4, 3.2	2.5, 2.6, 2.8, 3.1, 3.2, 3.3	1, 10	40, 41	
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning Equipment/Material: • Manufacturer’s catalogues • Relays • NO pushbuttons • NC pushbuttons • Indicator lamps • Power supply • Fuse/protective device					

2 Remote Stop-Start Control and Electrical Interlocking

- Wiring panels
- Multimeter

3 Time Delay Relays						
Purpose:	In this topic you will learn about the use of timers in electrical control circuits and the development of electrical control circuits incorporating timers from a written description.					
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
3.1 Timers						
Knowledge						
List the various types of time delay relays.		1.2	-	-	40, 41	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe the circuit diagram symbols used for electrical time delay relays.		4	-	-	40, 41	
Explain the operating principles of on delay and off delay time delay relays.		4	-	-	40, 41	
Describe the basic contact configurations and identification of time delay relays.		4	-	-	40, 41	
List the common applications of time delay relays.		4	-	-	40, 41	
Skills						
Select timers for specified functions from manufacturers’ catalogues.		1.2, 4, 13	1.6	3.6	40, 41	Topic 3.1 Skill Practice
3.2 Circuit Development, Connections and Testing						
Knowledge						
Describe the development of time delay electrical control circuits from a written description.		4	-	-	40, 41	Topic 3 Content Quiz Topic 3.2 Learning Activity
Skills						

3 Time Delay Relays

Develop time delay electrical control circuits from a written description.	4, 13	1.2, 1.3, 1.4	7.4	40, 41	Topic 3.2 Skill Practice
Connect a timer controlled circuit using a circuit diagram as a guide.	2.1, 4	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	2, 9.11	40, 41	
Demonstrate the timer circuit checking and testing procedures.	3.2, 4	2.5, 2.6, 2.8, 3.1, 3.2, 3.3	1, 10	40, 41	

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Equipment/Material:

- Manufacturer's catalogues
- Relays
- On-delay timer
- NO pushbuttons
- NC pushbuttons
- Indicator lamps
- Power supply
- Fuse/protective device
- Wiring panels
- Multimeter
- Stop watch

4 Circuits Using Contactors					
Purpose:	In this topic you will learn about using electrical contactors and thermal overloads in motor control circuits.				
Duration:	This topic represents around 7.5% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Contactors					
Knowledge					
List the types of contactors used for motor control circuits.	1.3	-	-	7	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe the circuit diagram symbols used for electrical contactors.	4.1	-	-	7	
Explain the operating principles of electrical contactors.	4.2	-	-	7	
Describe the basic contact configurations and identification of electrical contactors.	4.2, 4.3	-	-	7	
List the common applications of electrical contactors, including the duty categories.	4.3	-	-	7	
List the compliance requirements for contactors used as devices for isolating circuits.	4.3	-	-	7	
Skills					
Select electrical contactors for specified functions from manufacturers' catalogues.	1.3, 4.3, 13	1.6	3.1	7	Topic Skills Practice 4.2
4.2 Thermal Overloads					
Knowledge					
List the types of thermal overloads.	1.4	-	-	40, 41	Topic 4 Content Quiz

4 Circuits Using Contactors					
Describe the circuit diagram symbols used for thermal overloads.	1.4	-	-	40, 41	Topic 4.2 Learning Activity
Explain the thermal overload operating principles.	1.4	-	-	40, 41	
Explain the thermal overload basic contact configurations and identification.	1.4	-	-	40, 41	
List the common applications of thermal overloads.	1.4	-	-	40, 41	
Skills					
Select thermal overloads for specified functions from manufacturers' catalogues.	1.4, 13	1.6	3.1	40, 41	Topic Skills Practice 4.2
4.3 Circuit Development, Connections and Testing					
Knowledge					
Explain the development of circuit diagrams incorporating electrical contactors and thermal overloads for motor control.	1.3, 1.4, 4.3	-	-	40, 41	Topic 4 Content Quiz Topic 4.3 Learning Activity
Skills					
Develop circuit diagrams using electrical contactors and thermal overloads for motor control circuits.	1.3, 1.4, 4.1, 4.2, 4.3, 13	1.2, 1.3, 1.4	7.1	40, 41	Topic 4.3 Skills Practice
Connect an electrical contactor/thermal overload circuit for motor control.	1.3, 1.4, 2.1, 4.3	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	2, 9.10	40, 41	
Demonstrate the contactor circuit checking and testing procedures.	3.2	2.5, 2.6, 2.8, 3.1, 3.2, 3.3	1, 10	40, 41	
Reference Text:					
• Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades, McGraw-Hill					

4 Circuits Using Contactors

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Phillips, P., Electrical Principles, Cengage Learning

Equipment/Material:

- Manufacturer's catalogues
- Contactor
- Thermal overload
- NO pushbuttons
- NC pushbuttons
- Indicator lamps
- Power supply
- Variable mechanical load
- Fuse/protective device
- Wiring panels
- Multimeter

5 Jogging and Interlocking Circuits						
Purpose:	In this topic you will learn about the various jogging circuits used for motor control and the use of interlocking circuits.					
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 Jogging Control Circuits						
Knowledge						
List the purpose and applications of jogging control for motors.		6.1.1	-	-	40, 41	Topic 5 Content Quiz Topic 5.1 Learning Activity
List the types of jogging control circuits.		6.1.1	-	-	40, 41	
Describe the operation of motor control using start, stop and jog buttons.		6.2	-	-	40, 41	
List the purpose and application of electrical interlocking used for motor control.		6.1.2	-	-	40, 41	
Skills						
Select circuit components using manufacturers' catalogues for appropriate duty ratings.		2.3, 13	1.6	3.3, 3.4	40, 41	Topic 5.1 Skills Practice
5.2 Circuit Development, Connections and Testing						
Knowledge						
Explain the development of a multiple motor starting circuit from a description of the circuit operation including jog and interlock functions.		6.1.1, 6.1.2	-	-	40, 41	Topic 5 Content Quiz Topic 5.2 Learning Activity
Explain the circuit checking and testing techniques for a multiple motor starting circuit which		3.2	-	-	40, 41	

5 Jogging and Interlocking Circuits					
incorporates start, stop and jog control.					
Skills					
Develop a multiple motor starting circuit which incorporates start, stop and jog control including interlocking.	3.1.1, 6.2, 13	1.2, 1.3, 1.4	6	40, 41	Topic 5.2 Skills Practice
Connect a motor control circuit using start, stop and jog buttons and interlocking control.	2.1,	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	2, 9.8, 9.9	40, 41	
Demonstrate the multiple motor starting circuit checking and testing procedures.	3.2, 6.1.1, 6.1.2	2.5, 2.6, 2.8, 3.1, 3.2, 3.3	1, 10	40, 41	
Reference Text: - Jenneson, J., Harper, B, Moore, B, Electrical Principles for the Electrical Trades, Volume 2, McGraw-Hill - Hampson, J., Electrotechnology Practice, Pearson Education Equipment/Material: - Manufacturer’s catalogues - Contactors - Thermal overloads - NO and NC pushbuttons - Indicator lamps - Power supply - Fuse/protective device - Wiring panels - Multimeter					

6 Control Devices						
Purpose:	In this topic you will learn about the various control devices used to determine the various physical conditions of products and processes and how these devices are used in control circuits.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
6.1 Light Sensors						
Knowledge						
List the common light sensor control devices used in automatic control circuits (photoelectric cell).		7.1	-	-	41	Topic 6 Content Quiz Topic 6.1 Learning Activity
Explain the basic operating principles of common light sensor control devices.		7.2	-	-	41	
Describe the connection of common light sensor control devices into control circuits.		7.1	-	-	41	
List the advantages and disadvantages of common light sensor control devices.		7.3	-	-	41	
List the application of common light sensor control devices.		7.4	-	-	41	
Skills						
Connect light sensor control devices into control circuits.		2.1, 7.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	9.2	40, 41	Topic 6.1 Skills Practice
6.2 Proximity Sensors						
Knowledge						

6 Control Devices					
List the common proximity sensor control devices used in automatic control circuits (limit switches, inductive and capacitive proximity switches.)	7.1	-	-	7, 41	Topic 6 Content Quiz Topic 6.2 Learning Activity
Explain the basic operating principles of the common proximity sensor control devices.	7.2	-	-	7, 41	
Describe the connection of the common proximity sensor control devices into control circuits.	7.1	-	-	7, 41	
List the advantages and disadvantages of the common proximity sensor control devices.	7.3	-	-	7, 41	
List the application for the common proximity sensor control devices.	7.4	-	-	7, 41	
Skills					
Connect proximity sensor control devices into control circuits.	2.1, 7.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	9.2	40, 41	Topic 6.2 Skills Practice
6.3 Other Sensors					
Knowledge					
List the other common control devices used in automatic control circuits (pressure switches, float switches, light sensors, temperature sensors).	7.1	-	-	41	Topic 6 Content Quiz Topic 6.3 Learning Activity
Explain the basic operating principles of other common control devices.	7.2	-	-	41	
Describe the connection of other common control devices into control circuits.	7.1	-	-	41	
List the advantages and disadvantages of other common control devices.	7.3	-	-	41	
List the applications for other common control	7.4	-	-	41	

6 Control Devices					
devices.					
Skills					
Connect other common control devices into control circuits.	2.1, 7.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	9.2	40, 41	Topic 6.3 Skills Practice
6.4 Circuit Development, Connections and Testing					
Knowledge					
Explain the development of a control circuit incorporating control device sensors from a description of the circuit.	7.4	-	-	40, 41	Topic 6 Content Quiz Topic 6.4 Learning Activity
Explain the circuit checking and testing techniques for circuits which incorporate control devices.	3.2	-	-	40, 41	
Skills					
Select control devices using manufacturers’ catalogues for a specified application.	13	1.6	3.2	40, 41	Topic 6.4 Skills Practice
Develop control circuits which incorporate various control devices.	7.4	1.2, 1.3, 1.4	7.1	40, 41	
Connect common control devices into control circuits.	2.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	2, 9.2	40, 41	
Demonstrate the control circuit checking and testing procedures.	3.2, 7.4	2.5, 2.6, 2.8, 3.1, 3.2, 3.3	1, 10	40, 41	
Reference Text:					

6 Control Devices

- Hampson, J., Electrotechnology Practice, Pearson Education

Equipment/Material:

- PE cell
- Luminaire
- Capacitive/inductive proximity switch
- PIR sensor
- Control relays
- Contactors
- Thermal overloads
- Time delay relays
- Indicator lamps
- NO pushbuttons
- NC pushbuttons
- Mounting/wiring panel
- Power supply
- Selector switch
- Standard light switch
- Master ON/OFF switch
- Alarm bell/siren
- Circuit protective device
- Multimeter
- Lux meter

7 Programmable Relays					
Purpose:	In this topic you will learn about how programmable relays are used to control various electrical control processes.				
Duration:	This topic represents around 12.5% of the knowledge and skills specification contents, and should take the learner approximately 10 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Programmable Relays					
Knowledge					
Describe programmable relays and list the advantages over electromagnetic circuit control.	8.1	-	-	41	Topic 7 Content Quiz Topic 7.1 Learning Activity
List the typical application of programmable relays.	8.2	-	-	41	
Explain block diagram representation and basic principles of programmable relays.	8.3	-	-	41	
7.2 Programmable Relay Connections					
Knowledge					
Explain the documentation needed for listing input and output parameters, connections and output types.	8.4	-	-	41	Topic 7 Content Quiz Topic 7.2 Learning Activity
Describe the connections of input and output devices to a programmable relay using a diagram.	8.4	-	-	40, 41	
List the external devices used with programmable relays.	8.8	-	-	41	
Explain the installation of programmable relays.	8.4	-	-		
Skills					
Connect input and output devices to a programmable relay using a diagram.	2.1, 8.4	1.1, 1.5, 1.7, 1.8, 2.1, 2.2,	2, 9.7	40, 41	Topic 7.2 Skills Practice

7 Programmable Relays					
		2.3, , 2.4, 2.8			
7.3 Programmable Relay Programming					
Knowledge					
Describe basic programming of ladder circuits consisting of inputs and outputs such as a stop-start circuit.	8.5	-	-	41	Topic 7 Content Quiz Topic 7.3 Learning Activity
State the implications of programming normally closed field devices.	8.9	-	-	41	
Describe programming timers and the use of the monitoring facility of the programmable relay to check the value of timers.	8.7	-	-	41	
State the conversions of control circuits.	8.10		-	40, 41	
Skills					
Demonstrate the basic programming of ladder circuits consisting of inputs and outputs such as a stop-start circuit.	8.5	-	-	41	Topic 7.3 Skills Practice
Demonstrate the programming of timers and use the monitoring facility of the programmable relay to check the values of timers.	8.7	-	-	41	
7.4 Operation of Programmable Relays					
Knowledge					
Describe the use of the monitoring facility of the programmable relay to verify each ladder circuit operation.	8.6	-	-	41	Topic 7 Content Quiz Topic 7.4 Learning Activity
State the common faults and their symptoms of programmable control relays.	8.11	-	-	41	
Skills					
Use of monitoring facility of the programmable	8.6	-	-	41	Topic 7.3 Skills

7 Programmable Relays					
relay to verify each ladder circuit operation.					Practice
Identify common faults and their symptoms.	8.11	-	-	41	
7.5 Circuit Development Using Programmable Relays					
Knowledge					
Explain the development of control circuits using programmable relays from a description of the circuit.	8.5	-	-	40, 41	Topic 7 Content Quiz Topic 7.5 Learning Activity
Explain the circuit checking and testing techniques for circuits which use programmable relays.	3.2	-	-	40, 41	
Skills					
Input a program into a programmable relay developed from a written specification.	8.5	-	-	41	Topic 7.5 Skills Practice
Install programmable control relays and connect input and output devices.	8.4	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	2, 9.7	40, 41	
Apply the use of monitoring facility of the programmable relay to verify each ladder circuit operation.	8.6	-	-	41	
Reference Text: - Jenneson, J., Harper, B, Moore, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Hampson, J., Hanssen, S., Electrical Trade Principles, Pearson Education					
Standards and Codes: AS/NZS 3000 Wiring Rules (current edition)					
Equipment/Material:					

7 Programmable Relays

- Programmable relay
- Power supply
- Stop-start station
- Proximity sensors
- Indicator lamps

8 Three Phase Induction Motor Starters					
Purpose:	In this topic you will learn about three phase induction motor starters including DOL and electronic (soft) starters.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Motor Starters					
Knowledge					
Explain the reasons for limiting the starting current of large motors.	9.1	-	-	13	Topic 8 Content Quiz Topic 8.1 Learning Activity
List the requirements of the AS/NZS 3000 Wiring Rules and the network provider service installation rules, with regard to starting and control of induction motors.	9.2	-	-	13	
8.2 DOL Motor Starters					
Knowledge					
Describe the DOL starter operating principles and circuit configuration.	9.3.1	-	-	13, 40	Topic 8 Content Quiz Topic 8.2 Learning Activity
List the DOL starter applications.	9.3.1	-	-	13	
List the advantages and disadvantages of DOL starters.	9.3.1	-	-	13	
Skills					
Connect a DOL motor starter and test the operation of the power and control circuits.	2.1, 9.3.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4,	1, 2, 9.3, 10	13, 40	Topic 8.2 Skills Practice

8 Three Phase Induction Motor Starters					
		2.8			
8.3 Electronic Soft Starters					
Knowledge					
Describe electronic soft starter operating principles and circuit configurations.	9.3.4	-	-	13, 41	Topic 8 Content Quiz Topic 8.3 Learning Activity
List the electronic soft starter applications.	9.3.4	-	-	13, 41	
List the advantages and disadvantages of electronic soft starters.	9.3.4	-	-	13, 41	
Skills					
Connect an electronic soft starter and test its operation.	2.1, 9.3.4	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	1, 2, 9.5, 10	13, 40, 41	Topic 8.3 Skills Practice
Reference Texts: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning Standards and codes: - AS/NZS 3000 Wiring Rules (current edition) - Local Service and Installation Rules (SIR) Equipment/Material: - Three phase squirrel cage induction motor - DOL motor stater - Electronic soft starter - Tachometer - Torque meter - Tong tester					

8 Three Phase Induction Motor Starters

- Three phase variable voltage supply
- Variable load
- Rotor shaft locking device

9 Three Phase Induction Motor Starters – Reduced Voltage

Purpose:	In this topic you will learn about the various forms of three phase induction motor convectional reduced voltage starters.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
9.1 Star Delta Starters					
Knowledge					
Describe the star-delta motor starter operating principles and various circuit configurations.	10.1	-	-	13	Topic 9 Content Quiz Topic 9.1 Learning Activity
Describe the star-delta starter characteristics.	10.3	-	-	13	
List the advantages and disadvantages of the star-delta starter.	10.2	-	-	13	
List the star-delta starter applications.	10.2	-	-	13	
Skills					
Select the most suitable star-delta starter for a givens situation.	10.1, 13	1.2, 1.3, 1.4	3.5	13	Topic 9.1.1 Skills Practice Topic 9.1.2 Skills Practice Topic 9.4.2 Skills Practice
Connect the star-delta starter power and control circuits for correct operation.	2.1, 10.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3,, 2.4, 2.8	1, 2, 9.8	13, 40, 41	
Determine the star-delta motor starter characteristics including starting current and torque.	10.3	2.5, 3.1, 3.2, 3.3	8, 10	13	
9.2 Primary Resistance Starters					
Knowledge					

9 Three Phase Induction Motor Starters – Reduced Voltage					
Describe the primary resistance motor starter operating principles and various circuit configurations.	10.1	-	-	13	Topic 9 Content Quiz Topic 9.2 Learning Activity
Describe the primary resistance starter characteristics.	10.3	-	-	13	
List the advantages and disadvantages of the primary resistance starter.	10.2	-	-	13	
List the primary resistance starter applications.	10.2	-	-	13	
Skills					
Select the most suitable primary resistance motor starter for a given situation	10.1, 13	1.2, 1.3, 1.4	3.5	13	Topic 9.2 Skills Practice Topic 9.4.2 Skills Practice
Connect the primary resistance motor starter power and control circuits for correct operation.	2.1, 10.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	1, 2, 9.8	13, 40, 41	
Determine the primary resistance motor starter characteristics including current and torque.	10.3	2.5, 3.1, 3.2, 3.3	8, 10	13	
9.3 Autotransformer Starters					
Knowledge					
Describe the autotransformer motor starter operating principles and various circuit configurations.	10.1	-	-	13	Topic 9 Content Quiz Topic 9.3 Learning Activity
Describe the autotransformer starter characteristics.	10.3	-	-	13	
List the advantages and disadvantages of the autotransformer starter.	10.2	-	-	13	
List the autotransformer starter applications.	10.2	-	-	13	
Skills					

9 Three Phase Induction Motor Starters – Reduced Voltage					
Select the most suitable autotransformer motor starter for a given situation.	10.1, 13	1.2, 1.3, 1.4	3.5	13	Topic 9.3 Skills Practice
Connect the autotransformer motor starter power and control circuits for correct operation.	2.1, 10.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3,, 2.4, 2.8	1, 2, 9.8	13, 40, 41	Topic 9.4.2 Skills Practice
Determine the autotransformer motor starter characteristics including starting current and torque.	10.3	2.5, 3.1, 3.2, 3.3	8, 10	13	
9.4 Secondary Resistance Starters					
Knowledge					
Describe the secondary resistance motor starter operating principles and various circuit configurations.	10.1	-	-	13	Topic 9 Content Quiz Topic 9.4 Learning Activity
Describe the secondary resistance starter characteristics.	10.3	-	-	13	
List the advantages and disadvantages of the secondary resistance starter.	10.2	-	-	13	
List the secondary resistance starter applications.	10.2	-	-	13	
Skills					
Select the most suitable secondary resistance motor starter for a given situation.	10.1, 13	1.2, 1.3, 1.4	3.5	13	Topic 9.4.1 Skills Practice
Connect the secondary resistance motor starter power and control circuits for correct operation.	2.1, 10.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3,, 2.4, 2.8	1, 2, 9.8	13, 40, 41	Topic 9.4.2 Skills Practice
Determine the secondary resistance motor starter characteristics including starting current and	10.3	2.5, 3.1, 3.2, 3.3	8, 10	13	

9 Three Phase Induction Motor Starters – Reduced Voltage

torque.

Reference Texts:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Equipment/Material:

- Three phase squirrel cage induction motor
- Star-delta starter
- Stop-start station
- Contactors and control relays, including on-delay relay
- Thermal overloads
- Starting resistors
- Autotransformers
- Tachometer, torque meter and tong tester
- Three phase variable voltage supply
- Variable load
- Rotor shaft locking device

10 Three Phase Induction Motor Braking						
Purpose:	In this topic you will learn about the various methods of braking a three phase induction motor and the circuit configurations for each method.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
10.1 Motor Reversing and Motor Braking						
Knowledge						
Describe the operating principles and control circuits for reversing the direction of rotation of a three phase motor.		11.1	-	-	40, 41	Topic 10 Content Quiz Topic 10.1 Learning Activity
List the various methods used for braking a three phase induction motor.		11.1	-	-	41	
Skills						
Connect a three phase induction motor reversing power and control circuit and examine its operation.		2.1, 11.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	1, 2, 9.1, 10	40, 41	Topic 10.1 Skills Practice
10.2 Plug Braking						
Knowledge						
Describe the plug braking operating principles and circuit configurations.		11.1	-	-	40, 41	Topic 10 Content Quiz Topic 10.2 Learning Activity
Describe the plug braking characteristics.		11.2	-	-	41	
List the advantages and disadvantages for the plug braking method.		11.3	-	-	41	
List the plug braking method applications.		11.3	-	-	41	

10 Three Phase Induction Motor Braking					
Skills					
Connect a three phase motor incorporating plug braking and examine its operation.	2.1, 11.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	1, 2, 9.1, 10	40, 41	Topic 10.2 Skills Practice
10.3 Dynamic Braking					
Knowledge					
Describe the dynamic braking operating principles and circuit configurations.	11.1	-	-	40, 41	Topic 10 Content Quiz Topic 10.3 Learning Activity
Describe the dynamic braking characteristics.	11.2	-	-	41	
List the advantages and disadvantages for the dynamic braking method.	11.3	-	-	41	
List the dynamic braking method applications.	11.3	-	-	41	
Skills					
Connect a three phase motor incorporating dynamic braking and examine its operation.	2.1, 11.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	1, 2, 9.1, 10	40, 41	Topic 10.3 Skills Practice
10.4 Regenerative Braking					
Knowledge					
Describe the regenerative braking operating principles and circuit configurations.	11.1	-	-	40, 41	Topic 10 Content Quiz Topic 10.4 Learning Activity
Describe the regenerative braking characteristics.	11.2	-	-	41	
List the advantages and disadvantages for the regenerative braking method.	11.3	-	-	41	
List the regenerative braking method applications.	11.3	-	-	41	

10 Three Phase Induction Motor Braking					
10.5 Eddy Current Braking					
Knowledge					
Describe the eddy current brake operating principles.	11.1	-	-	41	Topic 10 Content Quiz Topic 10.5 Learning Activity
Describe the eddy current brake characteristics.	11.2	-	-	41	
List the advantages and disadvantages for the eddy current brake method.	11.3	-	-	41	
List the eddy current brake method applications.	11.3	-	-	41	
10.6 Mechanical Braking					
Knowledge					
Describe the mechanical brake operating principles and circuits.	11.1	-	-	7, 40, 41	Topic 10 Content Quiz Topic 10.6 Learning Activity
Describe the mechanical brake characteristics.	11.2	-	-	7, 41	
List the advantages and disadvantages for the mechanical brake method.	11.3	-	-	7, 41	
List the mechanical brake method applications.	11.3	-	-	7, 41	
Reference Texts: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill					
Equipment/Material: - Contactors - Control relays - Off-delay relay - Zero speed switch - Thermal overloads - NO pushbuttons - NO pushbutton - Stop-start station					

10 Three Phase Induction Motor Braking

- Indicator lamps
- Three phase induction motor
- Braking resistors
- Dynamic braking unit
- Three phase variable power supply
- Fuse/protective device
- Wiring panels
- Multimeter
- Torque meter
- Inertia load
- Tong tester
- Stop watch

11 Three Phase Induction Motor Speed Control						
Purpose:	In this topic you will learn about the various methods used to control the speed of three phase induction motors.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
11.1 Three Phase Induction Motor Speed Control						
Knowledge						
Describe the principles of varying the speed of a three phase induction motor.		12.1	-	-	41	Topic 11 Content Quiz Topic 11.1 Learning Activity
List the various methods used to control the speed of a three phase induction motor.		9.3.2, 12.1	-	-	41	
11.2 Pole Changing Methods						
Knowledge						
Describe the operating principles and circuits used for the pole changing method of motor speed control.		12.1	-	-	40, 41	Topic 11 Content Quiz Topic 11.2 Learning Activity
List the advantages and disadvantages of pole changing speed control.		12.1	-	-	41	
List the applications of pole changing speed control.		12.1	-	-	41	
11.3 Variable Frequency Drives						
Knowledge						
Describe the operating principles of variable frequency (VF) drives motor speed control.		9.3.3, 12.1	-	-	41	Topic 11 Content Quiz Topic 11.3 Learning
List the advantages and disadvantages of VF		9.3.3, 12.1	-	-	41	

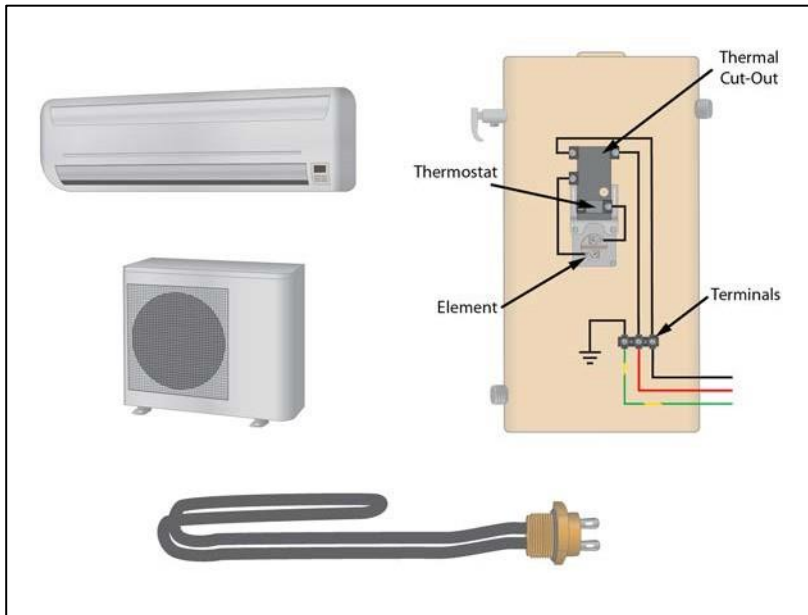
11 Three Phase Induction Motor Speed Control					
drives.					Activity
List the applications of VF drives.	9.3.3, 12.1	-	-	41	
Skills					
Connect a three phase motor to a VF drive and examine its operation.	2.1, 9.3.3, 12.1	1.1, 1.5, 1.7, 1.8, 2.1, 2.2, 2.3, , 2.4, 2.8	1, 2, 9.1, 10	40, 41	Topic 11.3 Skills Practice
11.4 Slip Ring Induction Motor Speed Control					
Knowledge					
Describe the operating principles and circuits used to control the speed of a slip ring induction motor.	12.1	-	-	40, 41	Topic 11 Content Quiz Topic 11.4 Learning Activity
List the advantages and disadvantages of slip ring motor speed control methods.	12.1	-	-	41	
List the applications of slip ring induction motor speed control methods.	12.1	-	-	41	
Reference Texts:					
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill					
Equipment/Material:					
- Three phase squirrel cage induction motor - Variable frequency drive - Tachometer - Torque meter - Three phase variable voltage supply - Variable mechanical load - Tong tester - Stop watch					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities required for licensing

Unit Learning Plan

UEEEL0008 – Evaluate and modify low voltage heating equipment and controls



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Electrical Heating Control	5
1.1 Heating Controls	5
1.2 Thermostats	5
1.3 Simmerstats	6
1.4 Electronic Heat Control	6
2 Fixed Heating Appliances	8
2.1 Electrical Heating Concepts	8
2.2 Electrical Heating Appliances	8
2.3 Heating Circuits and Requirements	9
3 Electric Water Heaters	10
3.1 Types of Water Heaters	10
3.2 Water Heater Controls	10
3.3 Water Heater Configurations	11
3.4 Solar Water Heaters	11
4 Fault Finding Heating Equipment	13
4.1 Common Faults and Symptoms	13
4.2 Fault Finding Techniques	14

A. Overview		
Competency Standard Unit (CSU)	UEEEL0008 Evaluate and modify low voltage heating equipment and controls	
CSU Application	This unit involves the skills and knowledge required to evaluate and modify low voltage (LV) heating equipment and controls. It includes working safely, identifying faults in heating equipment, repairing heating equipment, ensuring all work complies with relevant Australian Standards and legislation, and completing work and documenting activities. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0008	Performance Criteria
	KE-UEEEL0008	Knowledge Evidence
	PE-UEEEL0008	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 4	17 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Unit Skills Test	2 hours
	Total duration of structured learning program	20 hours

	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Electrical Heating Control

Purpose:	In this topic you will investigate the various methods of heating control including the use of thermostats, simmerstats and electronic heating control methods.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Heating Controls					
Knowledge					
Describe the methods of manual heating control.	1.1	-	-	41, 54	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the methods of automatic heating control.	1.2	-	-	41, 54	
1.2 Thermostats					
Knowledge					
List the different types of thermostats.	1.3	-	-	41, 54	Topic 1 Content Quiz Topic 1.2 Learning Activity
State the applications of common thermostats.	1.3	-	-	41, 54	
Describe the operation of a thermostat.	1.4	-	-	41, 54	
Define the terms sensitivity and differential with regards to thermostats.	1.5, 6	-	-	41, 54	
Skills					
Connect and test the operation of a thermostat circuit.	1.4, 1.6, 5, 6, 7, 8, 9	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.4	1, 3, 4, 13, 15	30, 41, 54	Topic 1.2 Skills Practice
Measure the differential of a thermostat.	1.5, 5, 6, 7, 8, 9	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.4	1, 3, 4, 13, 15	30, 41, 54	

1 Electrical Heating Control					
1.3 Simmerstats					
Knowledge					
State the applications of common simmerstats (infinite control).	1.7	-	-	41, 54	Topic 1 Content Quiz Topic 1.3 Learning Activity
Describe the operation of simmerstats including applicable circuit diagrams.	1.7, 4.1, 6	-	-	41, 54	
Skills					
Connect and test the operation of a simmerstat.	1.7, 4.1, 5, 6, 7, 8, 9	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.4	1, 3, 13, 15	41, 54	Topic 1.3 Skills Practice
1.4 Electronic Heat Control					
Knowledge					
Explain the basic operation of electronic heating controls, including: - Thyristor phase control - Zero voltage switching	1.8, 6	-	-	41, 51, 54	Topic 1 Content Quiz Topic 1.4 Learning Activity
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) Equipment: - Thermostats - Simmerstats - Test equipment					

1 Electrical Heating Control

- Heating source
- Thermometer
- Cables, fixings etc.
- PPE

2 Fixed Heating Appliances					
Purpose:	In this topic you will investigate the types of fixed electrical heating appliances, and the operation and connections of fixed heating appliances.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Electrical Heating Concepts					
Knowledge					
Define the following terms: - Heat energy - Temperature - Specific heat capacity - Thermal conductivity - Thermal stability	2.1	-	-	1	Topic 2 Content Quiz Topic 2.1 Learning Activity
Describe and name the methods of heat transfer.	2.3	-	-	1	
Skills					
Calculate the heat energy in joules and kWh in a simple heating process.	2.2	-	3, 5	1	Topic 2 Content Quiz Topic 2.1 Learning Activity
Calculate the heat energy from the input and output of a heating process.	2.2	-	3, 5	1	
2.2 Electrical Heating Appliances					
Knowledge					
Describe the operation of electric stoves (ranges) and other electric heating appliances including applicable circuit diagrams.	4.1, 6	-	-	5, 40	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe the possible connections to a two phase stove.	2.4, 6	-	-	33, 35	

2 Fixed Heating Appliances					
Describe the components and operation of basic reverse cycle air conditioning system.	2.5, 6	-	-	-	
2.3 Heating Circuits and Requirements					
Knowledge					
State the features and Wiring Rules requirements for electrical heating circuits and appliances.	4.1, 10	-	-	35, 41	Topic 2 Content Quiz Topic 2.3 Learning Activity
Skills					
Install wiring and accessories for the supply of a two phase stove and connect the stove using single phase and multiphase supply wiring.	2.4, 4.1, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.6, 3.1, 3.2, 3.4	1, 2, 7, 8, 11, 13, 14, 15, 16	30, 31, 33, 34, 35, 36, 37	Topic 2.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) Equipment: - Two phase stove - Double pole isolator - TPS cable - Cable supports, screws, etc. - Hand tools and PPE					

3 Electric Water Heaters					
Purpose:	In this topic you will investigate the types of water heaters, operation of water heaters and the various circuit configurations.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Types of Water Heaters					
Knowledge					
Describe the types of electric water heaters including instantaneous, storage type, and heat pump.	3.1, 3.7	-	-	40	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe single phase and three phase element resistance values as determined from measurement and/or calculation.	4.2, 6	-	-	-	
3.2 Water Heater Controls					
Knowledge					
Describe the methods of control for instantaneous and storage water heaters.	1.4, 3.1	-	-	-	Topic 3 Content Quiz Topic 3.2 Learning Activity
Describe intrinsic safety in terms of pressure relief and thermal cut-out.	1.4, 3.2	-	-	-	
State the Wiring Rules requirements for electrical water heating circuits and appliances.	10	-	-	-	
Skills					
Test an over temperature cut-out thermostat to confirm correct functionality.	1.4, 1.6, 3.2, 3.3, 5, 6, 7, 9	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.4	1, 3, 4, 6, 13, 15	30	Topic 3.3 Skills Practice 1 Topic 3.3 Skills Practice 2

3 Electric Water Heaters					
3.3 Water Heater Configurations					
Knowledge					
Describe the configurations and connections for single and three phase water heaters.	3.1, 3.4, 3.5	-	-	37	Topic 3 Content Quiz Topic 3.3 Learning Activity
Describe the switchboard requirements to supply a controlled load water heater.	3.4	-	-	37	
Skills					
Draw the internal circuit of a twin element water heater and its connection to the supply.	3.5, 4.1, 8	-	-	40	Topic 3.3 Skills Practice 1 Topic 3.3 Skills Practice 2
Connect single and three phase water heater circuits and equipment.	3.1, 3.4, 4.1, 4.2, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.6, 3.1, 3.2, 3.4	1, 2, 3, 8, 11, 13, 14, 15, 16	30, 33, 34, 35, 36, 37, 40	
3.4 Solar Water Heaters					
Knowledge					
Describe the components of a solar thermal system including: • Collector • Storage • Reticulation • Controls	3.6, 6	-	-	54	Topic 3 Content Quiz Topic 3.4 Learning Activity
Describe the different types of domestic solar water heating (SWH) systems and their integration into an installation.	3.6, 6	-	-	54	
Describe types of solar collector suitable for low, medium and high temperature applications.	3.6, 6	-	-	54	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill					

3 Electric Water Heaters

- Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)

Equipment:

- Thermostat
- Cables, screws, etc.
- Test equipment
- Twin element hot water heater
- Three phase instantaneous water heater
- Isolator

4 Fault Finding Heating Equipment					
Purpose:	In this topic you will learn about the various faults found in electrical single phase and three phase water heaters and the methods used to find and repair these faults using troubleshooting techniques.				
Duration:	This topic represents around 25% of the knowledge and skills specification contents, and should take the learner approximately 5 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Common Faults and Symptoms					
Knowledge					
List the common faults and associated symptoms that occur in heating circuits and equipment, including: • Open-circuits • Short-circuits • Incorrect connections • Component/mechanical faults • Supply faults • Operator faults	4.6	-	-	54	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe testing methods to check the insulation resistance and continuity of single and three phase heating appliances.	4.3, 6	-	-	30, 54	
Skills					
Test single phase and three phase heating appliances and elements for correct insulation resistance and continuity.	4.3, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4	1, 2, 3, 9, 10, 12, 13, 14, 15, 16	30, 54	Topic 4.1 Skills Practice

4 Fault Finding Heating Equipment					
4.2 Fault Finding Techniques					
Knowledge					
Describe techniques for locating and repairing faults in single and three phase heating appliances.	4.5, 4.7, 9	-	-	30, 54	Topic 4 Content Quiz Topic 4.2 Learning Activity
Describe techniques for replacing the element of an electric water heater.	4.4, 9	-	-	54	
Skills					
Demonstrate the techniques for replacing the element of an electric water heater.	4.4, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4	1, 2, 3, 7, 8, 9, 10, 12, 13, 14, 15, 16	54	Topic 4.2 Skills Practice 1 Topic 4.2 Skills Practice 2
Identify and repair faults in single and three phase heating appliances.	1.4, 1.6, 4.5, 4.7, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4	1, 2, 3, 7, 8, 9, 10, 12, 13, 14, 15, 16	30, 54	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning • Phillips, P., Electrical Principles, Cengage Learning					
Standards and Codes: • AS/NZS 3000 Wiring Rules (current edition) • AS/NZS 3017 Verification guidelines (current edition)					

4 Fault Finding Heating Equipment

Equipment:

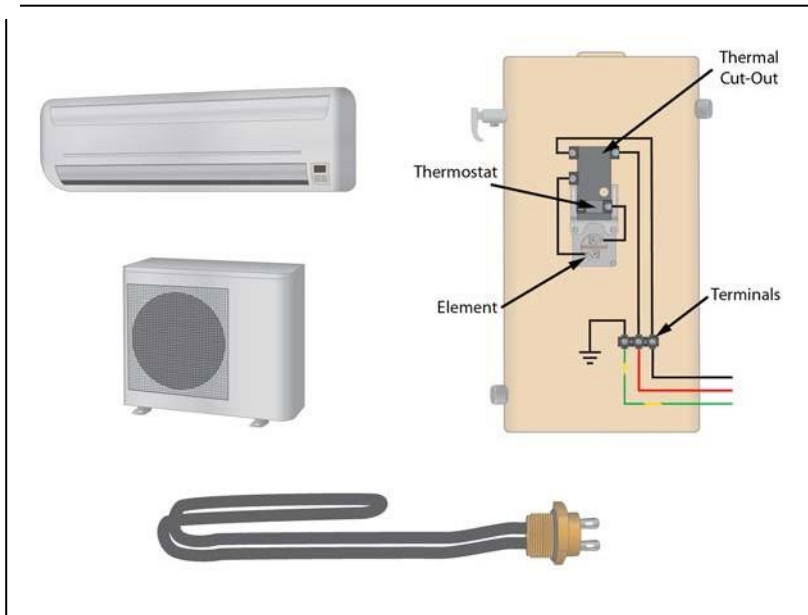
- Single and three phase heating appliances and circuits (e.g. cooktops, ovens, radiant heaters, instantaneous and storage type water heaters)
- Heating appliance circuits with fault switches
- Replacement heating element
- Variety of test equipment (e.g. IR testers, multimeters)
- Hand tools and PPE

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0008 – Evaluate and modify low voltage heating equipment and controls



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Electrical Heating Control	5
1.1 Heating Controls	5
1.2 Thermostats	5
1.3 Simmerstats	6
1.4 Electronic Heat Control	6
2 Fixed Heating Appliances	8
2.1 Electrical Heating Concepts	8
2.2 Electrical Heating Appliances	8
2.3 Heating Circuits and Requirements	9
3 Electric Water Heaters	10
3.1 Types of Water Heaters	10
3.2 Water Heater Controls	10
3.3 Water Heater Configurations	11
3.4 Solar Water Heaters	11
4 Fault Finding Heating Equipment	13
4.1 Common Faults and Symptoms	13
4.2 Fault Finding Techniques	14

A. Overview		
Competency Standard Unit (CSU)	UEEEL0008 Evaluate and modify low voltage heating equipment and controls	
CSU Application	This unit involves the skills and knowledge required to evaluate and modify low voltage (LV) heating equipment and controls. It includes working safely, identifying faults in heating equipment, repairing heating equipment, ensuring all work complies with relevant Australian Standards and legislation, and completing work and documenting activities. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0008	Performance Criteria
	KE-UEEEL0008	Knowledge Evidence
	PE-UEEEL0008	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 4	17 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Unit Skills Test	2 hours
	Total duration of structured learning program	20 hours

	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Electrical Heating Control

Purpose:	In this topic you will investigate the various methods of heating control including the use of thermostats, simmerstats and electronic heating control methods.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Heating Controls					
Knowledge					
Describe the methods of manual heating control.	1.1	-	-	41, 54	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the methods of automatic heating control.	1.2	-	-	41, 54	
1.2 Thermostats					
Knowledge					
List the different types of thermostats.	1.3	-	-	41, 54	Topic 1 Content Quiz Topic 1.2 Learning Activity
State the applications of common thermostats.	1.3	-	-	41, 54	
Describe the operation of a thermostat.	1.4	-	-	41, 54	
Define the terms sensitivity and differential with regards to thermostats.	1.5, 6	-	-	41, 54	
Skills					
Connect and test the operation of a thermostat circuit.	1.4, 1.6, 5, 6, 7, 8, 9	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.4	1, 3, 4, 13, 15	30, 41, 54	Topic 1.2 Skills Practice
Measure the differential of a thermostat.	1.5, 5, 6, 7, 8, 9	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.4	1, 3, 4, 13, 15	30, 41, 54	

1 Electrical Heating Control					
1.3 Simmerstats					
Knowledge					
State the applications of common simmerstats (infinite control).	1.7	-	-	41, 54	Topic 1 Content Quiz Topic 1.3 Learning Activity
Describe the operation of simmerstats including applicable circuit diagrams.	1.7, 4.1, 6	-	-	41, 54	
Skills					
Connect and test the operation of a simmerstat.	1.7, 4.1, 5, 6, 7, 8, 9	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.4	1, 3, 13, 15	41, 54	Topic 1.3 Skills Practice
1.4 Electronic Heat Control					
Knowledge					
Explain the basic operation of electronic heating controls, including: - Thyristor phase control - Zero voltage switching	1.8, 6	-	-	41, 51, 54	Topic 1 Content Quiz Topic 1.4 Learning Activity
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) Equipment: - Thermostats - Simmerstats - Test equipment					

1 Electrical Heating Control

- Heating source
- Thermometer
- Cables, fixings etc.
- PPE

2 Fixed Heating Appliances					
Purpose:	In this topic you will investigate the types of fixed electrical heating appliances, and the operation and connections of fixed heating appliances.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Electrical Heating Concepts					
Knowledge					
Define the following terms: - Heat energy - Temperature - Specific heat capacity - Thermal conductivity - Thermal stability	2.1	-	-	1	Topic 2 Content Quiz Topic 2.1 Learning Activity
Describe and name the methods of heat transfer.	2.3	-	-	1	
Skills					
Calculate the heat energy in joules and kWh in a simple heating process.	2.2	-	3, 5	1	Topic 2 Content Quiz Topic 2.1 Learning Activity
Calculate the heat energy from the input and output of a heating process.	2.2	-	3, 5	1	
2.2 Electrical Heating Appliances					
Knowledge					
Describe the operation of electric stoves (ranges) and other electric heating appliances including applicable circuit diagrams.	4.1, 6	-	-	5, 40	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe the possible connections to a two phase stove.	2.4, 6	-	-	33, 35	

2 Fixed Heating Appliances					
Describe the components and operation of basic reverse cycle air conditioning system.	2.5, 6	-	-	-	
2.3 Heating Circuits and Requirements					
Knowledge					
State the features and Wiring Rules requirements for electrical heating circuits and appliances.	4.1, 10	-	-	35, 41	Topic 2 Content Quiz Topic 2.3 Learning Activity
Skills					
Install wiring and accessories for the supply of a two phase stove and connect the stove using single phase and multiphase supply wiring.	2.4, 4.1, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.6, 3.1, 3.2, 3.4	1, 2, 7, 8, 11, 13, 14, 15, 16	30, 31, 33, 34, 35, 36, 37	Topic 2.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) Equipment: - Two phase stove - Double pole isolator - TPS cable - Cable supports, screws, etc. - Hand tools and PPE					

3 Electric Water Heaters					
Purpose:	In this topic you will investigate the types of water heaters, operation of water heaters and the various circuit configurations.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Types of Water Heaters					
Knowledge					
Describe the types of electric water heaters including instantaneous, storage type, and heat pump.	3.1, 3.7	-	-	40	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe single phase and three phase element resistance values as determined from measurement and/or calculation.	4.2, 6	-	-	-	
3.2 Water Heater Controls					
Knowledge					
Describe the methods of control for instantaneous and storage water heaters.	1.4, 3.1	-	-	-	Topic 3 Content Quiz Topic 3.2 Learning Activity
Describe intrinsic safety in terms of pressure relief and thermal cut-out.	1.4, 3.2	-	-	-	
State the Wiring Rules requirements for electrical water heating circuits and appliances.	10	-	-	-	
Skills					
Test an over temperature cut-out thermostat to confirm correct functionality.	1.4, 1.6, 3.2, 3.3, 5, 6, 7, 9	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.4	1, 3, 4, 6, 13, 15	30	Topic 3.3 Skills Practice 1 Topic 3.3 Skills Practice 2

3 Electric Water Heaters					
3.3 Water Heater Configurations					
Knowledge					
Describe the configurations and connections for single and three phase water heaters.	3.1, 3.4, 3.5	-	-	37	Topic 3 Content Quiz Topic 3.3 Learning Activity
Describe the switchboard requirements to supply a controlled load water heater.	3.4	-	-	37	
Skills					
Draw the internal circuit of a twin element water heater and its connection to the supply.	3.5, 4.1, 8	-	-	40	Topic 3.3 Skills Practice 1 Topic 3.3 Skills Practice 2
Connect single and three phase water heater circuits and equipment.	3.1, 3.4, 4.1, 4.2, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.6, 3.1, 3.2, 3.4	1, 2, 3, 8, 11, 13, 14, 15, 16	30, 33, 34, 35, 36, 37, 40	
3.4 Solar Water Heaters					
Knowledge					
Describe the components of a solar thermal system including: • Collector • Storage • Reticulation • Controls	3.6, 6	-	-	54	Topic 3 Content Quiz Topic 3.4 Learning Activity
Describe the different types of domestic solar water heating (SWH) systems and their integration into an installation.	3.6, 6	-	-	54	
Describe types of solar collector suitable for low, medium and high temperature applications.	3.6, 6	-	-	54	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill					

3 Electric Water Heaters

- Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)

Equipment:

- Thermostat
- Cables, screws, etc.
- Test equipment
- Twin element hot water heater
- Three phase instantaneous water heater
- Isolator

4 Fault Finding Heating Equipment					
Purpose:	In this topic you will learn about the various faults found in electrical single phase and three phase water heaters and the methods used to find and repair these faults using troubleshooting techniques.				
Duration:	This topic represents around 25% of the knowledge and skills specification contents, and should take the learner approximately 5 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Common Faults and Symptoms					
Knowledge					
List the common faults and associated symptoms that occur in heating circuits and equipment, including: • Open-circuits • Short-circuits • Incorrect connections • Component/mechanical faults • Supply faults • Operator faults	4.6	-	-	54	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe testing methods to check the insulation resistance and continuity of single and three phase heating appliances.	4.3, 6	-	-	30, 54	
Skills					
Test single phase and three phase heating appliances and elements for correct insulation resistance and continuity.	4.3, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4	1, 2, 3, 9, 10, 12, 13, 14, 15, 16	30, 54	Topic 4.1 Skills Practice

4 Fault Finding Heating Equipment					
4.2 Fault Finding Techniques					
Knowledge					
Describe techniques for locating and repairing faults in single and three phase heating appliances.	4.5, 4.7, 9	-	-	30, 54	Topic 4 Content Quiz Topic 4.2 Learning Activity
Describe techniques for replacing the element of an electric water heater.	4.4, 9	-	-	54	
Skills					
Demonstrate the techniques for replacing the element of an electric water heater.	4.4, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4	1, 2, 3, 7, 8, 9, 10, 12, 13, 14, 15, 16	54	Topic 4.2 Skills Practice 1 Topic 4.2 Skills Practice 2
Identify and repair faults in single and three phase heating appliances.	1.4, 1.6, 4.5, 4.7, 5, 6, 7, 8, 9, 10	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4	1, 2, 3, 7, 8, 9, 10, 12, 13, 14, 15, 16	30, 54	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning • Phillips, P., Electrical Principles, Cengage Learning					
Standards and Codes: • AS/NZS 3000 Wiring Rules (current edition) • AS/NZS 3017 Verification guidelines (current edition)					

4 Fault Finding Heating Equipment

Equipment:

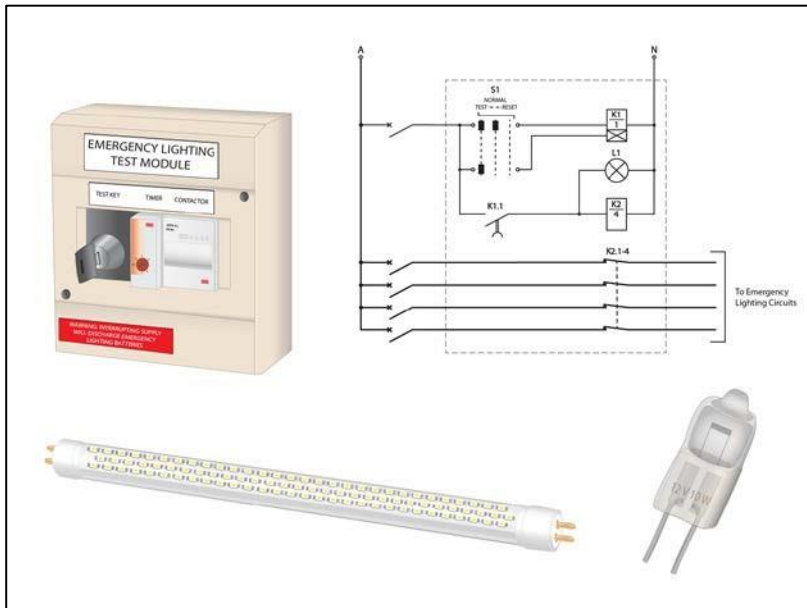
- Single and three phase heating appliances and circuits (e.g. cooktops, ovens, radiant heaters, instantaneous and storage type water heaters)
- Heating appliance circuits with fault switches
- Replacement heating element
- Variety of test equipment (e.g. IR testers, multimeters)
- Hand tools and PPE

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0009 – Evaluate and modify low voltage lighting circuits, equipment and controls



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Lighting Circuits and Controls	5
1.1 Wiring Methods and Operation	5
1.2 Wiring Requirements	5
1.3 Lighting Controls	6
2 Residential Fire and Smoke Alarms	8
2.1 Types of Fire and Smoke Alarms	8
2.2 Smoke Alarm Wiring Configurations	8
3 Emergency and Evacuation Lighting	10
3.1 Emergency Evacuation Lighting Requirements	10
3.2 Emergency Evacuation Lighting Systems	10
4 Fundamental Lighting Concepts	12
4.1 Lighting Concepts	12
4.2 Types of Luminaires	12
4.3 Lighting Layouts	12
5 Low Intensity Discharge Lighting	14
5.1 Low Intensity Discharge Luminaires	14
5.2 Low Intensity Discharge Lighting Requirements	14
6 High Intensity Discharge Lighting	16
6.1 HID Luminaires and Requirements	16
6.2 LED Lighting	16
6.3 Other Types of Lighting	17
7 Fault Finding Lighting Circuits	19
7.1 Common Faults and Symptoms	19
7.2 Fault Finding Techniques	19

A. Overview		
Competency Standard Unit (CSU)	UEEEL0009 Evaluate and modify low voltage lighting circuits, equipment and controls	
CSU Application	This unit involves the skills and knowledge required to evaluate and modify low voltage (LV) lighting circuits, equipment and controls. It includes working safely, identifying faults in luminaires and associated control equipment, repairing/replacing luminaire and control equipment components, ensuring all work complies with relevant Australian Standards and legislation, and completing work and documenting activities. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0009	Performance Criteria
	KE-UEEEL0009	Knowledge Evidence
	PE-UEEEL0009	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 7	26 hours
	Completion of Unit Knowledge Test	1.5 hour
	Completion of Unit Skills Test	2.5 hours
	Total duration of structured learning program	30 hours

	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Lighting Circuits and Controls

Purpose:	In this topic you will investigate the methods of wiring basic lighting circuits and the different lighting circuit configuration, including multi way switching.				
Duration:	This topic represents around 13.3 % of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Wiring Methods and Operation					
Knowledge					
Describe the 'loop at the light' method of wiring lighting circuits.	1, 11.3	-	-	40, 53	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the 'loop at the switch' method of wiring lighting circuits.	2, 11.3	-	-	40, 53	
Describe the various lighting circuit switching configurations using one-way, two-way, and two-way intermediate switching of light points.	3, 11.3	-	-	40, 53	
Skills					
Develop wiring diagrams for lighting circuits with one-way, two-way, and intermediate switching using the loop at the light method.	1, 2, 3, 11.3	1.1, 2.1	4.1, 4.2, 4.3, 5	41, 53	Topic 1.2 Skills Practice 1 Topic 1.2 Skills Practice 2
Develop wiring diagrams for lighting circuits with one-way, two-way, and intermediate switching using the loop at the switch method.	1, 2, 3, 11.3	1.1, 2.1	4.1, 4.2, 4.3, 5	41, 53	
1.2 Wiring Requirements					
Knowledge					
State the TPS cabling requirements for loop at the light/switch lighting circuit configurations.	4, 11.3, 21	-	-	53	Topic 1 Content Quiz

1 Lighting Circuits and Controls					
Describe the installation methods of accessories and TPS wiring for a lighting circuit incorporating one-way, two-way and intermediate switching using the loop at the light/switch methods.	3, 11.3, 21	-	-	53	Topic 1.2 Learning Activity
Skills					
Install and connect a lighting circuit incorporating one-way, two-way, and intermediate switching of lighting points using the 'loop at the light' method of TPS wiring.	1, 2, 3, 4, 11.3, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.6, 3.1, 3.2, 3.4	1, 2, 4.1, 4.2, 4.3, 5, 8, 11, 12	33, 34, 35, 36, 37, 53	Topic 1.2 Skills Practice 1 Topic 1.2 Skills Practice 2
Install and connect a lighting circuit incorporating one-way, two-way, and intermediate switching of lighting points using the 'loop at the switch' method of TPS wiring.	1, 2, 3, 4, 11.3, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.6, 3.1, 3.2, 3.4	1, 2, 4.1, 4.2, 4.3, 5, 8, 11, 12	33, 34, 35, 36, 37, 53	
Confirm correct operation of the circuits and test for compliance with AS/NZS 3000 requirements for earth continuity, insulation resistance and polarity.	5, 13, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.6, 3.1, 3.2, 3.4	1, 2, 3, 10, 11, 12	30	
1.3 Lighting Controls					
Knowledge					
Describe the operation and expected input/output parameters of a range of lighting control including: - Dimmers and time clocks - Passive infra-red (PIR) - Photoelectric switches - Electronic controls	19	-	-	51, 53, 54	Topic 1 Content Quiz Topic 1.1 Learning Activity
List the hazards and safety considerations associated with handling and testing electronic lighting control equipment.	20	-	-	51, 53, 54	

1 Lighting Circuits and Controls

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)

Equipment:

- Two-way light switch
- Intermediate light switch
- TPS cabling
- Batten holders
- Any other required accessories
- Clips and screws etc.
- PPE

2 Residential Fire and Smoke Alarms					
Purpose:	In this topic you will investigate the types, operation and installation of fire protection alarms.				
Duration:	This topic represents around 10 % of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Types of Fire and Smoke Alarms					
Knowledge					
Describe the available types of fire and smoke alarms.	17.1, 21	-	-	33, 35, 53	Topic 2 Content Quiz Topic 2.1 Learning Activity
Outline the regulations and standards requirements regarding residential fire and smoke alarms.	17.2	-	-	33, 35, 53	
Describe suitable locations for residential fire and smoke alarms.	17.3	-	-	33, 35, 53	
Describe the operation of typical residential fire and smoke alarms.	17.5, 21	-	-	33, 35, 53	
2.2 Smoke Alarm Wiring Configurations					
Knowledge					
Describe suitable wiring methods for residential fire and smoke alarms.	11.3, 17.4, 21	-	-	33, 35, 53	Topic 2 Content Quiz Topic 2.2 Learning Activity
Skills					
Apply wiring methods required for residential fire and smoke alarms.	11.3, 17.4, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.6, 3.1, 3.2, 3.4	1, 2, 4.1, 5, 8, 11, 12	33, 34, 35, 36, 37, 53	Topic 2.2 Skills Practice

2 Residential Fire and Smoke Alarms

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)
- National Construction Code – Volume 2 (current edition)
- AS 1670.6 Fire detection, warning, control and intercom systems – System design, installation and commissioning – Smoke Alarms (current edition)

Equipment:

- Appropriate cabling
- Fire and smoke alarms
- Clips and screws, etc.
- Hand tools and PPE

3 Emergency and Evacuation Lighting					
Purpose:	In this topic you will investigate the operation and installation of emergency and evacuation lighting.				
Duration:	This topic represents around 10 % of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Emergency Evacuation Lighting Requirements					
Knowledge					
State the factors and requirements of emergency and evacuation lighting including: • Minimum illumination levels • Minimum operating periods • Luminaire positioning	6.1, 11.1, 11.2, 13	-	-	35, 53	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe the characteristics of maintained, non-maintained and sustained emergency lighting systems.	6.2, 11.1, 11.2, 21	-	-	53	
3.2 Emergency Evacuation Lighting Systems					
Knowledge					
Describe the arrangement of batteries in point and central bank emergency supply systems.	6.3, 11.1, 11.2	-	-	35, 53	Topic 3 Content Quiz Topic 3.2 Learning Activity
Outline emergency and evacuation lighting control methods.	6.4, 11.1, 11.2, 19	-	-	41, 53	
Describe the operation and expected input/output parameters of rectifiers and inverters used in emergency and evacuation lighting battery charging systems.	19	-	-	51, 53, 54	

3 Emergency and Evacuation Lighting

Skills					
Demonstrate emergency and evacuation lighting control methods.	6.1, 6.2, 6.3, 6.4, 11.1, 11.2, 13, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.3, 2.6, 3.1, 3.2, 3.4	1, 3, 10, 11, 12	53	Topic 3.2 Skills Practice

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)
- AS 2293 (Series) Emergency escape lighting and escape signs for buildings (current editions)
- National Construction Code – Volume 1 (current edition)

Equipment:

- Emergency lighting system
- Centralised test module
- Lux meter
- Stop watch

4 Fundamental Lighting Concepts					
Purpose:	In this topic you will investigate the basic lighting concepts and incandescent lighting.				
Duration:	This topic represents around 13.3 % of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Lighting Concepts					
Knowledge					
Describe the basic concepts of lighting, including: - Terminology - Colour theory	7.1, 7.2, 7.3	-	-	53	Topic 4 Content Quiz Topic 4.1 Learning Activity
Define appropriate terminology, principles and standards relevant to lighting (energy efficiency as per National Construction Code requirements).	9, 21	-	-	53	
4.2 Types of Luminaires					
Knowledge					
Identify the basic types of luminaires.	7.3, 10.1	-	-	53	Topic 4 Content Quiz Topic 4.2 Learning Activity
Describe the operation of an incandescent lamp.	10.2	-	-	53	
Identify the available types of incandescent lamps.	10.1	-	-	53	
List the expected lamp life, colour rendering and efficacy for typical incandescent lamps.	10.3, 21	-	-	53	
4.3 Lighting Layouts					
Knowledge					
Describe the factors to consider in designing a	12, 13, 21	-	-	53	Topic 4 Content Quiz

4 Fundamental Lighting Concepts					
lighting layout in terms of visual comfort and relevant Australian Standards.					Topic 4.3 Learning Activity
Skills					
Evaluate a lighting layout in terms of visual comfort and relevant Australian Standards.	10.1, 11.1, 12, 13, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.6, 3.1, 3.2, 3.4	1, 3, 11, 12	53	Topic 4.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) - National Construction Code – Volume 1 (current edition) Equipment: - Lighting installation - Lux meter - Measuring tape					

5 Low Intensity Discharge Lighting					
Purpose:	In this topic you will investigate the various low intensity discharge lighting types.				
Duration:	This topic represents around 13.3 % of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Low Intensity Discharge Luminaires					
Knowledge					
List the commonly available types of low intensity discharge lamps.	10.1, 11.1, 11.2, 21	-	-	53	Topic 5 Content Quiz Topic 5.1 Learning Activity
List the expected lamp life, colour rendering and efficacy of low intensity discharge lamps.	10.3, 11.1, 11.2, 21	-	-	53	
Describe the operation of low intensity discharge luminaires including their control equipment.	10.2, 11.1, 11.2, 21	-	-	53	
5.2 Low Intensity Discharge Lighting Requirements					
Knowledge					
Outline Australian Standards and local requirements for low intensity discharge lighting and associated methods of compliance.	8, 13	-	-	13, 27, 65	Topic 5 Content Quiz Topic 5.2 Learning Activity
Skills					
Install and connect low intensity discharge luminaires and associated circuits in accordance with Australian Standards and local requirements.	8, 11.1, 11.2, 13, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.6, 3.1, 3.2, 3.4	1, 2, 4.1, 5, 8, 10, 11, 12	33, 34, 35, 36, 37, 53	Topic 5.2 Skills Practice
Reference Text: Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill					

5 Low Intensity Discharge Lighting

- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)

Equipment:

- Light switches
- Fluorescent luminaires
- TPI/TPS cables
- Various accessories and fixings
- Test equipment

6 High Intensity Discharge Lighting

Purpose:	In this topic you will investigate the various types of high intensity discharge lighting systems.				
Duration:	This topic represents around 13.3 % of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 HID Luminaires and Requirements					
Knowledge					
List the commonly available types of high intensity discharge lamps.	10.1, 11.1, 11.2, 21	-	-	53	Topic 6 Content Quiz Topic 6.1 Learning Activity
List the expected lamp life, colour rendering and efficacy for typical types of high intensity discharge lamps.	10.3, 11.1, 11.2, 21	-	-	53	
Describe the operation of high intensity discharge luminaires including their control equipment.	10.2, 11.1, 11.2, 21	-	-	53	
Outline Australian Standards and local requirements for high intensity discharge lighting and associated methods of compliance.	8	-	-	53	
Skills					
Connect high intensity discharge lighting circuits in accordance with Australian Standards and local requirements.	8, 11.1, 11.2, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.6, 3.1, 3.2, 3.4	1, 2, 4.1, 5, 8, 10, 11, 12	33, 34, 35, 36, 37, 53	Topic 6.1 Skills Practice
6.2 LED Lighting					
Knowledge					
List the commonly available types of LED lighting.	10.1, 11.1, 11.2, 11.3,	-	-	53	Topic 6 Content Quiz

6 High Intensity Discharge Lighting					
	14, 21				Topic 6.2 Learning Activity
List the expected lamp life, colour rendering and efficacy of LED lighting.	10.3, 11.1, 11.2, 11.3, 14, 21	-	-	53	
Describe the operation of LED lighting.	10.2, 11.1, 11.2, 11.3, 14, 21	-	-	53	
State the typical applications of LED lighting.	11.1, 11.2, 11.3, 14	-	-	53	
Skills					
Connect LED lighting circuits.	11.3, 14, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.6, 3.1, 3.2, 3.4	1, 2, 4.1, 5, 8, 10, 11, 12	33, 34, 35, 36, 37, 53	Topic 6.2 Skills Practice
6.3 Other Types of Lighting					
Knowledge					
Describe Neon, Argon and Xenon lighting.	11.1, 15, 21	-	-	53	Topic 6 Content Quiz Topic 6.3 Learning Activity
List the applications of Neon, Argon and Xenon lighting.	11.1, 15, 21	-	-	53	
Skills					
Compare and contrast the characteristics and features of incandescent, low intensity discharge, high intensity discharge, LED and other types of lighting.	10.1, 10.3, 11.1, 11.2, 11.3, 16, 21	-	-	53	Topic 6 Content Quiz Topic 6.3 Learning Activity
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education					

6 High Intensity Discharge Lighting

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)

Equipment:

- Light switches
- TPS/TPI cables
- Various accessories and fixings
- Test equipment.
- Various types lighting

7 Fault Finding Lighting Circuits					
Purpose:	In this topic you will learn about the various faults found in lighting circuits and the methods used to find and repair these faults using systematic troubleshooting techniques.				
Duration:	This topic represents around 13.3 % of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Common Faults and Symptoms					
Knowledge					
List the common faults and associated symptoms that occur in lighting circuits and equipment, including: • Open-circuits • Short-circuits • Incorrect connections • Component/mechanical faults • Supply faults • Operator faults	18.1	-	-	53, 54	Topic 7 Content Quiz Topic 7.1 Learning Activity
List the common causes of faults in lighting circuits and luminaires including: • Transformer (iron core or electronic) • Voltage drop • Heat • Over-voltage • Poor connections • Incompatible dimmers	18.2	-	-	53, 54	
7.2 Fault Finding Techniques					
Knowledge					
List the causes of wiring faults from supplied	18.1	-	-	53, 54	Topic 7 Content Quiz

7 Fault Finding Lighting Circuits					
symptoms and circuit and/or wiring diagrams.					Topic 7.2 Learning Activity
Describe techniques for locating and repairing faults in low voltage lighting circuits and associated equipment, including sectional/split-half testing.	18.1, 18.2, 18.3	-	-	30, 53, 54	
Skills					
Identify and repair faults in domestic, commercial and industrial lighting circuits.	5, 11.1, 11.2, 11.3, 18.1, 18.2, 18.3, 19, 20, 21	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4	1, 2, 3, 5, 6, 7, 9, 10, 11, 12	30, 53, 54	Topic 7.2 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Jenneson, J. and Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning - Phillips, P., Electrical Principles, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) - AS/NZS 3017 Verification guidelines (current edition) Equipment: - One-way, two-way and intermediate switched lighting circuits - Lighting circuits controlled by dimmers - Lighting circuits controlled by PIR sensors - Lighting circuits controlled by PE cells - Lighting circuits with fault switches					

7 Fault Finding Lighting Circuits

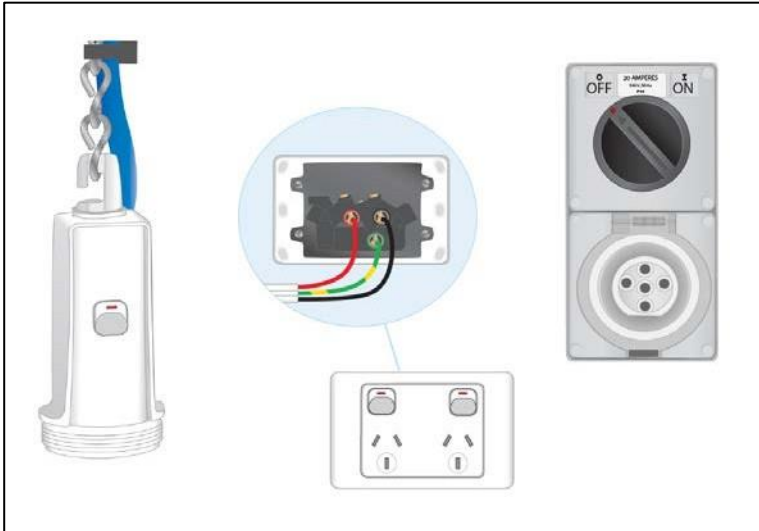
- Variety of luminaires
- Variety of test equipment (e.g. IR testers, multimeters)
- Lux meter
- Hand tools and PPE

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0010 – Evaluate and modify low voltage socket outlets
circuits



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Socket Outlets	5
1.1 Types of Socket Outlets	5
1.2 Socket Outlet Requirements	5
2 Circuits Supplying Socket Outlets	7
2.1 Socket Outlet Circuits	7
2.2 Mixed Circuits	8
2.3 Circuit Segregation	8
3 Fault Finding Socket Outlets Circuits	10
3.1 Common Faults and Symptoms	10
3.2 Fault Finding Techniques	10

A. Overview		
Competency Standard Unit (CSU)	UEEEL0010 Evaluate and modify low voltage socket outlets circuits	
CSU Application	This unit involves the skills and knowledge required to evaluate and modify low voltage (LV) socket outlets circuits. It includes working safely, identifying and repairing/replacing faulty socket outlets, ensuring all work complies with relevant Australian Standards and legislation, and completing work and documenting activities. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0010	Performance Criteria
	KE-UEEEL0010	Knowledge Evidence
	PE-UEEEL0010	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 3	8 hours
	Completion of Unit Knowledge Test	30 minutes
	Completion of Unit Skills Test	1.5 hours
	Total duration of structured learning program	10 hours

	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits <i>In addition, whilst not listed as a pre-requisite in the unit of competency, it is recommended that the learner has met the requirements of:</i> • <i>UEEEL0009 Evaluate and modify low voltage lighting circuits, equipment and controls</i>

B. Knowledge and Skills Delivery

1 Socket Outlets

Purpose:	In this topic you will investigate the different types, applications and requirements for single and three phase socket outlets.
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the objectives.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Types of Socket Outlets					
Knowledge					
State the purpose of socket outlets within an electrical installation.	1.1	-	-	-	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the features and applications of the different types of single and three phase socket outlets including: 10 A, 15 A, 20 A and 32 A socket outlets - Three, four and five pin socket outlets - Pendant socket outlets - Socket outlets for vehicle charging	1.1, 1.10, 5	-	-	34, 39	
1.2 Socket Outlet Requirements					
Knowledge					
Describe the socket configurations and wiring connections for socket outlets.	3.1, 5	-	-	40	Topic 1 Content Quiz Topic 1.2 Learning Activity
State the requirements concerning the polarity and phase rotation of switched socket outlets.	1.2, 1.3	-	-	30	
State the requirements for RCD protection of socket outlets.	1.8	-	-	23	

1 Socket Outlets					
Explain correct operation of the circuits and tests required to comply with Australian Standards.	1.7	-	-	30	
Describe the guidance provided in the Wiring Rules relating to the installation and location of socket outlets for vehicle charging purposes.	1.10	-	-	34	
Skills					
Test the polarity of a single phase socket outlet.	1.2, 5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3	1, 2, 3, 9, 10, 13	30	Topic 1.2 Skills Practice
Test the polarity and phase rotation of a three phase socket outlet.	1.3, 5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3	1, 2, 3, 9, 13	30	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					
Standards and Codes: • AS/NZS 3000 Wiring Rules					
Equipment: • Range of single and three phase socket outlets • Test equipment – digital multimeter, phase rotation meter					

2 Circuits Supplying Socket Outlets					
Purpose:	In this topic you will investigate the wiring and requirements of final subcircuits supplying socket outlets, including considerations and requirements for mixed circuits and segregation of wiring systems.				
Duration:	This topic represents around 30% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Socket Outlet Circuits					
Knowledge					
List the types of accessories and installation methods used to install socket outlets circuits.	1.6	-	-	34, 35	Topic 2 Content Quiz Topic 2.1 Learning Activity
List the types of supports required for pendant socket outlets.	1.9	-	-	39	
State the minimum acceptable cable sizes for the supply of 10 A, 15 A, 20 A and 32 A single and three phase socket outlets for different installation conditions.	1.4	-	-	22, 23	
State the maximum number of socket outlets to be connected to 16 A and 20 A circuit breakers as per guidance tables provided in the Wiring Rules.	1.5, 1.8	-	-	22	
Skills					
Install and connect single and three phase socket outlets circuits, including at least one pendant socket outlet.	1.6, 1.9, 3.1, 5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.6, 3.1, 3.2, 3.4	1, 5, 8, 13	32, 33, 34, 35, 36, 37, 39	Topic 2.3 Skills Practice
Confirm the correct operation of single and three phase socket outlets circuits and verify compliance with Wiring Rules requirements for earth	1.2, 1.3, 1.7, 5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3	1, 2, 9, 10, 12, 13	30	

2 Circuits Supplying Socket Outlets					
continuity, insulation resistance and polarity.					
2.2 Mixed Circuits					
Knowledge					
Describe the purpose and common applications of mixed circuits.	2.1	-	-	-	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe the common arrangements, loading and installation requirements for mixed circuits.	2.2, 2.4, 2.5	-	-	22, 23	
Skills					
Determine the circuit loading for a mixed circuit.	2.2	-	5, 12	22, 23	Topic 2 Content Quiz Topic 2.2 Learning Activity Topic 2.3 Skills Practice
2.3 Circuit Segregation					
Knowledge					
State the purpose of circuit segregation and the associated Wiring Rules requirements.	2.3	-	-	36	Topic 2 Content Quiz Topic 2.3 Learning Activity
Skills					
Install a single phase mixed circuit supplying socket outlets and lighting.	2.4, 3.1, 5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.6, 3.1, 3.2, 3.4	1, 4, 5, 7, 13	32, 33, 34, 35, 36, 37	Topic 2.3 Skills Practice
Confirm the correct operation of the mixed circuit and verify compliance with Wiring Rules requirements for earth continuity, insulation resistance and polarity.	2.5, 5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3	1, 2, 9, 10, 12, 13	30	
Reference Text:					
• Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					

2 Circuits Supplying Socket Outlets

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)
- AS/NZS 3017 Verification guidelines (current edition)

Equipment:

- Single and three phase socket outlets
- TPS cabling
- Protection devices (e.g. RCBOs)
- Any other required accessories
- Clips and screws etc.
- Batten holders
- Light switch

3 Fault Finding Socket Outlets Circuits					
Purpose:	In this topic you will learn about the various faults found in socket outlets circuits and the methods used to find and repair these faults using systematic troubleshooting techniques.				
Duration:	This topic represents around 30% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Common Faults and Symptoms					
Knowledge					
List the common faults and associated symptoms that occur in socket outlets circuits, including: • Open-circuits • Short-circuits • Incorrect connections • Supply faults • Operator faults • Earth leakage	3.2, 3.3	-	-	54	Topic 3 Content Quiz Topic 3.1 Learning Activity
3.2 Fault Finding Techniques					
Knowledge					
Describe the methods of identifying a portable appliance that is causing an RCD to trip.	3.4, 3.5	-	-	54	Topic 3 Content Quiz Topic 3.2 Learning Activity
Describe the techniques for locating and repairing faults in single and three phase socket outlets circuits.	3.4	-	-	30, 54	
State the hazards and safety requirements related to equipment incorporating electronic components used in electrical systems.	4	-	-	51	

3 Fault Finding Socket Outlets Circuits

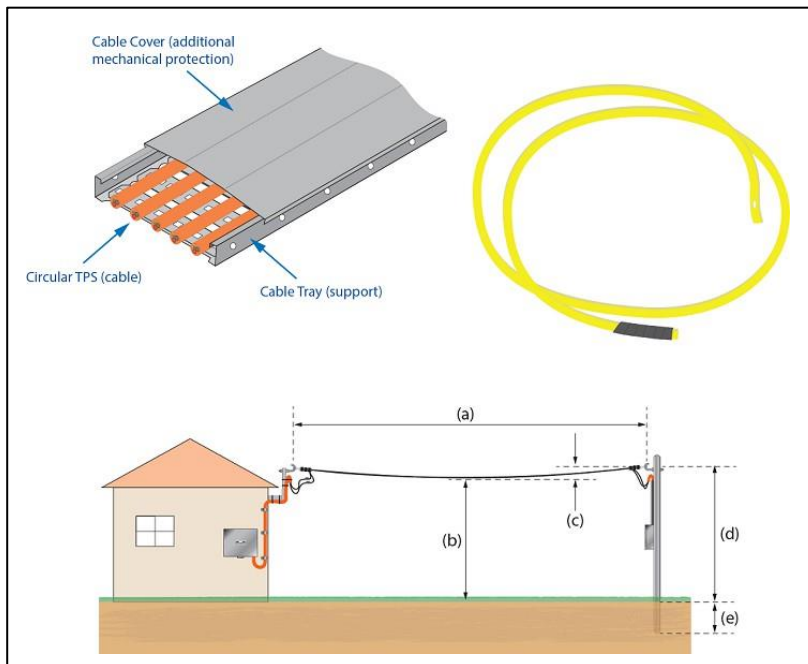
Skills					
Identify and repair faults in single and three phase socket outlets circuits.	3.1, 3.2, 3.3, 3.4, 3.5, 5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4	1, 2, 3, 6, 10, 11, 12, 13	30, 54	Topic 3.2 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning - Phillips, P., Electrical Principles, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) - AS/NZS 3017 Verification guidelines (current edition) Equipment: - Socket outlets circuits with fault switches - Variety of socket outlets - Variety of test equipment (e.g. IR testers, multimeters) - Hand tools and PPE					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0012 – Install low voltage wiring, appliances, switchgear and associated accessories



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Building Codes and Heritage Requirements	5
1.1 Building Code of Australia	5
1.2 Safety Service Requirements	6
1.3 Heritage Buildings and Premises	6
2 Wiring Rules Requirements	8
2.1 Protection and Control	8
2.2 Low Voltage Wiring Systems	8
2.3 Wiring Systems Requirements	9
2.4 Low Voltage Equipment	9
3 Special Electrical Installations	11
3.1 Medical Treatment Areas	11
3.2 Construction and Demolition Sites	11
3.3 Relocatable Installations	12
3.4 Caravan Parks	12
3.5 Marinas and Boats	12
3.6 Shows and Carnivals	13
3.7 Alternative Supply Systems	13
4 Hazardous Areas	15
4.1 Classification of Hazardous Areas	15
4.2 Hazardous Area Wiring Standards	15
5 Damp Situations and ELV Installations	17
5.1 Damp Situations Electrical Installations	17
5.2 ELV Electrical Installations	18
6 Aerial Cabling	19
6.1 Aerial Cables	19
6.2 Aerial Cabling Requirements	19
6.3 Catenary Wiring Systems	20
7 Underground Cabling	22
7.1 Underground Wiring Systems	22
7.2 Underground Cabling Requirements	22
8 Techniques for Installing Wiring Systems	24
8.1 Cable Routes	24
8.2 Fire Rating Integrity	25
8.3 Wiring Systems Inspection and Testing	25
9 Equipment Terminal Configurations	27
9.1 Cooking and Heating Appliances	27
9.2 Single and Three Phase Motors	27
9.3 Single and Three Phase Transformers	28
9.4 Socket Outlets	28
9.5 Luminaires and Lamp Holders	28
9.6 Switchgear and Controlgear	29
9.7 Connection of Wiring at Switchboards	29

A. Overview		
Competency Standard Unit (CSU)	UEEEL0012 Install low voltage wiring, appliances, switchgear and associated accessories	
CSU Application	This unit includes the installation of wiring enclosures, cable support systems, cables, protection devices, switchgear, control gear, switchboards, and accessories designed to operate at voltages up to 1,000 volt (V) alternating current (a.c.) or 1,500 V direct current (d.c.). It covers working safely and to installation standards, routing cables to specified locations, terminating cables and connecting wiring at accessories, matching appliances and accessories with that specified, making required circuit connections and completing the necessary installation documentation. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 V a.c. or 120 V d.c. Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0012	Performance Criteria
	KE-UEEEL0012	Knowledge Evidence
	PE-UEEEL0012	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 9	35 hours
	Completion of Unit Knowledge Test	2 hours
	Completion of Unit Skills Test	3 hours

	Total duration of structured learning program	40 hours
	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0003 Arrange circuits, control and protection for electrical installations • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits • UEEEL0018 Select wiring systems and select cables for low voltage electrical installations • UEEEL0005 Develop and connect electrical control circuits • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0014 Isolate, test and troubleshoot low voltage electrical circuits • UEEEL0008 Evaluate and modify low voltage heating equipment and controls • UEEEL0009 Evaluate and modify low voltage lighting circuits, equipment and controls • UEEEL0010 Evaluate and modify low voltage socket outlets circuits • UEEEL0024 Test and connect alternating current (a.c.) rotating machines • UEEEL0025 Test and connect transformers and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits	

B. Knowledge and Skills Delivery

1 Building Codes and Heritage Requirements

Purpose:	In this topic you will learn about the building codes and heritage regulations that affect the installation of low voltage wiring and equipment in buildings, structures and premises.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Building Code of Australia					
Knowledge					
List the Building Codes that affect the installation of low voltage wiring and equipment in buildings, structures and premises, including: - Limitation on penetration of structural elements - Maintaining the integrity of fire barriers - Wiring above suspected ceilings	1.5	-	-	10, 36	Topic 1 Content Quiz Topic 1.1 Learning Activity
Skills					
Apply building code requirements for the installation of low voltage wiring and equipment in buildings/structures/premises.	1.5, 2.1	-	1, 2, 9, 10, 12, 13, 15	10, 36	Topic 1.1 Skills Practice
Reinstate the integrity of fire barriers.	1.5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4, 3.5,	17	10, 36	

1 Building Codes and Heritage Requirements					
		3.6, 4.1, 4.2, 4.3			
1.2 Safety Service Requirements					
Knowledge					
Describe the Building Code requirements for safety services in buildings, structures and premises.	1.5	-	-	29	Topic 1 Content Quiz Topic 1.2 Learning Activity
1.3 Heritage Buildings and Premises					
Knowledge					
Describe the features of heritage buildings and premises.	1.6	-	-	-	Topic 1 Content Quiz Topic 1.3 Learning Activity
List the various codes and regulations concerning the installation of electrical equipment in heritage buildings and premises.	1.6	-	-	-	
Describe the limitations on type and colour of exposed accessories in heritage buildings, structures and premises.	1.6	-	-	34	
Describe the methods employed in installing electrical equipment in heritage buildings and premises.	1.6	-	-	36	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					
Standards and Codes: - AS/NZS 3000 Wiring Rules – current edition - National Construction Code (Volumes 1 and 2) – current edition					

1 Building Codes and Heritage Requirements

- Environment Protection and Biodiversity Conservation Act 1999
- State/Territory Heritage Legislation and Regulations

Equipment:

- Fire-rated wall
- Socket-outlets
- Fire-rated wall boxes
- Fire-rated mastic
- Low voltage cabling
- 2.5 mm² twin and earth TPS (suggested)
- Suitable cable supports/enclosures
- PPE
- Hand tools

2 Wiring Rules Requirements					
Purpose:	In this topic you will learn about the Wiring Rules installation requirements for low voltage wiring, accessories and current-using equipment.				
Duration:	This topic represents around 7.5% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Protection and Control					
Knowledge					
Explain the methods of protection against thermal effects used in low voltage installations.	1.7	-	-	23	Topic 2 Content Quiz Topic 2.1 Learning Activity
Explain the methods of overcurrent and RCD protection used in low voltage installations.	1.9	-	-	23	
Describe the various methods of control and switching used for low voltage equipment.	1.9	-	-	23	
State the requirements for equipotential bonding in low voltage installations.	1.10	-	-	16	
Skills					
Identify and apply Wiring Rules requirements for protection and control of low voltage electrical installations.	1.7, 1.9, 1.10	-	-	23	Topic 2 Content Quiz Topic 2.1 Learning Activity
2.2 Low Voltage Wiring Systems					
Knowledge					
List the types of cables, supports, enclosures and methods of mechanical protection used for low voltage wiring systems, as specified in the Wiring Rules.	1.1	-	-	36	Topic 2 Content Quiz Topic 2.2 Learning Activity

2 Wiring Rules Requirements					
2.3 Wiring Systems Requirements					
Knowledge					
List prohibited cable locations in an installation.	1.3	-	-	36	Topic 2 Content Quiz Topic 2.3 Learning Activity
Explain the protection methods against and from other services in an installation.	1.2	-	-	36	
Explain the use of space factors for sizing of wiring enclosures.	1.11	-	-	36	
Skills					
Identify and apply Wiring Rules requirements for the installation of low voltage wiring, including the application of space factors for sizing wiring enclosures.	1.1, 1.2, 1.3, 1.11	-	-	36	Topic 2 Content Quiz Topic 2.3 Learning Activity
2.4 Low Voltage Equipment					
Knowledge					
Explain the considerations for protection against the thermal effects of electrical equipment.	1.8	-	-	23	Topic 2 Content Quiz Topic 2.4 Learning Activity
Describe the required and permitted locations for current-using equipment and accessories used in low voltage installations.	1.8	-	-	35	
List the relevant AS/NZS 3000 clauses for the installation of electrical equipment including: ○ Appliances ○ Accessories ○ Switchgear and control-gear ○ Switchboards ○ Socket-outlets ○ Lighting equipment and accessories ○ Lamps and luminaires	1.8	-	-	35	

2 Wiring Rules Requirements					
○ Smoke and fire detectors ○ Cooking appliances ○ Appliances producing hot water or steam ○ Room heaters ○ Electric heating cables ○ Trace heating ○ Duct heaters ○ Electricity convertors ○ Motors ○ Transformers ○ Capacitors ○ Batteries					
Skills					
Identify and apply Wiring Rules requirements for the installation of low voltage current-using equipment.	1.8	-	-	23, 35	Topic 2 Content Quiz Topic 2.4 Learning Activity
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: • AS/NZS 3000 Wiring Rules (current edition)					

3 Special Electrical Installations					
Purpose:	In this topic you will learn about the various standards for electrical installations in special situations.				
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Medical Treatment Areas					
Knowledge					
Describe the standards that apply to medical treatment areas.	4.1	-	-	29	Topic 3 Content Quiz Topic 3.1 Learning Activity
Skills					
Use the relevant standards for electrical installations in patient treatment areas.	4.1	-	-	29	Topic 3.1 Skills Practice
3.2 Construction and Demolition Sites					
Knowledge					
Describe the additional standards requirements for construction and demolition sites, including: • Site supply • Switchboards • Circuit protection • Construction wiring • Lighting • Socket outlets • Lifts circuits	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7	-	-	26	Topic 3 Content Quiz Topic 3.2 Learning Activity
Describe the requirements for periodic inspection and testing of in-service electrical equipment on construction and demolition sites.	5.8, 5.9, 5.10	-	-	26	

3 Special Electrical Installations					
Skills					
Use the relevant standards for electrical installations on construction and demolition sites.	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10	-	-	26	Topic 3.2 Skills Practice
3.3 Relocatable Installations					
Knowledge					
Describe the standards associated with relocatable installations.	4.3	-	-	29	Topic 3 Content Quiz Topic 3.3 Learning Activity
Skills					
Use the relevant standards for relocatable electrical installations.	4.3	-	-	29	Topic 3.3 Skills Practice
3.4 Caravan Parks					
Knowledge					
Describe the additional standards requirements for caravan parks.	4.3	-	-	29	Topic 3 Content Quiz Topic 3.4 Learning Activity
Skills					
Use the relevant standards for electrical installations in caravan parks.	4.3	-	-	29	Topic 3.4 Skills Practice
3.5 Marinas and Boats					
Knowledge					
Describe the additional standards requirements for electrical installations in marinas and low voltage pleasure craft.	4.2	-	-	29	Topic 3 Content Quiz Topic 3.5 Learning Activity
Skills					
Use the relevant standards for marinas and	4.2	-	-	29	Topic 3.5 Skills Practice

3 Special Electrical Installations					
pleasure craft installations.					
3.6 Shows and Carnivals					
Knowledge					
Describe the additional standards requirements for shows and carnivals electrical installations.	4.4	-	-	29	Topic 3 Content Quiz Topic 3.6 Learning Activity
Skills					
Use the relevant standards for electrical installations for shows and carnivals.	4.4	-	-	29	Topic 3.6 Skills Practice
3.7 Alternative Supply Systems					
Knowledge					
Explain the hazards posed by alternative supply systems in electrical installations	1.4	-	-	55	Topic 3 Content Quiz Topic 3.7 Learning Activity
Explain how to identify alternative supply systems in electrical installations	1.4	-	-	55	
Describe the additional standards requirements for alternative supply systems.	4.5	-	-	55	
Skills					
Identify alternative supply system arrangements and associated standards.	1.4, 4.5	-	-	55	Topic 3.7 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) - AS/NZS 3008.1.1 Electrical Installations – Selection of Cables (current edition) - AS/NZS 3001 Electrical installations – Relocatable premises (current edition)					

3 Special Electrical Installations

- AS/NZS 3004 Electrical installations – Marinas and boats (current edition)
- AS/NZS 3002 Electrical installations – Shows and carnivals (current edition)
- AS/NZS 3012 Electrical installations – Construction and demolition sites (current edition)
- AS/NZS 3010 Electrical installations – Generating sets (current edition)
- AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays (current edition)
- AS/NZS 4777 (series) Grid connection of energy systems via inverters (current edition)

4 Hazardous Areas					
Purpose:	In this topic you will learn about wiring in hazardous areas, including the installation conditions, classification of hazardous areas and the relevant wiring standards.				
Duration:	This topic represents around 2.5% of the knowledge and skills specification contents, and should take the learner approximately 1 hour to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Classification of Hazardous Areas					
Knowledge					
State the conditions that apply for equipment and installations in areas that are deemed as 'hazardous'.	6.2	-	-	28	Topic 4 Content Quiz Topic 4.1 Learning Activity
State the responsible person for classifying a hazardous area.	6.3	-	-	28	
4.2 Hazardous Area Wiring Standards					
Knowledge					
Describe the additional training required to work competently with electrical equipment for hazardous areas.	6.1	-	-	28	Topic 4 Content Quiz Topic 4.2 Learning Activity
State the AS/NZS 3000 Wiring Rules requirements for selection, installation, inspection and maintenance of electrical equipment in hazardous areas.	6.4	-	-	28	
Skills					
Apply AS/NZS 3000 requirements for the selection, installation, inspection and maintenance of electrical equipment in hazardous areas.	6.4	-	-	28	Topic 4.2 Skills Practice

4 Hazardous Areas

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)
- AS/NZS 60079 (Series) Explosive atmospheres (current edition)

5 Damp Situations and ELV Installations					
Purpose:	In this topic you will learn about how the various requirements for wiring systems used for damp situations and ELV installations.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Damp Situations Electrical Installations					
Knowledge					
Explain the restricted zones for a given installation including: - Baths. - Showers. - Fixed water containers. - Pools. - Fountains and water features. - Saunas. - Refrigeration rooms. - Sanitization/hosing down areas.	7.1	-	-	25	Topic 5 Content Quiz Topic 5.1 Learning Activity
Describe the methods of enhanced protective measures required in damp situations, including the use of RCDs.	7.2, 7.4	-	-	25	
State the requirements for equipotential bonding in showers, bathrooms, swimming and spa pools.	7.7	-	-	25	
Skills					
Select equipment suitable for installation in given damp situations.	7.1, 7.2	1.1, 1.7, 1.8	1, 11	25	Topic 5.1 Skills Practice

5 Damp Situations and ELV Installations					
5.2 ELV Electrical Installations					
Knowledge					
Describe voltage range that defines extra-low voltage.	7.3	-	-	20	Topic 5 Content Quiz Topic 5.2 Learning Activity
Explain 'Separated extra-low voltage (SELV) systems' and 'Protected extra-low voltage' (PELV) systems.	7.5	-	-	20	
State the AS/NZS 3000 requirements for selecting extra-low voltage systems and devices for a range of installations and conditions.	7.6	-	-	20	
Skills					
Using AS/NZS 3000, select extra-low voltage systems and devices for a range of installations and conditions.	7.6	1.1, 1.7, 1.8	1	20	Topic 5.2 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) - AS/NZS 3008.1.1 (current edition) Equipment: - Manufacturer's catalogues (ELV equipment, water resistant equipment)					

6 Aerial Cabling

Purpose:	In this topic you will learn the various methods of installing and terminating aerial cabling systems for services, consumer's mains and the relevant Australian Standards and local service rules applying to aerial cabling systems.
Duration:	This topic represents around 7.5% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Aerial Cables					
Knowledge					
Describe the various types and applications of aerial cables.	8.2	-	-	27	Topic 6 Content Quiz Topic 6.1 Learning Activity
State the AS/NZS 3000 and local supply authority requirements for aerial cables.	8.1	-	-	27	
6.2 Aerial Cabling Requirements					
Knowledge					
State the AS/NZS 3000 requirements relating to spans and clearances of aerial wiring systems.	8.1, 8.3	-	-	27	Topic 6 Content Quiz Topic 6.2 Learning Activity
State the AS/NZS 3000 and local requirements for the termination of aerial cables.	8.1, 8.9	-	-	27	
State the AS/NZS 3000 and local requirements for the installation of consumer mains for connection via overhead consumer terminals.	8.1, 8.11	-	-	27	
State the AS/NZS 3000 and local requirements for testing of installed cables.	8.1, 8.10	-	-	27	
Skills					
Select aerial supporting poles/post and struts for given applications.	8.1, 8.4	1.1, 1.7, 1.8	1	27	Topic 6 Content Quiz

6 Aerial Cabling					
Perform the termination of aerial cables in accordance with AS/NZS 3000 and local requirements.	8.1, 8.9	2.3, 2.6	13	27	Topic 6.2 Learning Activity Topic 6.2 Skills Practice
Install consumer mains for connection via overhead consumer terminals in accordance with AS/NZS 3000 and local requirements.	8.1, 8.11	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8 ,1.9, 1.10, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 4.1, 4.2, 4.3	1, 5, 6, 8	27	
Test installed cables to verify compliance with Australian Standards.	2.6, 8.1, 8.10	2.4, 2.5	16	27, 30	
6.3 Catenary Wiring Systems					
Knowledge					
Describe the various types of catenary wiring systems	8.1, 8.5	-	-	32, 39	Topic 6 Content Quiz Topic 6.3 Learning Activity
Describe the accessories/equipment used with catenary wiring systems	8.1, 8.5	-	-	33, 39	
State the Australian Standard requirements for the installation of catenary wiring systems	8.1, 8.5	-	-	35, 39	
Skills					
Install a catenary wiring system and test to verify it is safe and operates as intended.	2.6, 8.1, 8.5	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8 ,1.9, 1.10, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 4.1, 4.2, 4.3	1, 5, 8, 13, 16	30, 35, 39	Topic 6.3 Skills Practice

6 Aerial Cabling

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)
- AS/NZS 3008.1.1 Electrical installations – Selection of cables (current edition)
- Local Service and Installation Rules (SIR)

Equipment:

- Riser bracket(s)
- Aerial cabling
- Service connectors
- Consumer mains cabling
- Wiring enclosure/support
- 25 mm² LV Al ABC (suggested)
- 16 mm² X90-UV SDI (suggested)
- HD PVC conduit – rigid and corrugated (suggested)
- Al-Cu IPCs (suggested)
- Flat/circular TPS cables
- Flexible cords/cables
- PVC cable ties and jack chain
- Pendant socket-outlets
- Multimeter and insulation resistance tester
- Hand tools
- PPE

7 Underground Cabling					
Purpose:	In this topic you will learn about the installation of underground cabling systems for services, consumer's mains and the relevant Australian Standards and local service rules.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Underground Wiring Systems					
Knowledge					
Describe permissible underground cabling systems.	8.1, 8.6, 8.7	-	-	27	Topic 7 Content Quiz Topic 7.1 Learning Activity
Describe the process to identify other underground services.	8.8	-	-	27	
State the AS/NZS 3000 requirements for segregation of underground cabling from other services.	8.1, 8.8	-	-	27	
Skills					
Identify underground services and associated minimum clearances from low voltage underground wiring systems.	8.8	1.1	1, 3	27	Topic 7.1 Skills Practice
7.2 Underground Cabling Requirements					
Knowledge					
Describe the selection process for underground consumer mains in accordance with AS/NZS 3000 and local requirements.	8.1, 8.11	-	-	27	Topic 7 Content Quiz Topic 7.2 Learning Activity
Skills					
Select underground consumer mains in accordance with AS/NZS 3000 and local	8.1, 8.11	1.1, 1.7, 1.8	4	27	Topic 7.2 Skills Practice

7 Underground Cabling

requirements.

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules (current edition)
- AS/NZS 3008.1.1 Electrical installations – Selection of cables (current edition)
- Local Service and Installation Rules (SIR)

Equipment:

- Plans of underground infrastructure
- Manufacturer's catalogues

8 Techniques for Installing Wiring Systems					
Purpose:	In this topic you will learn about the various requirements for the installation of wiring systems in buildings and premises.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Cable Routes					
Knowledge					
Describe the typical cable routes through buildings, structures and premises.	2.1	-	-	36	Topic 8 Content Quiz Topic 8.1 Learning Activity
List the applications for various accessories used with low voltage wiring systems.	2.2	-	-	34	
Explain the process of drawing-in, placing and fixing of cables.	2.3	-	-	36	
Describe the requirements and techniques for termination of cables and conductors.	2.4	-	-	33	
Skills					
Install and secure cables on cable tray.	2.2	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 2.1, 2.2, 2.6	1, 2, 5, 7, 8, 9	36	Topic 9.7 Skills Practice 1 Topic 9.7 Skills Practice 2
Demonstrate the drawing-in, placing and fixing of cables.	2.3	2.1, 2.2	1, 2, 5, 7, 8, 9	36	
Demonstrate the termination of cables and conductors.	2.4	2.3	1, 2, 5, 8, 13	33	

8 Techniques for Installing Wiring Systems					
8.2 Fire Rating Integrity					
Knowledge					
Describe the methods of maintaining fire rating integrity.	2.5	-	-	36	Topic 8 Content Quiz Topic 8.2 Learning Activity
8.3 Wiring Systems Inspection and Testing					
Knowledge					
Describe the inspection and testing requirements for installed and terminated cables to ensure they comply with continuity and insulation resistance and are safe to connect to the supply, including considerations for equipment incorporating electronic components.	2.6, 9	-	-	36	Topic 8 Content Quiz Topic 8.3 Learning Activity
Skills					
Perform the inspection and testing of installed and terminated cables to ensure they comply with continuity and insulation resistance and are safe to connect to the supply.	2.6, 9	2.4, 2.5	1, 2, 5, 16	36	Topic 9.7 Skills Practice 1 Topic 9.7 Skills Practice 2
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules (current edition) - AS/NZS 3008.1.1 Electrical installations – Selection of cables (current edition) - AS/NZS 3017 Verification guidelines (current edition) Equipment:					

8 Techniques for Installing Wiring Systems

- Conduit
- Cable tray
- Suitable cable (e.g. TPS and TPI)
- Snake
- Cable ties
- Multimeter, IR tester and/or multifunction tester
- Hand tools
- PPE

9 Equipment Terminal Configurations					
Purpose:	In this topic you will learn electrical equipment configurations, connection methods and standards, and the techniques and considerations for connecting final subcircuit wiring at switchboards.				
Duration:	This topic represents around 30% of the knowledge and skills specification contents, and should take the learner approximately 12 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
9.1 Cooking and Heating Appliances					
Knowledge					
Describe the terminal and connection configurations of different types of cooking, heating and cooling appliances including connection of phase/s, neutral and protective earthing conductors.	2.7.1, 2.7.6	-	-	33, 35	Topic 9 Content Quiz Topic 9.1 Learning Activity
Skills					
Terminate cables and conductors for the connection of cooking, heating and/or cooling appliances.	2.4, 2.7.1, 2.7.6	3.3	1, 2, 5, 10, 13, 15	33, 35	Topic 9.7 Skills Practice 2
9.2 Single and Three Phase Motors					
Knowledge					
Describe the terminal and connection configurations of single and three phase motors including connection of phase/s, neutral and protective earthing conductors.	2.7.3	-	-	33, 35	Topic 9 Content Quiz Topic 9.2 Learning Activity
Skills					
Terminate cables and conductors for the connection of single and/or three phase motors.	2.4, 2.7.3	3.3	1, 2, 5, 10, 13, 15	33, 35	Topic 9.7 Skills Practice 1

9 Equipment Terminal Configurations					
9.3 Single and Three Phase Transformers					
Knowledge					
Describe the terminal and connection configurations of single and three phase transformers including connection of phase/s, neutral and protective earthing conductors.	2.7.4	-	-	33, 35	Topic 9 Content Quiz Topic 9.3 Learning Activity
Skills					
Terminate cables and conductors for the connection of single and/or three phase transformers.	2.4, 2.7.4	3.3	1, 2, 5, 10, 13, 15	33, 35	Topic 9.7 Skills Practice 1
9.4 Socket Outlets					
Knowledge					
Describe the terminal and connection configurations of socket outlets including connection of phase/s, neutral and protective earthing conductors.	2.7.5	-	-	33, 35	Topic 9 Content Quiz Topic 9.4 Learning Activity
Skills					
Terminate cables and conductors for the connection of socket outlets.	2.4, 2.7.5	3.3	1, 2, 5, 10, 13, 15	33, 35	Topic 9.7 Skills Practice 1
9.5 Luminaires and Lamp Holders					
Knowledge					
Describe the terminal and connection configurations of luminaires and lamp holders including connection of phase/s, neutral and protective earthing conductors.	2.7.2	-	-	33, 35	Topic 9 Content Quiz Topic 9.5 Learning Activity
Skills					
Terminate cables and conductors for the connection of luminaires or lamp holders.	2.4, 2.7.2	3.3	1, 2, 5, 10, 13, 15	33, 35	Topic 9.7 Skills Practice 1

9 Equipment Terminal Configurations					
9.6 Switchgear and Controlgear					
Knowledge					
Describe the terminal and connection configurations for a range of switchgear and controlgear.	2.7.5	-	-	33, 35	Topic 9 Content Quiz Topic 9.6 Learning Activity
Skills					
Terminate cables and conductors at a range of switchgear and controlgear.	2.4, 2.7.5	3.3	1, 2, 5, 10, 13, 15	33, 35	Topic 9.7 Skills Practice 1 Topic 9.7 Skills Practice 2
9.7 Connection of Wiring at Switchboards					
Knowledge					
Describe the correct interconnection between switchgear, protection devices and links, including considerations for selecting adequately sized cables for switchboard wiring.	3.1, 3.3	-	-	24, 37	Topic 9 Content Quiz Topic 9.7 Learning Activity
Explain the requirements and considerations for preparation/fitting/connection of local supply authority equipment.	3.2	-	-	24, 37	
Explain the requirements for correct marking of equipment, including clear identification of circuit neutral conductors.	3.4, 3.5	-	-	24, 37	
Explain the techniques for safe removal of equipment and termination of unused cable.	3.7	-	-	24, 37	
Skills					
Install and connect: - Switchgear, controlgear and protection equipment in a switchboard - Socket outlets - Lighting equipment, accessories, lamps	2.4, 2.7.2, 2.7.5, 3.1, 3.2, 3.3, 3.4,	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 3.1, 3.2, 3.3, 3.6, 4.1,	1, 2, 5, 10, 12, 13, 14.1, 14.2, 14.3, 14.4, 15, 17	24, 33, 35, 37	Topic 9.7 Skills Practice 1 Topic 9.7 Skills Practice 2

9 Equipment Terminal Configurations

and luminaires • Smoke and fire detectors	3.5, 3.6, 3.7	4.2, 4.3			
Install and connect at least four of the following: • Accessories • Cooking appliances • Appliances producing hot water or steam • Room heaters • Electric heating cables • Trace heating • Duct heaters • Electricity convertors • Motors • Transformers • Capacitors • Batteries	2.4, 2.7.1, 2.7.3, 2.7.4, 2.7.6	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 3.1, 3.2, 3.3, 3.6, 4.1, 4.2, 4.3	1, 2, 5, 10, 12, 13, 14.1, 14.2, 14.3, 14.4, 15, 17	33, 35, 37	
Inspect and test installed circuits and equipment to verify compliance and functionality in accordance with AS/NZS 3000 requirements.	2.6, 3.6, 9	2.4, 2.5, 3.4, 3.5	5, 14.1, 14.2, 14.3, 14.4, 16	33, 35, 37	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules

Equipment:

- Wiring booth.
- Switchboard.
- Circuit breakers and RCDs.

9 Equipment Terminal Configurations

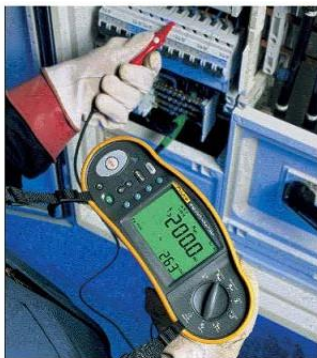
- Isolators and functional switches.
- Dimmer switch.
- Socket-outlets.
- ELV downlights and transformers or other suitable lighting/luminaires.
- Smoke and fire detectors.
- Exhaust fans.
- Fixed room heater.
- Stove or other suitable cooking appliances.
- Hot water heater.
- Other substitute appliances as necessary (e.g. heating cables, trace heating, duct heaters, electricity converters, motors, transformers, capacitors and batteries).
- PPE.
- Hand tools.
- Battery drill.
- Low voltage cabling/wiring systems.
- Cable tray.
- Fixings/fasteners.
- Other suitable electrical accessories.

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0014 – Isolate, test and troubleshoot low voltage electrical circuits



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Regulatory Requirements	5
1.1 MEN Electrical Installations	5
1.2 Electrical Safety Regulations	5
1.3 Electrical Testing Documentation	6
2 Safe Isolation Procedures	7
2.1 Electrical Hazards	7
2.2 Preparing to Isolate	7
2.3 Safe Isolation Procedures	8
3 Visual Inspection	10
3.1 Visual Inspection	10
4 Mandatory Testing	12
4.1 Mandatory Tests	12
4.2 Earth Resistance/Continuity	12
4.3 Insulation Resistance	13
4.4 Polarity and Circuit Connections	14
4.5 Earth Fault Loop Impedance and RCD Operation	14
5 Optional and Other Tests	17
5.1 Optional Tests	17
5.2 Testing Alternative Supplies	17
6 Fault Finding Concepts	19
6.1 Common Faults and Symptoms	19
6.2 Fault Finding Practices	20
7 Fault Diagnosis and Repair	22
7.1 Specifications and Parameters	22
7.2 Finding and Repairing Faults	22

A. Overview		
Competency Standard Unit (CSU)	UEEEL0014 Isolate, test and troubleshoot low voltage electrical circuits	
CSU Application	This unit involves the skills and knowledge required to isolate, test and troubleshoot electrical circuits operating at voltages up to 1,000 volts (V) alternating current (a.c.) or 1,500 V direct current (d.c.). It includes working safely, isolating electrical circuits, evaluating low voltage (LV) electrical circuits, applying systematic fault-finding procedures, conducting repairs and completing the necessary documentation. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical circuits and equipment which are designed to operate at voltages greater than 50 V a.c. or 120 V d.c. Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0014	Performance Criteria
	KE-UEEEL0014	Knowledge Evidence
	PE-UEEEL0014	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 7	54 hours
	Completion of Unit Knowledge Test	2 hour
	Completion of Unit Skills Test	4 hours
	Total duration of structured learning program	60 hours

	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0003 Arrange circuits, control and protection for electrical installations • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0024 Test and connect alternating current (a.c.) rotating machines • UEEEL0025 Test and connect transformers • UEEEL0047 Identify, shut down and restart systems with alternate supplies and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Regulatory Requirements

Purpose:	In this topic you will learn about the potential hazards that can arise due to no-compliant electrical work, and the associated electrical safety regulations and requirements for verifying the safety and correct functioning of electrical installations.				
Duration:	This topic represents around 6.7% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 MEN Electrical Installations					
Knowledge					
State the importance of the MEN link when a fault occurs.	11	-	-	16, 17	Topic 1 Content Quiz Topic 1.1 Learning Activity
Explain the likely consequences of the absence of the MEN link or a high impedance in the PEN conductor when a fault occurs.	12, 14	-	-	16, 17	
Describe the requirements for installation of a MEN link in an installation and an outbuilding.	13	-	-	16, 17	
1.2 Electrical Safety Regulations					
Knowledge					
List the electrical safety legislation and regulations that require installations and equipment to be inspected and tested to ensure they are safe.	4	-	-	30	Topic 1 Content Quiz Topic 1.2 Learning Activity
List the person/bodies responsible for the various aspects of ensuring electrical installations are safe.	5	-	-	30	

1 Regulatory Requirements					
1.3 Electrical Testing Documentation					
Knowledge					
Explain the test results and required documentation to show an electrical installation is safe for connection to the supply.	7, 18	-	-	30	Topic 1 Content Quiz Topic 1.3 Learning Activity
Explain the test results and required documentation to show construction site wiring and equipment is safe to use.	6, 18	-	-	30	
Explain the test results and required documentation to show in-service electrical equipment is safe to use.	7, 18	-	-	30	
Skills					
Complete a Certificate of Electrical Safety/Compliance for an electrical installation scenario, as required in your State/Territory.	18	3.10, 3.12, 5.3	14	30	Topic 1.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules - State/Territory Electrical Safety Regulations Equipment: - Certificate of Electrical Safety/Compliance					

2 Safe Isolation Procedures					
Purpose:	In this topic you will learn about the various hazards and risks associated when working on low voltage, and the correct techniques for the safe isolation, locking out and tagging of electrical supplies.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Electrical Hazards					
Knowledge					
Describe the hazards, risks and control measures for working on low voltage circuits and equipment, including power electronics.	1, 2, 22	-	-	44	Topic 2 Content Quiz Topic 2.1 Learning Activity
Explain the hazards, risks and restrictions for working on “live” low voltage equipment.	19.5	-	-	42, 44	
Skills					
Complete a Job Safety Analysis (JSAs) or Safe Work Methods (SWMs) to undertake modification, fault finding, maintenance and/or repair of low voltage equipment.	1, 2, 22	1.1, 1.2, 1.3, 1.4	1.1, 2, 3.1	44	Topic 2 Content Quiz Topic 2.1 Skills Practice
2.2 Preparing to Isolate					
Knowledge					
List the Australian Standard related to safe isolation of electrical supplies.	19.5	-	-	31	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe and list the steps needed to prepare for safe isolation as per AS/NZS 4836, including: - Undertaking a risk assessment - Identifying all sources of supply and isolation points	1, 2, 19.1, 19.2	-	-	31, 55	

2 Safe Isolation Procedures					
- Notifying relevant personnel - Equipment needed to prevent others from re-energising the supply					
2.3 Safe Isolation Procedures					
Knowledge					
Describe the procedure for safe isolation “lock out and tag out” (LOTO) procedures, as per AS/NZS 4836, including: - Switching off, locking out and tagging - Testing to confirm isolation - Verifying correct operation of test equipment - Ensuring disconnected/unused conductors and equipment are safe	1, 2, 10, 19.3, 19.4	-	-	31, 55	Topic 2 Content Quiz Topic 2.3 Learning Activity
Skills					
Perform the safe isolation and lockout procedure of an electrical circuit in accordance with AS/NZS 4836.	1, 2, 10, 19.1, 19.2, 19.3, 19.4, 19.5	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 5.1, 5.2, 5.3	1.1, 2, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10.1, 3.10.2, 3.10.3, 3.10.4, 4, 14	31	Topic 2.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					

2 Safe Isolation Procedures

Standards and Codes:

- Codes of Practice – electrical risks

Equipment:

- Lock-out devices
- Personal danger tags
- Voltage test equipment

3 Visual Inspection					
Purpose:	In this topic you will learn about the requirements and safe techniques to visually inspect a low voltage electrical installation to verify compliance with the Wiring Rules.				
Duration:	This topic represents around 6.7% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Visual Inspection					
Knowledge					
State the requirements and safe practices for visual inspection of an electrical installation to determine whether the installation complies with the Wiring Rules and applicable specific installation standards.	1, 2, 3	-	-	30	Topic 3 Content Quiz Topic 3.1 Learning Activity
List the items/areas that should be inspected when undertaking a visual inspection on a general electrical installation (checklist as per AS/NZS 3000 – Section 8).	8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 15	-	-	30	
List the items/areas that should be inspected when undertaking a visual inspection on common alternative supply systems (e.g. PVs, batteries), including: - Ratings and polarity of switchgear - Earthing and equipotential bonding	20.3, 20.4	-	-	55	
Skills					
Carry out a visual inspection of an electrical installation and complete a report using the checklist in Section 8 AS/NZS 3000.	1, 2, 3, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 15	1.1, 1.2, 1.3, 1.4, 1.5, 3.1, 5.1, 5.2,	1.1, 2, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 8,	30	Topic 3.1 Skills Practice

3 Visual Inspection

5.3

14

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3017 Verification guidelines

Equipment:

- Electrical installation (for inspection)
- PPE (safety glasses etc.)

4 Mandatory Testing					
Purpose:	In this topic you will learn about the mandatory tests required by Wiring Rules, to verify compliance and functionality of low voltage electrical installations. You will also learn how to identify compliant and non-compliant test results.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 12 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Mandatory Tests					
Knowledge					
List the mandatory tests required to verify compliance and functionality of an electrical installation in accordance with AS/NZS 3000.	9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 16	-	-	30	Topic 4 Content Quiz Topic 4.1 Learning Activity
Identify a suitable sequence for mandatory testing in accordance with AS/NZS 3000.	9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 16	-	-	30	
4.2 Earth Resistance/Continuity					
Knowledge					
List the appropriate tools and test equipment necessary to carry out earth resistance/continuity tests on an electrical installation.	3, 9.2	-	-	30	Topic 4 Content Quiz Topic 4.2 Learning Activity
Describe techniques for verifying the resistance/continuity of the main earth, equipotential bonding conductors and protective earthing conductors.	1, 2, 9.2, 16	-	-	30	
Explain the test results that would indicate compliant/non-compliant earth resistance.	9.2, 17	-	-	30	

4 Mandatory Testing					
Skills					
Select tools and test equipment for earth resistance/continuity testing.	3, 9.2	1.1	1.1, 2, 6.1, 6.3	30	Topic 4.5.1 Skills Practice Topic 4.5.2 Skills Practice
Carry out earth resistance/continuity tests on an electrical installation following guidance given in AS/NZS 3017.	1, 2, 9.2, 16	3.2, 3.3	1.1, 6.1, 6.3	30	
Identify and document compliant/non-compliant earth resistance test results and make suitable recommendations for rectification of defects.	9.2, 17	3.10, 3.11, 3.12	6.1, 6.3, 14	30	
4.3 Insulation Resistance					
Knowledge					
List the appropriate tools and test equipment necessary to carry out insulation resistance tests on an electrical installation.	3, 9.1	-	-	30	Topic 4 Content Quiz Topic 4.3 Learning Activity
Describe techniques for verifying insulation resistance.	1, 2, 9.1, 16	-	-	30	
Explain the test results that would indicate compliant/non-compliant insulation resistance.	9.1, 17	-	-	30	
Skills					
Select tools and test equipment for insulation resistance testing.	3, 9.1	1.1	1.1, 2, 6.1, 6.2	30	Topic 4.5.1 Skills Practice Topic 4.5.2 Skills Practice
Carry out insulation resistance tests on an electrical installation following guidance given in AS/NZS 3017.	1, 2, 9.1, 16	3.2, 3.4	1.1, 6.1, 6.2	30	
Identify and document compliant/non-compliant insulation resistance test results and make suitable recommendations for rectification of defects.	9.1, 17	3.10, 3.11, 3.12	6.1, 6.2, 14	30	

4 Mandatory Testing					
4.4 Polarity and Circuit Connections					
Knowledge					
List the appropriate tools and test equipment necessary to carry out tests to verify correct polarity and circuit connections.	3, 9.3, 9.4	-	-	30	Topic 4 Content Quiz Topic 4.4 Learning Activity
Describe techniques for verifying correct polarity and circuit connections.	1, 2, 9.3, 9.4, 16	-	-	30	
Explain the test results that would indicate compliant/non-compliant polarity and circuit connections.	9.3, 9.4, 17	-	-	30	
Skills					
Select tools and test equipment for testing correct polarity and circuit connections.	3, 9.3, 9.4	1.1	1.1, 2, 6.4, 6.5	30	Topic 4.5.1 Skills Practice Topic 4.5.2 Skills Practice
Carry out polarity and circuit connections tests on an electrical installation following guidance given in AS/NZS 3017.	1, 2, 9.3, 9.4, 16	3.2, 3.5, 3.6	1.1, 6.4, 6.5	30	
Identify and document compliant/non-compliant circuit connections test results and make suitable recommendations for rectification of defects.	9.3, 9.4, 17	3.10, 3.11, 3.12	6.4, 6.5, 14	30	
4.5 Earth Fault Loop Impedance and RCD Operation					
Knowledge					
List the appropriate tools and test equipment necessary to carry out tests to verify earth fault loop impedance and operation of RCDs.	3, 9.5, 9.6	-	-	30	Topic 4 Content Quiz Topic 4.5 Learning Activity
Describe techniques for verifying earth fault loop impedance and operation of RCDs.	1, 2, 9.5, 9.6, 16	-	-	30	

4 Mandatory Testing					
Explain the test results that would indicate compliant/non-compliant earth fault loop impedance and operation of RCDs.	9.5, 9.6, 17	-	-	30	
Skills					
Select tools and test equipment for testing earth fault loop impedance and operation of RCDs.	3, 9.5, 9.6	1.1	1.1, 2, 6.6, 6.7	30	Topic 4.5.1 Skills Practice Topic 4.5.2 Skills Practice
Carry out earth fault loop impedance and RCD operation tests on an electrical installation following guidance given in AS/NZS 3017.	1, 2, 9.5, 9.6, 16	3.2, 3.8, 3.9	1.1, 6.6, 6.7	30	
Identify and document compliant/non-compliant earth fault loop impedance and RCD operation test results and make suitable recommendations for rectification of defects.	9.5, 9.6, 17	3.10, 3.11, 3.12	6.6, 6.7, 14	30, 54	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules - AS/NZS 3017 Verification guidelines Equipment: - Electrical installation (for mandatory testing) - Multimeter and IR tester - Phase rotation meter - Fault loop impedance tester - Other test equipment (e.g. series test lamps, voltmeter, trailing lead) - Lock-out device, padlock, key and danger tag					

4 Mandatory Testing

- Hand tools
- PPE (safety glasses etc.)

5 Optional and Other Tests					
Purpose:	In this topic you will learn about the optional tests that can be used to determine the correct/optimal performance of circuit and equipment. You will also learn about the additional tests and considerations for testing installations with alternative supply systems.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Optional Tests					
Knowledge					
Explain optional test that show all circuits and devices operate as intended, including: - Apparatus calibration. - Load current of appliance/apparatus. - Appliance/apparatus performance characteristics tests.	3, 16	-	-	30	Topic 5 Content Quiz Topic 5.1 Learning Activity
Skills					
Perform optional tests to determine the correct operation of circuits and devices.	3, 16	1.1, 1.2, 1.3, 1.4, 1.5, 5.1, 5.2, 5.3	1.1, 2, 14	30	Topic 5.1 Skills Practice
5.2 Testing Alternative Supplies					
Knowledge					
Explain the additional tests and considerations for installations with multiple/alternative supply systems, including: - Anti-islanding - Nominal voltage	9.7, 20.1, 20.2, 20.3, 20.4	-	-	30, 55	Topic 5 Content Quiz Topic 5.2 Learning Activity

5 Optional and Other Tests					
- d.c. polarity - Earthing					
Skills					
Perform tests to determine the correct operation of alternative supply systems.	9.7, 20.1, 20.2, 20.3, 20.4	1.1, 1.2, 1.3, 1.4, 1.5, 3.7, 3.10, 3.11, 3.12, 5.1, 5.2, 5.3	1.1, 2, 7.1, 7.2.1, 7.2.2, 7.3, 7.4, 8, 14	30, 55	Topic 5.2 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules - AS/NZS 3017 Verification guidelines Equipment: - Electrical installation with alternative supply system (for testing) - Multimeter and IR tester - Other test equipment (e.g. series test lamps, voltmeter, trailing lead) - Lock-out device, padlock, key and danger tag - Hand tools - PPE (safety glasses etc.)					

6 Fault Finding Concepts					
Purpose:	In this topic you will learn about the basic concepts used in fault finding electrical circuits and systems, including the different types of faults commonly found in electrical equipment and their symptoms.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Common Faults and Symptoms					
Knowledge					
Explain the importance of understanding the correct operation of equipment when fault finding that equipment.	21.1	-	-	54	Topic 6 Content Quiz Topic 6.1 Learning Activity
Explain the various types of faults commonly found in electrical equipment, including: • Open circuits • Short circuits • Incorrect connections • Insulation failure • Unsafe condition • Component failure • Mechanical failure • Earth leakage • Operator faults • Supply faults	21.2.1, 21.2.2, 21.2.3, 21.2.4, 21.2.5, 21.2.6, 21.2.7, 21.2.8, 21.2.9, 21.2.10	-	-	54	
Describe typical faults symptoms and their causes, including: • Operation of circuit protection device • Equipment does not operate • Equipment operates abnormally	21.3.1, 21.3.2	-	-	54	

6 Fault Finding Concepts					
6.2 Fault Finding Practices					
Knowledge					
Describe the factors to consider in clarifying the nature of a fault: - Initial fault report - Confirmation of symptoms of the fault - Comparison of symptoms with normal operation	21.4.1, 21.4.2, 21.4.3	-	-	54	Topic 6 Content Quiz Topic 6.2 Learning Activity
Explain "effect to cause" reasoning and assumptions of possible causes.	1, 2	-	-	54	
Describe the methods for testing assumptions including: - Visual inspection - Component isolation - Test equipment - Sectional/split-half testing	1, 2, 21.5.1, 21.5.2, 21.5.3, 21.5.4	-	-	54	
Skills					
Demonstrate basic fault finding techniques to diagnose simple electrical problems.	1, 2, 21.5.1, 21.5.2, 21.5.3, 21.5.4	1.1, 1.2, 1.3, 1.4, 1.5, 4.1, 4.2, 4.3, 4.9, 4.10, 5.1, 5.2, 5.3	1.1, 2, 9, 14	54	Topic 6.2 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					

6 Fault Finding Concepts

Standards and Codes:

- AS/NZS 3000 Wiring Rules

Equipment:

- Circuit fault panels.
- Test equipment.
- PPE

7 Fault Diagnosis and Repair					
Purpose:	In this topic you will learn about the techniques for diagnosing and rectifying faults in electrical equipment and associated circuits.				
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 12 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Specifications and Parameters					
Knowledge					
Describe the documents used to determine the arrangement and intended operation of electrical installations (circuit diagrams, wiring diagrams, cable schedules, specifications).	1, 21.1	-	-	54	Topic 7 Content Quiz Topic 7.1 Learning Activity
Skills					
Interpret electrical diagrams as a part of fault finding work.	1, 21.1	1.1, 4.3	9	54	Topic 7.2.1 Skills Practice Topic 7.2.2 Skills Practice
7.2 Finding and Repairing Faults					
Knowledge					
Describe the safe techniques for diagnosing and locating faults in electrical installations.	21.5.1, 21.5.2, 21.5.3, 21.5.4	-	-	54	Topic 7 Content Quiz Topic 7.2 Learning Activity
Describe the techniques for repairing faults and the steps needed to reduce the chance of re-occurrence.	21.7	-	-	54	
Describe typical causes and methods to deal with intermittent faults, such as vibration, shock, changes in temperature, and	21.6	-	-	54	

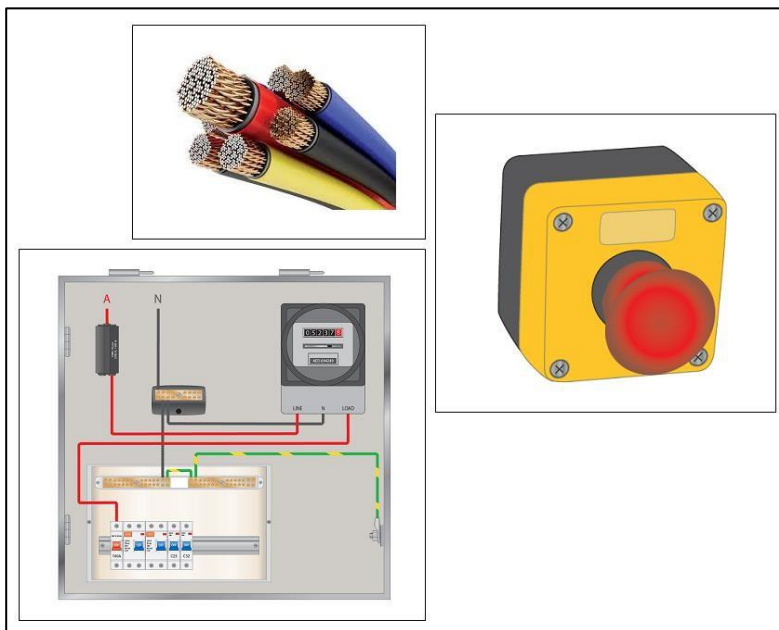
7 Fault Diagnosis and Repair					
electromagnetic interference.					
Skills					
Identify faults in electrical installation circuits and equipment, including at least one high impedance or open circuit neutral fault.	1, 2, 21.5.1, 21.5.2, 21.5.3, 21.5.4	1.1, 1.2, 1.3, 1.4, 1.5, 4.1, 4.2, 4.3, 4.10, 5.1, 5.2, 5.3	1.1, 2, 9, 10, 14	54	Topic 7.2.1 Skills Practice Topic 7.2.2 Skills Practice
Perform the repair, final testing and re-commissioning of faulty electrical installation circuit’s components and wiring.	21.7	4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 5.1, 5.2, 5.3	11, 12, 13, 14	54	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: • AS/NZS 3000 Wiring Rules • AS/NZS 3760 In-service safety inspection and testing electrical equipment Equipment: • Domestic/commercial/industrial installation arrangements with fault switches. • Variety of test equipment (e.g. IR testers, multimeters) • Hand tools • PPE					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0018 – Select wiring systems and select cables for low voltage electrical installations



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Performance Requirements – Design and Safety	5
1.1 External Design Factors	5
1.2 Electrical Design Features	5
1.3 Electrical Protection Design Requirements	6
2 Final Subcircuit Arrangements	8
2.1 Final Subcircuit Requirements	8
2.2 Final Subcircuit Arrangements	8
3 Suitability of Wiring Systems	10
3.1 Wiring System Installation Conditions	10
3.2 Wiring System Installation Requirements	10
4 Maximum Demand on Mains and Submains	12
4.1 Maximum Demand	12
4.2 Maximum Demand on Consumer Mains	12
4.3 Maximum Demand on Submains	13
5 Current Carrying Capacity Requirements	14
5.1 Cable Selection	14
5.2 Cable Selection Requirements	14
6 Voltage Drop Limitations	16
6.1 Voltage Drop Method	16
6.2 Cable Selections	16
7 Earth Fault Loop Impedance Limitations	18
7.1 Earth Fault Loop Impedance	18
7.2 Earth Fault Loop Calculations	18
8 Selecting Protection Devices	20
8.1 Circuit Protection Methods	20
8.2 Protection Devices Selection	20
9 Selecting Isolation and Switching Devices	22
9.1 Circuit Isolation	22
9.2 Circuit Switching	22
10 Switchboard Arrangements	24
10.1 Switchboard Requirements	24
10.2 Single Phase, Single Tariff Switchboard	24
10.3 Single Phase, Multiple Tariff Switchboard	25
10.4 Multiphase, Single Tariff Switchboard	25
10.5 Multiphase, Multiple Tariff Switchboard	26
10.6 Multiple Tenancy Switchboard	26
10.7 Three Phase CT Metering	26

A. Overview		
Competency Standard Unit (CSU)	UEEEL0018 Select wiring systems and select cables for low voltage electrical installations	
CSU Application	This unit involves the skills and knowledge required to select wiring systems and cables for electrical installations operating at voltages up to 1,000 volt (V) alternating current (a.c.) or 1,500 V direct current (d.c.). It includes application of wiring systems and cable types, selecting wiring system compatible with the installation conditions, selecting cables that comply with required current-carrying capacity and voltage drop and earth fault-loop impedance limitations, coordinating between protective devices and conductors, and documenting selection decisions. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 V a.c. or 120 V d.c.. Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0018	Performance Criteria
	KE-UEEEL0018	Knowledge Evidence
	PE-UEEEL0018	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 10	54 hours
	Completion of Unit Knowledge Test	2 hours
	Completion of Unit Skills Test	4 hours

	Total duration of structured learning program	60 hours
	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0003 Arrange circuits, control and protection for electrical installations • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0008 Evaluate and modify low voltage heating equipment and controls • UEEEL0009 Evaluate and modify low voltage lighting circuits, equipment and controls • UEEEL0010 Evaluate and modify low voltage socket outlets circuits • UEEEL0024 Test and connect alternating current (a.c.) rotating machines • UEEEL0025 Test and connect transformers and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits	

B. Knowledge and Skills Delivery

1 Performance Requirements – Design and Safety

Purpose:	In this topic you will learn about the design and safety performance requirements to be considered in the design of electrical installations.
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 External Design Factors					
Knowledge					
List the harmful effects against which the design of an electrical installation must provide protection.	1.1	1.2	23	10	Topic 1 Content Quiz Topic 1.1 Learning Activity
State the performance standards of a correctly functioning electrical installation.	1.2	1.2	23	10	
List typical external factors that may damage an electrical installation and that shall be considered in the installation design.	1.6	1.2	23	10	
Explain the need for protection against injury from mechanical movement and how this may be achieved.	1.13	1.2	23	10	
List the features of fire rated construction and how the integrity of the fire rating can be maintained in relation to electrical installation.	1.14	1.2	23	10	
1.2 Electrical Design Features					
Knowledge					
Describe supply characteristics that shall be considered when designing an electrical	1.3	1.2	23	10	Topic 1 Content Quiz

1 Performance Requirements – Design and Safety					
installation.					Topic 1.2 Learning Activity
List acceptable methods for determining the maximum demand in consumer mains and sub-mains.	1.4	1.2	23	10	
State the AS/NZS 3000 requirement for limiting voltage drop in an installation.	6.1	1.2	23	10	
Explain the reasons for dividing electrical installations into circuits and the factors that shall determine their number and type.	1.5	1.2	23	10	
1.3 Electrical Protection Design Requirements					
Knowledge					
List the likely sources of unwanted voltages and the methods for dealing with this potential hazard.	1.9	1.2	23	10	Topic 1 Content Quiz Topic 1.3 Learning Activity
List the acceptable methods for protecting persons and livestock against injury, and property against damage, from the effects of overcurrent.	1.10	1.2	23	10	
State the requirements for protection against direct and indirect contact.	1.7, 1.11	1.2	23	10	
State the requirements for protection against the harmful effects of faults, including those between live parts of circuits supplied at different voltages.	1.11, 1.12	1.2	23	10	
Skills					
Identify and apply the performance requirements specified in Part 1 of the Wiring Rules to a variety of electrical installation elements and scenarios, including protection against: - Shock current - Excessive temperatures - Explosive atmospheres	1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.13	1.1, 1.2, 3.2, 3.3	1, 2, 8, 16, 19, 23, 31	10	Topic 1.3 Skills Practice

1 Performance Requirements – Design and Safety

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

2 Final Subcircuit Arrangements					
Purpose:	In this topic you will learn about the requirements and arrangements of electrical installation final sub-circuits.				
Duration:	This topic represents around 6.7% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Final Subcircuit Requirements					
Knowledge					
List the factors that shall be considered in determining the number and type of circuit required for an installation.	2.1	1.2	23	22	Topic 2 Content Quiz Topic 2.1 Learning Activity
Explain the daily and seasonal demand for lighting, power, heating and other loads in a given installation.	2.2	1.2	23	22	
State the current requirements for a final sub-circuit.	2.4	1.2	18, 23	22	
2.2 Final Subcircuit Arrangements					
Knowledge					
List the various final subcircuit arrangement configurations.	2.5, 11	1.2	23	20, 22	Topic 2 Content Quiz Topic 2.2 Learning Activity
Skills					
Select the number and type of circuits required for a particular installation.	2.1, 2.3, 2.4	1.1, 1.2, 3.2, 3.3	1, 2, 8, 10, 11, 16, 18, 19, 22, 23, 31	22	Topic 2.2 Skills Practice
Develop the layout/schedule of circuits for given electrical installations.	2.5, 11	1.1, 1.2, 3.2, 3.3	1, 2, 8, 12, 16, 19, 21,	22	

2 Final Subcircuit Arrangements

23, 31

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

3 Suitability of Wiring Systems					
Purpose:	In this topic you will learn about the various requirements that must be considered in the selection of a suitable wiring system and the AS/NZS 3000 requirements.				
Duration:	This topic represents around 6.7% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Wiring System Installation Conditions					
Knowledge					
List wiring systems typically used with various construction methods and particular environments.	3.1, 11	1.2	23	21, 22	Topic 3 Content Quiz Topic 3.1 Learning Activity
Explain installation conditions that may affect the current-carrying capacity of cables.	3.2, 11	1.2	23	21, 22	
Describe external influences that may affect the current-carrying capacity and/or may cause damage to the wiring systems.	3.3, 11	1.2	23	21, 22	
3.2 Wiring System Installation Requirements					
Knowledge					
List the relevant sections of AS/NZS 3000 used for the selection of suitable wiring systems.	3.4	1.2	23	21, 22	Topic 3 Content Quiz Topic 3.2 Learning Activity
Skills					
Apply AS/NZS 3000 requirements for selecting wiring systems for a range of circuits, installation conditions and constructions methods into which the wiring system is to be installed. <i>NOTE: Wiring systems include cable enclosures, underground wiring, aerial wiring, catenary support, emergency systems, busbar trunking and</i>	3.1, 3.2, 3.3, 3.4, 11	1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3	1, 2, 8, 9, 13, 16, 19, 23, 31	21, 22	Topic 3.2 Skills Practice

3 Suitability of Wiring Systems

earth sheath return.

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3008.1.1 Electrical installations – Selection of cables

4 Maximum Demand on Mains and Submains						
Purpose:	In this topic you will learn about determining the maximum demand for consumer mains and submains.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Maximum Demand						
Knowledge						
List the acceptable methods for determining the maximum demand on an installation’s consumer main and submains, as detailed in AS/NZS 3000.		1.4, 4.1	1.2	23	21, 22	Topic 4 Content Quiz Topic 4.1 Learning Activity
Explain the method of limitation as a means of determining the maximum demand of an installation.		1.4, 4.1, 11	1.2	23	21, 22	
4.2 Maximum Demand on Consumer Mains						
Knowledge						
List the factors to consider when determining the maximum demand for the consumer mains for given installations up to 400 A per phase.		4.2	1.2	23	21	Topic 4 Content Quiz Topic 4.2 Learning Activity
Skills						
Use a calculation method to determine the maximum demand on mains cables supplying a single domestic installation.		4.2, 11	1.1, 1.2, 3.1, 3.2, 3.3	1, 2, 8, 16, 17, 19, 23, 31	21	Topic 4.2 Skills Practice Topic 4.3 Skills Practice
Use a calculation method to determine the maximum demand on mains cables supplying a single non domestic installation.		4.2, 11	1.1, 1.2, 3.1, 3.2, 3.3	1, 2, 8, 16, 17, 19, 23, 31	21	
Use a calculation method to determine the		4.2, 11	1.1, 1.2,	1, 2, 8, 16,	21	

4 Maximum Demand on Mains and Submains					
maximum demand on mains cables supplying a multi domestic installation.		3.1, 3.2, 3.3	17, 19, 23, 31		
4.3 Maximum Demand on Submains					
Knowledge					
List the factors to consider when determining the maximum demand for the sub-mains for given installations.	4.3	1.2	23	21	Topic 4 Content Quiz Topic 4.3 Learning Activity
Skills					
Use a calculation method to determine the maximum demand on submains cables supplying various types of installations.	4.3, 11	1.1, 1.2, 3.1, 3.2, 3.3	1, 2, 8, 16, 17, 19, 23, 31	21	Topic 4.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules					

5 Current Carrying Capacity Requirements					
Purpose:	In this topic you will learn to develop skills required to allow the selection of a cable type and size, dependant on the cable current carrying capacity for given installation conditions.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Cable Selection					
Knowledge					
Describe installation conditions for a range of wiring systems and applications.	5.1	1.2	23	21, 22	Topic 5 Content Quiz Topic 5.1 Learning Activity
Describe the factors that control the current carrying capacity of cables.	5.1, 5.2, 11	1.2	23	21, 22	
List external influences specified in AS/NZS 3000 that require the use of a derating factor.	5.2	1.2	23	21, 22	
5.2 Cable Selection Requirements					
Knowledge					
List the AS/NZS 3000 requirements for coordination of cables and protection devices.	5.4, 11	1.2	23	23	Topic 5 Content Quiz Topic 5.2 Learning Activity
List the AS/NZS 3008 requirements to select conductor size based on the maximum current requirement and insulation type for given installation conditions, including any applicable derating factors.	5.3, 5.5	1.2	23	21, 22	
Skills					
Apply the AS/NZS 3000 requirements for coordinating of cables and protection devices.	5.4, 11	1.1, 1.2, 3.2, 3.3	1, 2, 8, 9, 16, 23, 31	21, 22	Topic 5.2 Skills Practice
Apply AS/NZS 3008 to select conductor size based	5.1, 5.2,	1.1, 1.2,	1, 2, 8, 9,	21, 22	

5 Current Carrying Capacity Requirements

on the maximum current requirement for a given installation condition including any applicable derating factors.	5.3, 5.5, 11	1.3, 2.2, 3.1, 3.2, 3.3	14, 16, 23, 24, 25, 26, 31		
Use AS/NZS 3008.1.1 to determine the maximum permissible operating temperature of a cable type.	5.3, 11	1.1, 1.2, 1.3, 3.2, 3.3	1, 2, 23, 26, 31	21, 22	
Identify and apply the correct tables in AS/NZS 3008.1.1 to determine: • Current carrying capacity of a cable installed in a specified manner • Derating of cable current carrying capacity due to grouping or bunching of cables • Derating of cable current carrying capacity due to the effects of ambient temperature	5.3, 5.5, 11	1.1, 1.2, 1.3, 2.2, 3.2, 3.3	1, 2, 7, 8, 9, 14, 16, 18, 19, 23, 24, 25, 26, 31	21, 22	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3008.1.1 Electrical installations – Selection of cables

6 Voltage Drop Limitations					
Purpose:	In this topic you will learn to develop skills required to allow the selection of a cable size in order to comply with the voltage drop requirements within a circuit.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Voltage Drop Method					
Knowledge					
Describe the factors that regulate voltage drop within the cabling of a circuit.	6.1, 11	1.2	23	21, 22	Topic 6 Content Quiz Topic 6.1 Learning Activity
State the AS/NZS 3000 requirements for maximum voltage drop in an installation.	6.1	1.2	23	21, 22	
6.2 Cable Selections					
Knowledge					
List the relevant tables in AS/NZS 3008 for unit values of voltage drop.	6.2	1.2	23	21, 22	Topic 6 Content Quiz Topic 6.2 Learning Activity
Skills					
Calculate expected voltage drop in a given circuit.	6.2, 11	1.1, 1.2	1, 2, 3, 8, 9, 16, 19, 23, 31	21, 22	Topic 6.2 Skills Practice
Select cables to satisfy voltage drop requirements in addition to current carrying capacity requirements.	6.1, 6.2, 11	1.1, 1.2, 1.3, 2.2, 3.1, 3.2, 3.3	1, 2, 3, 5, 7, 8, 9, 14, 16, 17, 18, 19, 23, 24, 25, 26, 31	21, 22	
Use AS/NZS 3008.1.1 to calculate the voltage drop in a cable of given length, cross-sectional area,	6.2, 11	1.1, 1.2, 3.1, 3.2,	1, 2, 3, 8, 9, 16, 19,	21, 22	

6 Voltage Drop Limitations

material and current loading for a single phase circuit.		3.3	23, 31		
Use AS/NZS 3008.1.1 to calculate the voltage drop in a cable of given length, cross-sectional area, material and current loading for a three phase circuit.	6.2, 11	1.1, 1.2, 3.1, 3.2, 3.3	1, 2, 3, 8, 9, 16, 19, 23, 31	21, 22	
Use AS/NZS 3008.1.1 to select a cable size for a given circuit length, maximum allowable voltage drop, and current loading.	6.1, 6.2, 11	1.1, 1.2, 1.3, 2.2, 3.1, 3.2, 3.3	1, 2, 3, 5, 7, 8, 9, 14, 16, 17, 18, 19, 23, 24, 25, 26, 31	21, 22	

Reference Text:

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- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3008.1.1 Electrical installations – Selection of cables

7 Earth Fault Loop Impedance Limitations					
Purpose:	In this topic you will learn to builds on knowledge and skills developed in previous unit topics in the selection of cables to suit the requirements of fault loop impedance within a circuit.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Earth Fault Loop Impedance					
Knowledge					
Describe the factors that regulate the earth fault loop impedance of a circuit.	7.1, 11	1.2	23	16, 21, 22	Topic 7 Content Quiz Topic 7.1 Learning Activity
State the AS/NZS 3000 requirements for maximum earth fault loop impedance in an installation.	7.2	1.2	23	16, 21, 22	
7.2 Earth Fault Loop Calculations					
Knowledge					
List and explain the relevant tables in AS/NZS 3008 to determine cable impedances.	7.2	1.2	23	16, 21, 22	Topic 7 Content Quiz Topic 7.2 Learning Activity
Skills					
Calculate the expected earth fault loop impedance for given circuit arrangements.	7.2, 11	1.1, 1.2, 3.2, 3.3	1, 2, 4, 8, 9, 16, 19, 23, 31	16, 21, 22	Topic 7.2 Skills Practice
Select cables to satisfy earth fault loop impedance requirement in addition to current carrying capacity requirements and voltage drop requirements.	7.1, 7.2, 11	1.1, 1.2, 2.2, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 6, 7, 8, 9, 14, 16, 17, 18, 19, 23, 24, 25, 26, 31	16, 21, 22	
Determine the maximum earth fault loop	7.1, 7.2,	1.1, 1.2,	1, 2, 4, 8,	16, 21,	

7 Earth Fault Loop Impedance Limitations

impedance allowable for a circuit controlled by a given type of circuit protective device.	11	3.2, 3.3	9, 16, 19, 23, 31	22	
Determine the maximum length of sub circuit cabling for a given cable size and circuit protective device.	7.1, 7.2, 11	1.1, 1.2, 3.2, 3.3	1, 2, 4, 8, 9, 16, 19, 23, 31	16, 21, 22	
Select alternative active and/or earth cable sizes to provide compliance with sub circuit fault loop impedance requirements.	7.1, 7.2, 11	1.1, 1.2, 1.3, 2.2, 2.4, 3.1, 3.2, 3.3	1, 2, 6, 8, 9, 15, 16, 19, 23, 24, 25, 26, 31	16, 21, 22	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3008.1.1 Electrical installations – Selection of cables

8 Selecting Protection Devices					
Purpose:	In this topic you will learn about the various circuit protection methods and how to select the most suitable protection method for range of installation types and conditions.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Circuit Protection Methods					
Knowledge					
List acceptable methods of protection against indirect contact.	8.1	1.2	23	23	Topic 8 Content Quiz Topic 8.1 Learning Activity
State the AS/NZS 3000 requirements for the selection of devices/methods to protect against indirect contact and overcurrent for a range of installation types and conditions.	8.2, 11	1.2	23	23	
Explain the coordination between conductors and protection devices to ensure the protection of cables from over-heating due to overcurrent.	8.3, 11	1.2, 2.3	23, 27, 28	23	
List possible injuries to persons and livestock from hazards due to a short circuit current.	8.4	1.2	23	10	
8.2 Protection Devices Selection					
Knowledge					
List the factors to be considered in the selection of protection devices and methods.	8.5, 8.6, 11	1.2, 2.3	23, 27, 28	23	Topic 8 Content Quiz Topic 8.2 Learning Activity
List the short-circuit performance considerations for cable selection.	8.6, 11	1.2, 2.3	23, 27, 28	23	
Skills					
Apply AS/NZS 3000 requirements for selecting	8.2, 8.3,	1.1, 1.2,	1, 2, 8, 16,	23	Topic 8.2 Skills Practice

8 Selecting Protection Devices

devices to protect against overload current for a range of circuits and loads.	8.5, 11	2.3, 2.4, 3.1, 3.2, 3.3	19, 23, 27, 28, 31		
Apply AS/NZS 3000 requirements for selecting devices to protect against short-circuit current for a range of installation conditions.	8.2, 8.3, 8.6, 11	1.1, 1.2, 2.3, 2.4, 3.1, 3.2, 3.3	1, 2, 8, 16, 19, 23, 27, 28, 31	23	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3008.1.1 Electrical installations – Selection of cables

9 Selecting Isolation and Switching Devices					
Purpose:	In this topic you will learn about requirements in selecting devices for the isolation and switching of circuits in electrical installations.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
9.1 Circuit Isolation					
Knowledge					
List the requirements for the provision of the isolation of every circuit in an electrical installation.	9.1	1.2	23	23	Topic 9 Content Quiz Topic 9.1 Learning Activity
Explain the need for protection against mechanical movement of electrically activated equipment AS/NZS 3000 requirements.	9.2	1.2	23	23	
Skills					
Apply AS/NZS 3000 requirements for selecting devices for circuit isolation for a range of installations and conditions.	9.3, 11	1.1, 1.2, 3.1, 3.2, 3.3	1, 2, 8, 16, 19, 23, 29, 30, 31	23	Topic 9.1 Skills Practice
9.2 Circuit Switching					
Knowledge					
List the requirements for the provision of circuit switching in an electrical installation.	9.3	1.2	23	23	Topic 9 Content Quiz Topic 9.2 Learning Activity
Skills					
Apply AS/NZS 3000 requirements for selecting devices for circuit switching for a range of installations and conditions.	9.3, 11	1.1, 1.2, 3.1, 3.2, 3.3	1, 2, 8, 16, 19, 23, 29, 30, 31	23	Topic 9.2 Skills Practice
Reference Text:					

9 Selecting Isolation and Switching Devices

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

10 Switchboard Arrangements					
Purpose:	In this topic you will develop skills in the design of switchboards for single occupier installations and the design of switchboards and reticulation systems for multi-tenancy installations.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
10.1 Switchboard Requirements					
Knowledge					
List AS/NZS 3000 and local supply authority requirements for switchboards.	10.1	1.2	20, 23	24	Topic 10 Content Quiz Topic 10.1 Learning Activity
List the equipment installed at main switchboards with capacities up to 400 A per phase.	10.3	1.2	20, 23	24	
Skills					
Identify the local supply authority requirements for connection of an electrical installation to the electrical supply system.	10.7	1.2	1, 2, 8, 16, 19, 20, 23, 31	24	Topic 10.1 Skills Practice
Identify the local tariff structures for the supply of electricity.	10.2	1.2	20	24	
10.2 Single Phase, Single Tariff Switchboard					
Knowledge					
Describe the layout of a main switchboard for an installation supplied with single phase single tariff whole current metering.	10.4.1	1.2	20, 23	24	Topic 10 Content Quiz Topic 10.2 Learning Activity
Skills					
Use AS/NZS 3000 and local supply authority rules to design a switchboard layout for a single phase single tariff whole current metering for single	10.1, 10.3, 10.4.1	1.1, 1.2, 2.4, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	Topic 10.2 Skills Practice

10 Switchboard Arrangements					
occupier installation.					
10.3 Single Phase, Multiple Tariff Switchboard					
Knowledge					
Describe the layout of a main switchboard for an installation supplied with single phase multiple tariff whole current metering.	10.4.2	1.2	20, 23	24	Topic 10 Content Quiz Topic 10.3 Learning Activity
Skills					
Use AS/NZS 3000 and local supply authority rules to determine the location requirements for switchboards and metering for a single phase multiple tariff whole current metering for multi tenancy installations.	10.1, 10.3, 10.4.2	1.1, 1.2, 2.4, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	Topic 10.3 Skills Practice
Use AS/NZS 3000 and local supply rules to design a metering arrangement for a multi occupier installation.	10.1, 10.3, 10.4.2	1.1, 1.2, 2.4, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	
Use AS/NZS 3000 and local supply rules to design a switchboard layout for a multi occupier installation.	10.1, 10.3, 10.4.2	1.1, 1.2, 2.4, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	
10.4 Multiphase, Single Tariff Switchboard					
Knowledge					
Describe the layout of a main switchboard for an installation supplied with multiphase single tariff whole current metering.	10.4.3	1.2	20, 23	24	Topic 10 Content Quiz Topic 10.4 Learning Activity
Skills					
Use local supply authority documents and rules to draw the cabling requirements for three phase single tariff installations up to 100 amperes per phase.	10.1, 10.3, 10.4.3	1.1, 1.2, 2.4, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	Topic 10.4 Skills Practice

10 Switchboard Arrangements					
10.5 Multiphase, Multiple Tariff Switchboard					
Knowledge					
Describe the layout of a main switchboard for an installation supplied with multiphase multiple tariff whole current metering.	10.4.4	1.2	20, 23	24	Topic 10 Content Quiz Topic 10.5 Learning Activity
Skills					
Use local supply authority documents and rules to draw the cabling requirements of a main switchboard for an installation supplied with multiphase multiple tariff whole current metering.	10.1, 10.3, 10.4.4	1.1, 1.2, 2.4, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	Topic 10.5 Skills Practice
10.6 Multiple Tenancy Switchboard					
Knowledge					
Describe the layout of a main switchboard for a multiple tenancy installation with whole current metering.	10.5	1.2	20, 23	24	Topic 10 Content Quiz Topic 10.6 Learning Activity
Skills					
Use local supply authority documents and rules to draw the cabling requirements of a main switchboard for an installation supplied with multiple tenancy installation with whole current metering.	10.1, 10.3, 10.5	1.1, 1.2, 2.4, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	Topic 10.6 Skills Practice
10.7 Three Phase CT Metering					
Knowledge					
Describe the operating principles of C.T. metering.	10.6	1.2	20, 23	24	Topic 10 Content Quiz Topic 10.7 Learning Activity
Describe the reasons for using a link block or panel with C.T. metering.	10.6	1.2	20, 23	24	
Describe the layout of a main switchboard, including metering, for an installation supplied with	10.6	1.2	20, 23	24	

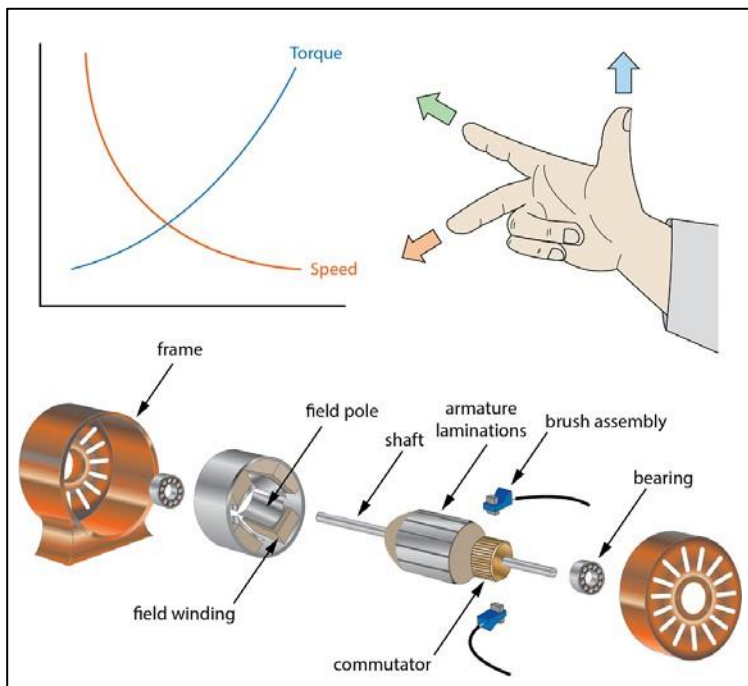
10 Switchboard Arrangements					
three phase CT metering.					
Skills					
Use AS/NZS 3000 and local supply authority rules to design and draw a wiring diagram for a three-phase switchboard containing C.T. metering, for a supply up to 400 amperes per phase.	10.1, 10.3, 10.6	1.1, 1.2, 2.4, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	Topic 10.7 Skills Practice
Draw a single line diagram of an installation switchboard that includes lift and fire-fighting services.	10.1, 10.6	1.1, 1.2, 3.2, 3.3	1, 2, 8, 16, 19, 20, 23, 31	24	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education					
Standards and Codes: - AS/NZS 3000 Wiring Rules - Local Service and Installation Rules (SIR)					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0019 – Solve problems in direct current (d.c.) machines



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Rotating Machine Construction, Testing and Maintenance	5
1.1 d.c. Machine Construction	5
1.2 d.c. Machine Testing	5
1.3 d.c. Machine Maintenance	6
2 Generators	7
2.1 d.c. Generators	7
2.2 d.c. Generator Operation	7
2.3 d.c. Generator Characteristics	8
3 Motors	9
3.1 d.c. Motors	9
3.2 d.c. Motor Operation	9
3.3 d.c. Motor Characteristics	10
4 Machine Efficiency	11
4.1 Machine Losses	11
4.2 Machine Efficiency	11
4.3 Minimum Energy Performance Standards (MEPS)	12

A. Overview		
Competency Standard Unit (CSU)	UEEEL0019 Solve problems in direct current (d.c.) machines	
CSU Application	This unit involves the skills and knowledge required to determine correct operation of direct current (d.c.) machines and provide solutions as they apply to electrical installations and equipment. It includes working safely, the use of testing and measuring devices, and providing solutions derived from measurements and calculations to predictable problems in d.c. machines. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V d.c. Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0019	Performance Criteria
	KE-UEEEL0019	Knowledge Evidence
	PE-UEEEL0019	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 4	24.5 hours
	Completion of Unit Knowledge Test	1.5 hours
	Completion of Unit Skills Test	4 hours
	Total duration of structured learning program	30 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur	

	before competence can be determined.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEEEL0021 Solve problems in magnetic and electromagnetic devices and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Rotating Machine Construction, Testing and Maintenance

Purpose:	In this topic you will learn about the basic principles of rotating machine construction, testing and maintenance.				
Duration:	This topic represents around 14% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 d.c. Machine Construction					
Knowledge					
List the components of a d.c. machine	1.2	-	-	52	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the difference between a generator and a motor in terms of energy conversion and energy flow	1.3	-	-	52	
Describe the nameplate of a machine	1.4	2.4	4	52	
Skills					
Identify the components of a d.c. machine	1.2	-	-	52	Topic 1.2 Skills Practice
Obtain information from the nameplate of a d.c. machine	1.4	2.4	4	52	
1.2 d.c. Machine Testing					
Knowledge					
List the safety risks associated with working on rotating machinery	1.5	1.3	1.1	52	Topic 1 Content Quiz Topic 1.2 Learning Activity
List possible faults in a d.c. machine	1.6	2.6	3	52	
Skills					
Use electrical test equipment to make electrical measurements and compare these readings with	1.1	2.5	2.4	52	Topic 1.2 Skills Practice

1 Rotating Machine Construction, Testing and Maintenance					
nameplate ratings					
Identify faults in a machine from electrical measurements	1.6	2.6	3	52	
Identify safety risks associated with using rotating machinery	1.5	2.1, 3.1	1.1	52	
1.3 d.c. Machine Maintenance					
Knowledge		-	-		
Describe care and maintenance processes for d.c. rotating machines	1.1	-	-	52	Topic 1 Content Quiz Topic 1.3 Learning Activity
Skills					
Apply care and maintenance processes to d.c. rotating machines	1.1	-	-	52	Topic 1.2 Skills Practice
Reference Texts: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning					

2 Generators					
Purpose:	In this topic you will learn about the principles of operation of d.c. generators, the various types of generators, their characteristics and applications.				
Duration:	This topic represents around 27% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 d.c. Generators					
Knowledge					
List the types of d.c. generators and their applications	2.9	-	-	52	Topic 2 Content Quiz Topic 2.1 Learning Activity
Describe the use of prime movers, energy sources and energy flow used to generate electricity	2.7	-	-	52	
List the methods of excitation used for d.c. generators	2.5	-	-	52	
2.2 d.c. Generator Operation					
Knowledge					
Describe the basic operation of a d.c. generator	2.1 2.11	-	-	7, 52	Topic 2 Content Quiz Topic 2.2 Learning Activity
State the importance of residual magnetism for a self-excited generator	2.3	-	-	52	
Describe how to reverse the polarity of a generator	2.8	-	-	52	
Skills					
Draw an equivalent circuit for a generator	2.2	-	-	52	Topic 2.3 Skills Practice
Calculate the generated and terminal voltage of	2.10	2.6	4	52	

2 Generators					
a d.c. shunt generator					
Apply Fleming’s right hand rule for generators	2.11	-	-	7	
Demonstrate the basic operation of a generator	2.1	-	-	52	
2.3 d.c. Generator Characteristics					
Knowledge					
Describe the open circuit characteristics of d.c. generators	2.6	-	-	52	Topic 2 Content Quiz Topic 2.3 Learning Activity
Describe the load characteristic of a d.c. generator	2.4	-	-	52	
Skills					
Connect and test a d.c. generator on no-load and load	2.4, 2.6	2.6, 2.7	2	52	Topic 2.3 Skills Practice
Identify safety risks associated with using generators	2.1	1.3,	1.1	52	
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					

3 Motors					
Purpose:	In this topic you will learn about the types, principles of operation and characteristics of various types of d.c. motors.				
Duration:	This topic represents around 28% of the knowledge and skills specification contents, and should take the learner approximately 8.5 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 d.c. Motors					
Knowledge					
List the types of d.c. motors and their applications	3.9	-	-	52	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe the circuit diagrams for the types of d.c. motors	3.2, 3.4	-	-	52	
3.2 d.c. Motor Operation					
Knowledge					
Describe the operation of a motor and its energy flow	3.5	-	-	52	Topic 3 Content Quiz Topic 3.2 Learning Activity
Explain torque as the product of the force on the conductors and the radius of the armature/rotor	3.7	-	-	7, 52	
Describe the effect of back e.m.f in d.c. motors	3.3	-	-	52	
Describe how to reverse the direction of a d.c. motor	3.2	-	5	52	
Skills					
Calculate the power output of a motor	3.5	2.6	-	52	Topic 3.3.1 Skills Practice
Reverse the direction of rotation of a shunt and series motor	3.2	2.7	5	52	Topic 3.3.2 Skills Practice

3 Motors					
3.3 d.c. Motor Characteristics					
Knowledge					
List the characteristic of the different types of d.c. motors	3.2	-	-	52	Topic 3 Content Quiz Topic 3.3 Learning Activity
List the risks associated with using motors (including risks of series d.c. motors)	3.6	1.3, 3.1	1.1, 1.2	52	
Skills					
Connect and test a d.c. shunt motor and series on no-load and load	3.2	2.3, 2.4, 2.5, 2.6, 2.7	2, 3, 4	52	Topic 3.3.1 Skills Practice Topic 3.3.2 Skills Practice
Identify safety risks associated with using motors (include risks of series d.c. motors)	3.6	1.3, 2.1	1.1, 1.2	52	
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					

4 Machine Efficiency					
Purpose:	In this topic you will learn about the concept of machine efficiency, losses in d.c. machines and efficiency calculations for generators and motors.				
Duration:	This topic represents around 14% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Machine Losses					
Knowledge					
Describe the losses that occur in a d.c. machine	4.2	-	-	52	Topic 4 Content Quiz Topic 4.1 Learning Activity
List the methods used to determine the losses in a d.c. machine	4.3	-	-	52	
Skills					
Determine the losses of a d.c. machine from measured results	4.3	1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 2.7, 3.1	1.1, 1.2, 2, 4, 6, 7	52	Topic 4.2 Skills Practice
4.2 Machine Efficiency					
Knowledge					
List the efficiency characteristics of a d.c. machine and the conditions for maximum efficiency	4.1	-	-	52	Topic 4 Content Quiz Topic 4.2 Learning Activity
Skills					
Determine the efficiency of a d.c. machine from measured results	4.4	1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 2.7, 3.1	1.1, 1.2, 2, 4, 6, 7	52	Topic 4.2 Skills Practice

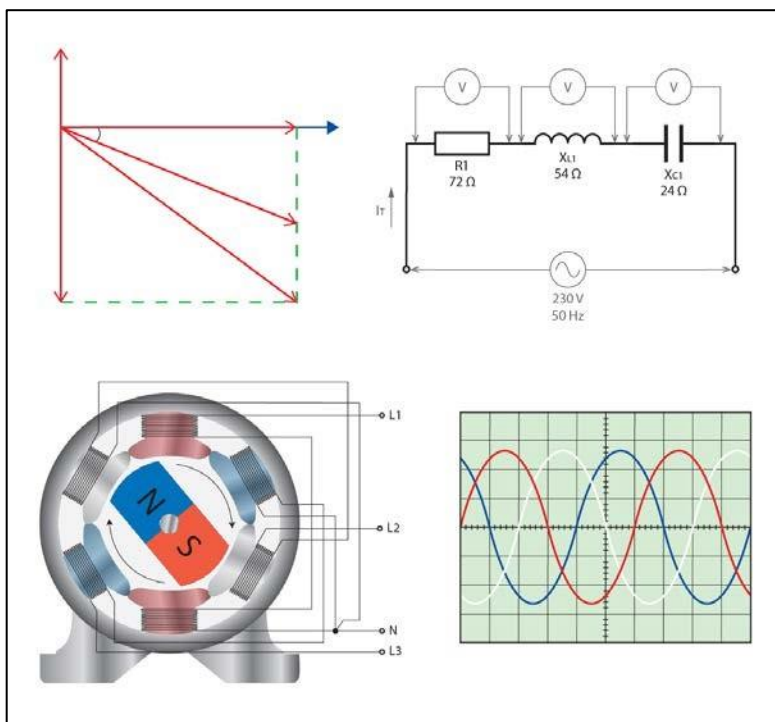
4 Machine Efficiency					
4.3 Minimum Energy Performance Standards (MEPS)					
Knowledge					
List application of Minimum Energy Performance standards (MEPS)	4.5	-	-	52	Topic 4 Content Quiz Topic 4.3 Learning Activity
Reference Text: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0020 Solve problems in low voltage a.c. circuits



Contents

Contents	2
A. Overview	4
B. Knowledge and Skills Delivery	6
1 Alternating current quantities	6
1.1 Trigonometry Ratios	6
1.2 Pythagoras' Theorem	6
1.3 CRO Operation	7
2 Phasor diagrams	9
2.1 Phasor Diagrams	9
2.2 Phasor Relationship	9
2.3 Using Phasor Diagrams	9
3 Single Element a.c. Circuits	11
3.1 Resistive a.c. Circuits	11
3.2 Inductive a.c. Circuits	11
3.3 Capacitive a.c. Circuits	12
4 RC and RL Series a.c. Circuits	14
4.1 Impedance	14
4.2 RC a.c. Circuits	14
4.3 RL a.c. Circuits	15
5 RLC Series a.c. Circuits	16
5.1 RLC Series a.c. Circuits	16
5.2 Impedance and Voltage Relationships	16
6 Parallel a.c. Circuits	18
6.1 Parallel a.c. Circuits	18
6.2 RL Parallel a.c. Circuits	18
6.3 RC Parallel a.c. Circuits	19
6.4 LC Parallel a.c. Circuits	19
6.5 RLC Parallel a.c. Circuits	20
7 Power in an a.c. Circuit	21
7.1 a.c. Power	21
7.2 Power Factor	21
7.3 a.c. Single Phase Power Measurement	22
8 Power Factor Improvement	23
8.1 Power Factor	23
8.2 Power Factor Improvement	23
9 Three Phase Systems	25
9.1 Multiphase Systems	25
9.2 Three Phase Systems	25
10 Three Phase Star Connections	27
10.1 Star Connected Systems	27
10.2 Star Connected Systems Conditions	27
11 Three Phase Four Wire Systems	29
11.1 Functions of Neutral Conductors	29
11.2 Neutral Conductors	29
11.3 Australian Standards Requirements	30
12 Three Phase Delta Connections and Interconnected Systems	31

12.1 Delta Connections	31
12.2 Delta Systems	31
12.3 Three Phase Interconnected Systems	32
13 Energy and Power Requirements of a.c. Systems	33
13.1 Three Phase Power	33
13.2 Power Factor	33
13.3 Measuring Three Phase Power	34
14 Harmonics and Resonance Effect in a.c. Systems	35
14.1 Harmonics	35
14.2 Series Resonance	36
14.3 Parallel Resonance	36
15 Earth Fault Loop Impedance	38
15.1 Earth Fault Loop Impedance	38
15.2 Australian Standards	38
15.3 Measuring Earth Fault Loop Impedance	38

A. Overview		
Competency Standard Unit (CSU)	UEEEL0020 Solve problems in low voltage a.c. circuits	
CSU Application	This unit involves the skills and knowledge required to ascertain correct operation of single and three phase alternating current (a.c.) circuits and solving circuit problems as they apply to servicing, fault finding, installation and compliance work functions. It includes safe working practices, multi-phase circuit arrangements, issues related to fault protection, power factor and multiple earthed neutral (MEN) systems and solutions to circuit problems derived from calculated and measured parameters. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) a.c. or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0020	Performance Criteria
	KE-UEEEL0020	Knowledge Evidence
	PE-UEEEL0020	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 15	72 hours
	Completion of Unit Knowledge Tests	3 hours
	Completion of Unit Skills Tests	5 hours
	Total duration of structured learning program	80 hours

	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEEEL0021 Solve problems in magnetic and electromagnetic devices and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Alternating current quantities

Purpose:	In this topic you will learn about how to apply trigonometric methods to solve electrical problems, using a cathode ray oscilloscope to measure basic electrical parameters of d.c. and a.c. waveforms and electrical quantities associated with an a.c. waveform.
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Trigonometry Ratios					
Knowledge					
State the sine, cosine and tangent ratios of a right angle triangle	KE1.2	-	-	8	Topic 1 Content Quiz Topic 1.1 Learning Activity
Skills					
Apply the sine, cosine and tangent ratios of a right angle triangle.	KE1.2	-	PE3.2	8	Topic 1 Content Quiz Topic 1.1 Learning Activity
Use a scientific calculator to find the sine, cosine and tangent of any angle.	KE1.2	-	PE3.2	8	
1.2 Pythagoras' Theorem					
Knowledge					
Explain Pythagoras' Theorem to a right angle triangle.	KE1.1	-	-	8	Topic 1 Content Quiz Topic 1.2 Learning Activity
Skills					
Apply the Pythagoras's Theorem to a right angle triangle.	KE1.1	-	PE3.2	8	

1 Alternating current quantities					
1.3 CRO Operation					
Knowledge		-	-		
Describe the basic functionality and controls of a cathode ray oscilloscope (CRO).	KE1.5	-	-	8	Topic 1 Content Quiz Topic 1.3 Learning Activity
Skills		-	-		
Correctly adjust the controls of a basic cathode ray oscilloscope (CRO) to obtain a trace on the screen.	KE1.5	2.4	PE2.1, 2.2	8	Topic 1.3 Skills Practice
Use the calibrate function of a CRO to check the calibration of the instrument.	KE1.5	2.4	PE2.1, 2.2	8	
Measure voltage level of d.c. and a.c. signals using a CRO.	KE1.5	2.4	PE2.1, 2.2	8	
1.4 a.c. Sinusoidal Waveform					
Knowledge					
Describe sinusoidal voltage generated by a single turn coil rotated in a uniform magnetic field.	KE1.3	-	-	8	Topic 1 Content Quiz Topic 1.4 Learning Activity
Define the terms period, maximum value, peak-to-peak value, instantaneous value, average value, root-mean-square (r.m.s) value, in relations to a sinusoidal waveform.	KE1.4.1, 1.4.2, 1.4.3, 1.4.4,1.4.5 , 1.4.6	-	-	8	
Skills					
Measure instantaneous, peak, peak-to-peak values and the period of a sinusoidal waveform.	KE1.4	2.4	PE2.1, 5.2	8	Topic 1.4 Skills Practice
Calculate root-mean-square (r.m.s) value and frequency of a sinusoidal waveform from values of peak voltage and period.	KE1.4	2.4	PE3.6, 5.1, 5.2	8	
Calculate instantaneous value of induced voltage.	KE1.4	2.4	PE5.2	8	

1 Alternating current quantities

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

2 Phasor diagrams						
Purpose:	In this topic you will learn about phasor diagrams and how to use these in determining values of current, voltage and phase angles in an a.c. circuit.					
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
2.1 Phasor Diagrams						
Knowledge						
Define the term vector and phasor.		KE2.1	-	-	8	Topic 2 Content Quiz Topic 2.1 Learning Activity
State the purpose of phasor diagrams.		KE2.2	-	-	8	
List the components of a phasor diagram (reference and direction of rotation – DOR).		KE2.1	-	-	8	
2.2 Phasor Relationship						
Knowledge						
State the convention for representing voltage, current and the reference quantity in a phasor diagram.		KE2.1	-	-	8	Topic 2 Content Quiz Topic 2.2 Learning Activity
Define in-phase, out-of-phase, phase angle, lead and lag.		KE2.1	-	-	8	
Skills						
Draw the phasor representation of sinusoidal alternating quantities.		KE2.1	-	PE3.1, 4.5.1	8	Topic 2.3 Skills Practice
2.3 Using Phasor Diagrams						
Knowledge						
Skills						
Identify phase angle between two or more		KE2.6	-	PE3.1	8	Topic 2.3 Skills

2 Phasor diagrams					
alternating quantities from a given sinusoidal waveform diagram.					Practice
Draw a phasor diagram to show the relationship between two or more a.c. values of voltage and/or current.	KE2.1	-	PE4.5.1	8	
Identify phase relationship between two or more sinusoidal waveforms from a given diagram and measurements.	KE2.1	-	PE3.1, 4.5.1	8	
Determine by phasor addition the total current or voltage in an a.c. circuit.	KE2.1	-	PE4.5.1	8	
Determine by phasor subtraction the total current or voltage in an a.c. circuit.	KE2.1	-	PE4.5.1	8	
Measure from a phasor diagram the individual branch currents or voltage drops across circuit components and the phase angle with respect to a reference.	KE2.1	-	PE4.5.1	8	
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					

3 Single Element a.c. Circuits						
Purpose:	In this topic you will learn about the various types of single elements a.c. circuits, namely resistive, inductive and capacitive circuits. You will also learn how Ohm’s law is applied to an a.c. circuit and the effects of capacitance and inductance in an a.c. circuit.					
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
3.1 Resistive a.c. Circuits						
Knowledge						
Describe the relationship between voltage and current in a resistive a.c. circuit.		KE3.3	-	-	8	Topic 3 Content Quiz Topic 3.1 Learning Activity
List applications of resistive a.c. circuits.		KE3.1	-	-	8	
Skills						
Perform the set up and connection of a single-source resistive a.c. circuit and take voltage and current measurements to determine the resistance.		KE3.3	2.4	PE7	8	Topic 3.1 Skill Practice
Identify the voltage, current and resistances from measurement of given values of any two of these quantities.		KE3.3	2.4	PE3.11	8	
Draw a phasor diagram for an a.c. resistive circuit.		KE3.3	2.4	-	8	
3.2 Inductive a.c. Circuits						
Knowledge						
Define the term inductive reactance.		KE3.2	-	-	6	Topic 3 Content Quiz Topic 3.2 Learning Activity
Describe the relationship (phase difference) between voltage and current in an inductive a.c. circuit.		KE3.4	-	PE3.2, 3.4	6	

3 Single Element a.c. Circuits					
List the effect and applications of inductive a.c. circuits.	KE3.1	-	PE3.3	6	
State the relationship between frequency and inductive reactance.	KE3.4	-	-	6	
Skills					
Calculate inductive reactance for a given inductor given the coil inductance and frequency.	KE3.4	2.4	PE5.3	6	Topic 3.2 Skill Practice
Apply Ohm's Law to determine voltage and current of inductive reactance in a purely inductive a.c. circuit given any two to these quantities.	KE3.4	2.4	PE5.3, 10	6	
Perform the set up and connection of a single-source inductive a.c. circuit and take voltage and current measurements to determine the inductive reactance.	KE3.4	2.4	PE7	6	
Draw the phasor diagram for an inductive a.c. circuit.	KE3.4	2.4	PE4.5.1	6	
3.3 Capacitive a.c. Circuits					
Knowledge					
Define the term capacitive reactance.	KE3.2	-	-	6	Topic 3 Content Quiz Topic 3.3 Learning Activity
Describe the relationship (phase difference) between voltage and current in a capacitive a.c. circuit.	KE3.4	-	PE3.2, 3.4	6	
List the effects and applications of capacitive a.c. circuits.	KE3.1	-	-	6	
State the relationship between frequency and capacitive reactance.	KE3.4	-		6	
Skills					
Calculate capacitive reactance for a given capacitor	KE3.4	2.4	PE5.3	6	Topic 3.3 Skill

3 Single Element a.c. Circuits

given the capacitance and frequency.					Practice
Apply Ohm's Law to determine voltage, current of capacitive reactance in a purely capacitive a.c. circuit given any two of the quantities.	KE3.4	2.4	PE5.3, 10	6	
Perform the set up and connection of a single-source capacitive a.c. circuit and take voltage and current measurements to determine the capacitive reactance.	KE3.4	2.4	PE7	6	
Draw the phasor diagram for a capacitive a.c. circuit.	KE3.4	2.4	PE4.5.1	6	

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

4 RC and RL Series a.c. Circuits						
Purpose:	In this topic you will learn about the effects of a.c. in a circuit containing a resistor and capacitor connected in series and a resistor and an inductor connected in series. You will also learn more about phasor diagrams and the impedance triangle used to show the relationships in these series circuits.					
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Impedance						
Knowledge						
Define impedance in relationship to a.c. circuits.		KE4.2	-	-	6	Topic 4 Content Quiz Topic 4.1 Learning Activity
List applications of impedances in a.c. circuits.		KE5.1	-	-	6	
4.2 RC a.c. Circuits						
Knowledge						
State the AS/NZS 3000 requirements for the installation of capacitors.		KE5.3, 15.1	-	-	6	Topic 4 Content Quiz Topic 4.2 Learning Activity
List examples of capacitive components in power circuits and systems and the effect on the phase relationship between voltage and current.		KE4.1	-		6	
Skills			-	-		
Determine the impedance, current and voltages for a series RC circuit given the resistance, capacitance and supply voltage.		KE5.3	2.4	PE3.2,	6	Topic Skills Practice 4.2
Perform the set up and connection of a single-source RC a.c. circuit and take voltage and current measurements to determine the voltage drops and phase angle.		KE4.3, 4.4	2.4	PE7	6	

4 RC and RL Series a.c. Circuits					
Draw and label an impedance triangle for a series RC circuit.	KE4.2	2.4	PE4.3	6	
Draw a phasor diagram for a series RC circuit.	KE4.1	2.4	PE4.5.2	6	
4.3 RL a.c. Circuits					
Knowledge					
List examples of inductive components in power circuits and systems.	KE4.1	-	PE3.3	6	Topic 4 Content Quiz Topic 4.3 Learning Activity
Describe inductive components effect on the phase relationship between voltage and current.	KE4.4	-	-	6	
Skills					
Determine impedance, current and voltages for a series RL circuit given the resistance, inductance and supply voltage.	KE4.4	2.4	PE3.2	6	Topic 4.3 Skills Practice
Perform the set up and connection of a single-source RL a.c. circuit and take voltage and current measurements to determine the voltage drops and phase angle.	KE4.3, 4.4	2.4	PE7	6	
Draw and label the impedance triangle for a series RL circuit.	KE4.2	2.4	PE4.3	6	
Draw the equivalent circuit of a practical inductor.	KE4.4	2.4	PE4.4	6	
Draw a phasor diagrams for a series RL circuit.	KE4.1	2.4	PE4.5.2	6	
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Phillips, P., Electrical Principles, Cengage Learning					
Standards and Codes AS/NZS 3000 Wiring Rules (current edition)					

5 RLC Series a.c. Circuits						
Purpose:	In this topic you will learn about a.c circuits that contain inductance, capacitance and resistance connected in series.					
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 RLC Series a.c. Circuits						
Knowledge						
Explain the comparison of current limiting characteristics of inductors and resistors.		KE5.1	-	PE3.3	6	Topic 5 Content Quiz Topic 5.1 Learning Activity
List practical examples of RLC series circuits.		KE5.1	-	-	6	
5.2 Impedance and Voltage Relationships						
Knowledge						
Describe relationship between impedance, current and voltages for a series a.c. RLC circuit.		KE4.4	-	-	6	Topic 5 Content Quiz Topic 5.2 Learning Activity
Skills						
Determine by calculation in a series RLC circuit the supply voltage and phase angle between circuit voltage and current.		KE5.2	2.4	PE3.2	6	Topic 5.2 Skills Practice
Using a phasor diagram, determine the supply voltage and phase angle given the voltage drops.		KE5.2	2.4	PE2.4, 4.5.2	6	
Perform the set up and connection of a single-source RLC a.c. circuit and take voltage and current measurements to determine the voltage drops and phase angle .		KE5.2	2.4	PE2.4, 7	6	
Draw and label the impedance triangle for a series		KE4.2	2.4	PE4.3	6	

5 RLC Series a.c. Circuits

RLC circuit.					
Calculate total impedance for a series RLC a.c. circuit.	KE4.2	2.4	PE5.4	6	
Calculate voltage drop for cables using the values for reactance and a.c. resistance from AS/NZS 3008.1.1	KE5.2	2.4	-	6	

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Standards and Codes

- AS/NZS 3008.1.1 (current edition)

6 Parallel a.c. Circuits						
Purpose:	In this topic you will learn about the effects of a.c. in a parallel circuit that contains resistance, inductance and capacitance.					
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
6.1 Parallel a.c. Circuits						
Knowledge						
List practical examples of parallel circuits.		KE5.1	-	-	6	Topic 6 Content Quiz Topic 6.1 Learning Activity
State the features of an a.c. parallel circuit.		KE5.1	-	-	6	
6.2 RL Parallel a.c. Circuits						
Knowledge						
List practical examples of a RL parallel circuit.		KE5.1	-	-	6	Topic 6 Content Quiz Topic 6.2 Learning Activity
Skills						
Perform the set up and connection of a single-source RL parallel a.c. circuit and take voltage and current measurements to determine the branch currents and phase angle.		KE5.3	2.4	PE2.4, 7	6	Topic 6.2 Skills Practice
Identify the branch currents of a parallel circuit that contain RL in two branches.		KE5.2, 5.3	2.4	PE2.4	6	
Draw a phasor diagram and determine the total circuit current and phase angle in parallel RL circuits.		KE5.2, 5.3	2.4	PE4.5.2	6	

6 Parallel a.c. Circuits					
Identify the total circuit impedance of parallel RL circuits.	KE5.2, 5.3	2.4	PE5.4	6	
6.3 RC Parallel a.c. Circuits					
Knowledge					
List practical examples of a RC parallel circuit.	KE5.1	-	-	6	Topic 6 Content Quiz Topic 6.3 Learning Activity
Skills					
Perform the set up and connection of a single-source RC parallel a.c. circuit and take voltage and current measurements to determine the branch currents and phase angle.	KE5.2, 5.3	2.4	PE2.4, 7	6	Topic 6.3 Skills Practice
Identify the branch currents of a parallel circuit that contain RC in two branches.	KE5.2, 5.3	2.4	PE2.4	6	
Draw a phasor diagram and determine the total circuit current and phase angle in parallel RC circuits.	KE5.2, 5.3	2.4	PE4.5.2	6	
Identify the total circuit impedance of parallel RC circuits.	KE5.2, 5.3	2.4	PE5.4	6	
6.4 LC Parallel a.c. Circuits					
Knowledge					
List practical examples of LC parallel circuits.	KE5.1	1.4	-	6	Topic 6 Content Quiz Topic 6.4 Learning Activity
Skills					
Perform the set up and connection of a single-source LC parallel a.c. circuit and take voltage and current measurements to determine the branch	KE5.2, 5.3	2.4	PE2.4, 7	6	Topic 6.4 Skills Practice

6 Parallel a.c. Circuits					
currents and phase angle.					
Identify the branch currents of a parallel circuit that contain LC in two branches.	KE5.2, 5.3	2.4	PE2.4	6	
Draw a phasor diagram and determine the total circuit current and phase angle in parallel LC circuits.	KE5.2, 5.3	2.4	PE4.5.2	6	
Identify the total circuit impedance of parallel LC circuits.	KE5.2, 5.3	2.4	PE5.4	6	
6.5 RLC Parallel a.c. Circuits					
Knowledge					
List practical examples of RLC parallel circuits.	KE5.1	-		6	Topic 6 Content Quiz Topic 6.4 Learning Activity
Skills					
Measure branch currents in a parallel RLC circuit and use a phasor diagram to determine the total current and phase angle between circuit voltage and circuit current.	KE5.2, 5.3	2.4	PE2.4, 7	6	Topic 6.5 Skills Practice
Identify branch impedance, branch currents and phase angles voltages for a parallel RLC circuit given resistance, inductance, and capacitance and supply voltage.	KE5.2, 5.3	2.4	PE2.4	6	
Calculate impedance for a parallel RLC circuit.	KE5.2, 5.3	2.4	PE5.4	6	
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					

7 Power in an a.c. Circuit					
Purpose:	In this topic you will learn about power in a single phase a.c. circuit. This includes the relationship between true, reactive and apparent power and the methods used to measure a.c. power.				
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 a.c. Power					
Knowledge					
State the difference between true power, apparent power and reactive power and the units in which these quantities are measured.	KE6.1	-	-	11	Topic 7 Content Quiz Topic 7.1 Learning Activity
Explain the purpose of a power triangle.	KE6.1	-	-	11	
Skills					
Calculate the true, reactive and apparent power in an a.c. load given the voltage, current and either the power factor, phase angle or resistance.	KE6.1	2.4	PE3.5	11	Topic 7.1 Skills Practice
Draw the power triangle to show the relationships between true power, apparent power and reactive power.	KE6.1	2.4	PE4.1	11	
7.2 Power Factor					
Knowledge					
Define the terms 'power factor' and 'phase angle'.	KE6.1	-	-	11	Topic 7 Content Quiz Topic 7.2 Learning Activity
Skills		-	-		
Determine the power factor and phase angle of a single phase circuit.	KE6.1	2.6	PE2.2	11	

7 Power in an a.c. Circuit					
7.3 a.c. Single Phase Power Measurement					
Knowledge					
List methods used to measure power, energy and demand in a single phase circuit.	KE6.2	-	-	11	
Skills					
Measure true power and apparent power using test equipment.	KE6.2	2.4, 2.6	PE3.5	11	Topic 7.1 Skills Practice
Connect a wattmeter to measure true power.	KE6.2	2.4, 2.6	PE3.5	11	
Reference Texts: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					

8 Power Factor Improvement						
Purpose:	In this topic you will learn about the importance of power factor and the methods used for power factor improvement.					
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
8.1 Power Factor						
Knowledge						
List the type of loads that causes low power factor.		KE6.3	-	-	11	Topic 8 Content Quiz Topic 8.1 Learning Activity
State the disadvantages and effects of low power factor in a single phase circuit.		KE6.3	-	-	11	
Explain the effect of load power factor on the voltage drop of the supply cables (refer to AS/NZS 3008.1.1:2017 – Clause 4.5).		KE7.3	-	-	11	
8.2 Power Factor Improvement						
Knowledge						
Explain the requirements for power factor improvement.		KE7.1	2.5	-	11	Topic 8 Content Quiz Topic 8.2 Learning Activity
List methods used to improve low power factor of an installation.		KE7.2	2.5	-	11	
State the local supply authority and AS/NZS 3000:2018 wiring rules requirements regarding the power factor of an installation and power factor improvement equipment.		KE7.4, 15.2	2.5	-	11	
List the methods used to measure single phase power factor.		KE7.2	2.5	-	11	

8 Power Factor Improvement					
Skills		-	-		
Determine the power factor of a single phase circuit by measurement and calculation.	KE7.2	2.6	PE4.1	11	Topic 8.1 Skills Practice
Determine the value of capacitance and /or VARs required to improve the power factor of a given circuit to a specified value.	KE7.2	2.6	PE4.1, 8, 11	11	
Utilise the manufacturer’s catalogues to select power factor equipment for a particular installation.	KE7.5, 17	2.7	PE8, 11	11	
Reference Texts: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning Standards and Codes • AS/NZS 3008.1.1 (current edition)					

9 Three Phase Systems						
Purpose:	In this topic you will learn about how a three phase voltage system is produced with an alternator. You will also learn how the phase voltages in a three phase system are represented with a phasor diagram.					
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
9.1 Multiphase Systems						
Knowledge						
List the features of a multiphase system.		KE9.1	-	-	8, 9	Topic 9 Content Quiz Topic 9.1 Learning Activity
Explain the comparison of voltages generated by single and multiphase alternators.		KE9.2	-	-	8, 9	
State the reasons for the adoption of three phases for power systems.		KE9.4	-	-	8, 9	
9.2 Three Phase Systems						
Knowledge						
Describe how three phases are generated in an alternator.		KE9.3	-	-	8	Topic 9 Content Quiz Topic 9.2 Learning Activity
Describe the relationship between the phase voltages generated in a three phase alternator and the conventions for identifying each.		KE9.5, 16	-	-	8	
Define the term 'phase sequence (also, referred to as 'phase rotation')'.		KE9.6	-	-	8	
Skills						
Calculate r.m.s value of voltage generated in each phase given the maximum value.		KE9.5	2.4	PE5.1	8	Topic 9.2 Skills Practice
Connect a three phase load and measure the voltage and current levels.		KE9.5	2.4	PE6	8	

9 Three Phase Systems

Identify and measure the phase sequence of a three phase supply.

KE9.6

2.4

PE3.12

8

Reference Texts:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning
-

10 Three Phase Star Connections					
Purpose:	In this topic you will learn about the principles associated with star connected three phase systems.				
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
10.1 Star Connected Systems					
Knowledge					
List the features of star connected systems and the common applications.	KE10.1	-	-	9	Topic 10 Content Quiz Topic 10.1 Learning Activity
Describe the relationship between line and phase voltages of a star connected system.	KE10.1, 16	-	-	9	
Describe the relationship between line and phase current of a star connected system.	KE10.1, 16	-	-	9	
Skills					
Perform the connection of a three phase star connected load.	KE10.1	2.4	PE6	9	Topic 10.1 Skills Practice
Measure line and phase voltages and currents.	KE10.1	2.4	PE3.6	9	
Calculate r.m.s value of line and phase voltage given any one of these quantities.	KE10.1	2.4	PE3.6	9	
Calculate r.m.s value of line and phase current given any one of these quantities.	KE10.1	2.4	PE3.6	9	
10.2 Star Connected Systems Conditions					
Knowledge					
Define the terms 'balanced load' and 'unbalanced load'.	KE10.4	-	-	9	Topic 10 Content Quiz Topic 10.2 Learning Activity
List the effects of a reversed phase winding of a	KE10.2	-	-	9	

10 Three Phase Star Connections					
star connected alternator.					
Skills		-	-		
Demonstrate an example of balanced and unbalanced loads in typical power systems.	KE10.3	2.4	PE6	9	Topic 10.2 Skills Practice
Investigate the effects of a reversed phase winding of a star connected system.	KE10.2	2.4	PE13	9	
Reference Texts: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					

11 Three Phase Four Wire Systems						
Purpose:	In this topic you will learn about the principles associated with a three phase four wire connected system, and how to determine the current in the neutral conductor.					
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
11.1 Functions of Neutral Conductors						
Knowledge						
State the functions of the neutral conductor in a three phase four wire system.		KE11.1	-	-	9	Topic 11 Content Quiz Topic 11.1 Learning Activity
Describe the effects of high impedance in the neutral conductor of a three phase four wire systems supplying an unbalanced load where MEN earthing is employed.		KE11.1	-	PE3.7	9	
Explain the effect in an unbalanced load on cable voltage drop determination (refer to AS/NZS 3008.1.1:2017 – Section 4.6).		KE11.3, 15.4		PE3.8	9	
11.2 Neutral Conductors						
Knowledge						
List the effects of broken/disconnected neutral conductors in balanced and unbalanced load conditions.		KE11.3	-	PE3.7	9	Topic 11 Content Quiz Topic 11.2 Learning Activity
Skills			-	-		
Determine the current in the neutral conductor in balanced and unbalanced load conditions.		KE11.1, 11.2	2.4	PE3.8, 6, 13	9	Topic 11.2 Skills Practice
Determine the star point voltage in an unbalanced load with a broken/disconnected neutral conductor.		KE11.1, 11.2	2.4	PE3.7, 6, 13	9	

11 Three Phase Four Wire Systems					
Identify the value and phase relationship of neutral current in an unbalanced three phase four wire system given line currents and power factors.	KE11.2	2.4	PE3.8, 13	9	
11.3 Australian Standards Requirements					
Knowledge					
State the AS/NZS 3000 requirements regarding neutral conductors.	KE11.2	-	-	9	Topic 11 Content Quiz Topic 11.3 Learning Activity
List the factors that must be considered when determining the size of the neutral conductor.	KE11.2	-	-	9	
Skills					
Use the AS/NZS 3000 wiring rules to determine the size of the neutral conductor in given situations.	KE11.2, 15.4	2.4	PE13	9	Topic 11 Content Quiz Topic 11.3 Learning Activity
Reference Texts: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning Standards and Codes - AS/NZS 3000 (current edition) - AS/NZS 3008.1.1 (current edition)					

12 Three Phase Delta Connections and Interconnected Systems						
Purpose:	In this topic you will learn about delta connected three phase systems and the relationships between the values of line and phase voltage and line and phase currents. You will also learn about three phase interconnected star and delta systems and the effects on star and the delta systems when an open circuit occurs in one line.					
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
12.1 Delta Connections						
Knowledge						
List the typical applications where delta connections are used.		KE12.1	-	-	9	Topic 12.1 Content Quiz Topic 12.1 Learning Activity
Describe the features of delta connections.		KE12.1	-	-	9	
Describe the phase relationship between line and phase voltages of a delta connected system.		KE12.1, 16	-	-	9	
Describe the phase relationship between line and phase currents of a delta connected system.		KE12.1, 16	-	-	9	
Skills						
Perform the connection of three phase delta load.		KE12.1	2.4	PE6	9	Topic 12 Content Quiz Topic 12.1 Learning Activity Topic 12.2 Skills Practice 1 Topic 12.2 Skills Practice 2
Measure the line and phase voltages and currents in a delta connected system.		KE12.1	2.4	PE3.6	9	
Calculate the r.m.s value of line and phase voltage given any one of these quantities.		KE12.1	2.4	PE3.6	9	
Calculate the r.m.s value of line and phase current given any one of these quantities.		KE12.1	2.4	PE3.6	9	
12.2 Delta Systems						
Knowledge						
List the limitations and uses of open delta		KE12.4	-	-	9	Topic 12 Content Quiz

12 Three Phase Delta Connections and Interconnected Systems					
connections.					Topic 12.2 Learning Activity
Explain the effects of a reversed phase winding of a delta connected transformer.	KE12.2	-	-	9	
Skills		-	-		
Connect an open delta system and measure the line and phase voltages and currents.	KE12.4	2.4	PE6	9	Topic 12.2 Skills Practice
Carry out a test on a delta connected transformer to check for phase reversal.	KE12.2	2.4	PE6	9	Topic 12.2 Skills Practice
12.3 Three Phase Interconnected Systems					
Knowledge					
List the typical loads, supplies and configurations found in three phase power systems.	KE12.3	-	PE4.2	9	Topic 11 Content Quiz Topic 11.3 Learning Activity
State examples of loads in typical power systems.	KE12.3		-	9	
Skills					
Draw the typical combinations of three phase interconnected systems using star and delta connections.	KE12.3	2.4	PE4.2	9	Topic 11 Content Quiz Topic 11.3 Learning Activity
Identify a relationship between line and phase voltages and line and phase currents in the typical interconnected systems using star connections and delta connections.	KE12.3, 16	2.4	PE4.2	9	Topic 12.2 Skills Practice Topic 12.2 Skills Practice
Identify system conditions with interconnected systems if one line is lost.	KE12.3	2.4	PE4.2,	9	
Reference Texts: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning					

13 Energy and Power Requirements of a.c. Systems					
Purpose:	In this topic you will learn how to calculate and measure power in a three phase supply system.				
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
13.1 Three Phase Power					
Knowledge					
List the difference between true power, apparent power and reactive power and the units in which these quantities are measured in a three phase system.	KE13.2	-	-	8	Topic 13.1 Content Quiz Topic 13.1 Learning Activity
Skills					
Draw the power triangle to show the relationships between true power, apparent power and reactive power in a three phase system.	KE13.2	-	PE4.1	8	Topic 13.2 Skills Practice
13.2 Power Factor					
Knowledge					
List the methods used to improve the power factor of a three phase installation	KE13.1	-	-	11	Topic 13 Content Quiz Topic 13.2 Learning Activity
Skills		-	-		
Identify how the power factor of a three phase installation can be improved.	KE13.1	2.5	PE3.9, 11, 13	11	Topic 13 Content Quiz Topic 13.2 Learning Activity Topic 13.3 Skills
Apply the use of manufactures catalogues to select power factor improvement equipment for a	KE13.4, 17	2.5	PE3.9, 11, 13	11	

13 Energy and Power Requirements of a.c. Systems					
particular installation.					Practice
13.3 Measuring Three Phase Power Knowledge					
List the purposes for measuring power, energy, power factor and maximum demand of a.c. three phase power systems and loads.	KE13.1	-	-	8	Topic 13 Content Quiz Topic 13.3 Learning Activity
Skills					
Select appropriate methods to measure three phase power, energy, power factor and demand.	KE13.3	2.4	PE3.9, 13	8	Topic 13.3 Skills Practice
Apply the use of manufactures catalogues to select measurement equipment for a particular installation.	KE13.4, 17	2.4	PE3.9, 13	8	
Reference Texts: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					

14 Harmonics and Resonance Effect in a.c. Systems						
Purpose:	In this topic you will learn about harmonics in a.c. circuits and the effects of series and parallel resonance effects in an a.c. system.					
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
14.1 Harmonics						
Knowledge						
Define the term 'harmonic' in relation to the sinusoidal waveform of an a.c. power system.		KE8.7	-	-	21	Topic 14.1 Content Quiz Topic 14.1 Learning Activity
State the classifications of harmonics in an a.c. system.		KE8.7	-	-	21	
List sources in a.c. systems that produce harmonics.		KE8.6	-	-	21	
Describe problems that may arise in a.c. circuits as a result of harmonics and how these are overcome.		KE8.5, 15.3	-	-	21	
State the AS/NZS 3000:2018 and the local supply authority requirements concerning harmonics in a.c. power systems.		KE8.7	-	-	21	
State the effects of harmonics on cables current carrying capacity (refer to AS/NZS 3008.1.1:2017 appendix C).		KE8.5	-	-	21	
Skills						
Use test equipment to test a.c. systems for harmonics.		KE8.3	2.4	PE13	21	Topic 14.1 Skills Practice
Apply methods used to reduce harmonics in a.c. power systems.		KE8.4	2.4	PE13	21	

14 Harmonics and Resonance Effect in a.c. Systems					
14.2 Series Resonance					
Knowledge					
Describe conditions in a series a.c. circuit that produce resonance conditions.	KE8.1	-	-	6	Topic 14 Content Quiz Topic 14.2 Learning Activity
List the dangers created by a series resonance circuit.	KE8.2, 15.3	-	-	6	
State the AS/NZS 3000:2018 and the local supply authority requirements concerning resonance effect in a.c. power systems.	KE8.2	-	-	6	
Skills		-	-		
Perform the set up and connection of a single-source RLC series a.c. circuit to demonstrate the resonance effect.	KE8.2	2.4	PE13	6	Topic 14.2 Skills Practice
14.3 Parallel Resonance					
Knowledge					
Describe conditions in a parallel a.c. circuit that produce resonance conditions.	KE8.1	-	-	6	Topic 14 Content Quiz Topic 14.3 Learning Activity
List the dangers of parallel resonance circuits.	KE8.2, 15.3	-	-	6	
State the AS/NZS 3000:2018 and the local supply authority requirements concerning resonance effect in a.c. power systems.	KE8.2	-	-	6	
Reference Texts: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning					
Standards and Codes AS/NZS 3000 (current edition)					

14 Harmonics and Resonance Effect in a.c. Systems

- AS/NZS 3008.1.1 (current edition)

15 Earth Fault Loop Impedance					
Purpose:	In this topic you will learn about the importance of earth fault loop impedance.				
Duration:	This topic represents around 5.5% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
15.1 Earth Fault Loop Impedance					
Knowledge					
Define the term earth fault loop impedance of an a.c. power system.	KE14.2	-	-	16	Topic 15.1 Content Quiz Topic 15.1 Learning Activity
State the importance of the earth fault loop impedance.	KE14.2	-	-	16	
15.2 Australian Standards					
Knowledge					
List the factors to be considered in calculating earth fault loop impedance of a circuit.	KE14.2	-	PE3.10	16	Topic 15 Content Quiz Topic 15.2 Learning Activity
Skills		-	-		
Identify the relevant clauses in AS/NSZ 3000 associated with earth fault loop impedance.	KE14.2	-	PE3.10	16	Topic 15 Content Quiz Topic 15.2 Learning Activity
Identify earth fault loop impedance using resistance and reactance values from AS/NZS 3008.1.1.	KE14.2	-	PE3.10	16	
15.3 Measuring Earth Fault Loop Impedance					
Knowledge					
List the procedures for testing earth fault loop impedance.	KE14.1	2.4	-	16, 30	Topic 14 Content Quiz Topic 14.3 Learning

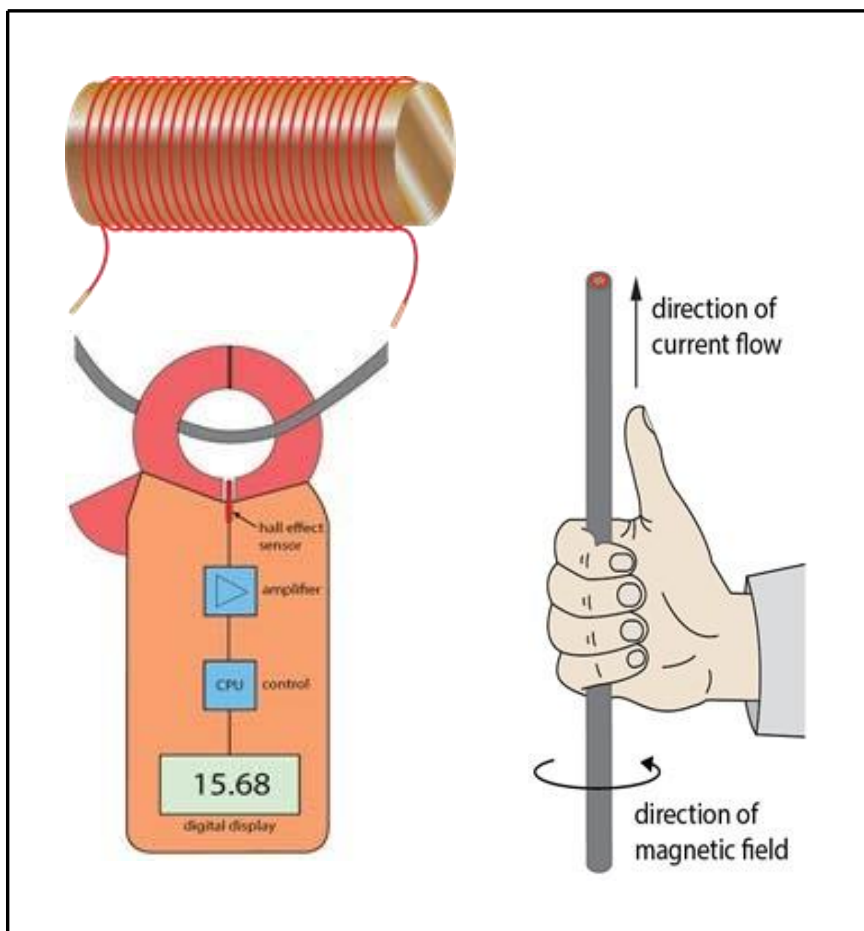
15 Earth Fault Loop Impedance					
					Activity
Skills					
Apply measuring methods for earth fault loop impedance of typical circuits.	KE14.1	2.4	PE2.3, 3.10	16, 30	Topic 15.3 Skills Practice
Reference Texts: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning Standards and Codes - AS/NZS 3000 (current edition) - AS/NZS 3008.1.1 (current edition)					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria		

Unit Learning Plan

UEEEL0021 Solve problems in magnetic and electromagnetic devices



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Magnetism	5
1.1 Permanent Magnet Principles	5
1.2 Magnetic Materials	5
1.3 Applications of Permanent Magnets	5
2 Electromagnetism	7
2.1 Electromagnetism Principles	7
2.2 Electromagnetic Forces	7
2.3 Applications of Electromagnets	8
3 Magnetic Circuits	9
3.1 Magnetic Terms	9
3.2 Magnetic Materials Characteristics	9
3.3 Magnetic Circuits	10
4 Electromagnetic Induction	11
4.1 Electromagnetic Induction Principles	11
4.2 Lenz's Law	11
4.3 Applications	12
5 Inductance	13
5.1 Inductors	13
5.2 Inductance Terms	13
5.3 RL Time Constants	14
6 Measurement Instruments	15
6.1 Measurement Instruments	15
6.2 Applications of Instruments	15
6.3 Instrument Selection and Maintenance	16
7 Magnetic Devices	17
7.1 Relays and Contactors	17
7.2 Magnetic Sensing Devices	17

A. Overview		
Competency Standard Unit (CSU)	UEEEL0021 Solve problems in magnetic and electromagnetic devices	
CSU Application	This unit involves the skills and knowledge required to determine correct operation of electromagnetic devices and related circuits and provide solutions as they apply to electrical installations and equipment. It includes working safely; applying power circuit problem-solving processes, including the use of testing and measuring devices; and providing solutions derived from measurements and calculations to predictable problems in electromagnetic devices and related circuits. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0021	Performance Criteria
	KE-UEEEL0021	Knowledge Evidence
	PE-UEEEL0021	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 7	27 hours
	Completion of Unit Knowledge Test	1 hour 15 minutes

	Completion of Unit Skills Test	1 hour 45 minutes
	Total duration of structured learning program	30 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace - and • UEECD0043 Solve problems in direct current circuits - or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits	

B. Knowledge and Skills Delivery

1 Magnetism

Purpose:	In this topic you will learn about the basic principles of magnetism.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Permanent Magnet Principles					
Knowledge					
Explain the magnetic field pattern of bar and horse-shoe magnets	KE1.2	-	-	7	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the magnets attraction and repulsion when brought in contact with each other	KE1.3	-	-	7	
Skills					
Map the magnetic fields of permanent magnet in various configurations	KE1.2, KE1.3	-	-	7	Topic 1.1 Skills Practice
1.2 Magnetic Materials					
Knowledge					
List common magnetic and non-magnetic materials and groupings (diamagnetic, paramagnetic and ferromagnetic material)	KE1.1	-	-	7	Topic 1 Content Quiz Topic 1.2 Learning Activity
1.3 Applications of Permanent Magnets					
Knowledge		-	-		
State the principles of magnetic screening (shielding) and its applications	KE1.5	-	-	7	Topic 1 Content Quiz Topic 1.3 Learning Activity
List practical application of permanent magnets	KE1.4	-	-	7	

1 Magnetism

Explain the construction, operation and applications of reed switches

KE1.4

-

-

7

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

2 Electromagnetism					
Purpose:	In this topic you will learn about the basic principles of electromagnetism.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Electromagnetism Principles					
Knowledge					
State the conventions representing direction of current flow in a conductor	KE2.1	-	PE3.1	7	Topic 2 Content Quiz Topic 2.1 Learning Activity
Describe the magnetic field pattern around a single conductor and two adjacent conductors carrying current	KE2.1	-	PE3.1	7	
Explain the 'right hand rule' to determine the direction of magnetic field around a current carrying conductor	KE2.4	-	-	7	
Explain the magnetomotive force (m.m.f.) and its relationship to the number of turns in a coil and the current flowing in the coil	KE2.5	-	-	7	
Skills					
Demonstrate the use of the right hand rule to determine direction of a magnetic field	KE2.1	-	PE3.1	7	Topic 2.3 Skills Practice
Use the right hand rule to determine the direction of magnetic field around a current carrying coil	KE2.1	-	-	7	
Identify a magnetic field around an electromagnet	KE2.4	-	-	7	
2.2 Electromagnetic Forces					
Knowledge					

2 Electromagnetism					
List the effects of current, length and distance apart on the force between conductors (including forces on bus bars during fault conditions)	KE2.3	-	PE3.2	7	Topic 2 Content Quiz Topic 2.2 Learning Activity
Explain the direction of force between adjacent current carrying conductors	KE2.2	-	PE3.2	7	
Skills					
Identify the direction of force between adjacent current carrying conductors	KE2.4	-	-	7	Topic 2.3 Skills Practice
2.3 Applications of Electromagnets					
Knowledge					
List applications of electromagnetics	KE2.6	-	-	7	Topic 2 Content Quiz Topic 2.3 Learning Activity
Skills					
Apply practical applications of electromagnets	KE2.6	-	-	7	Topic 2.3 Skills Practice
Reference Text: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning					

3 Magnetic Circuits					
Purpose:	In this topic you will learn about the basic concepts relating to magnetic circuits.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Magnetic Terms					
Knowledge					
Define magnetic flux and state its unit and symbol	KE3	-	-	7	Topic 3 Content Quiz Topic 3.1 Learning Activity
Define reluctance as the opposition to the establishment of magnetic flux and state its unit and symbol	KE3	-	-	7	
Define permeability and state its unit and symbol	KE3	-	-	7	
Define flux density and state its unit and symbol	KE3	-	-	7	
Define the magnetising force of a magnetic circuit and state its unit and symbol	KE3	-	-	7	
Describe the difference for magnetic and non-magnetic materials in regards to reluctance and permeability	KE3	-	-	7	
Skills					
Calculation of the m.m.f., magnetic flux or reluctance given any two values	KE3	-	-	7	Topic 3 Content Quiz Topic 3.1 Learning Activity
Calculate the flux density of a magnetic circuit	KE3	-	-	7	
Calculate the magnetising force of a magnetic circuit	KE3	-	-	7	
3.2 Magnetic Materials Characteristics					
Knowledge					

3 Magnetic Circuits					
Describe the magnetic characteristics using graphical representation for various materials and identify the various regions	KE4	-	-	7	Topic 3 Content Quiz Topic 3.2 Learning Activity
List factors which determine losses in magnetic material	KE4	-	-	7	
State the methods used to reduce electrical losses in a magnetic circuit	KE4	-	-	7	
3.3 Magnetic Circuits					
Knowledge					
List the common magnetic circuit types	KE3	-	-	7	Topic 3 Content Quiz Topic 3.3 Learning Activity
List the effect of air gap on magnetic circuit	KE3	-	-	7	
Define the term 'magnetic leakage' and 'magnetic fringing'	KE3	-	-	7	
Reference Text:					
• Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					

4 Electromagnetic Induction					
Purpose:	In this topic you will learn about the basic principles of electromagnetic induction.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Electromagnetic Induction Principles					
Knowledge					
State the principle of electromagnetic induction (Faraday's law of electromagnetic induction)	KE5.1	-	-	7	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe the purpose of 'Fleming's right hand rule'	KE5.1	-	-	7	
Skills					
Apply Fleming's right hand rule to a current carrying conductor under the influence of a magnetic field	KE5.1	-	-	7	Topic 4 Content Quiz Topic 4.1 Learning Activity Topic 4.3 Skills Practice
Calculate the induced e.m.f. in a conductor given the conductor length, flux density and velocity of the conductor	KE5.1	-	-	7	
Calculate the force on a conductor given the flux density of the magnetic field, length of the conductor and the current being carried by the conductor	KE5.1	-	-	7	
4.2 Lenz's Law					
Knowledge					
Define Lenz's law	KE5.3	-	-	7	Topic 4 Content Quiz Topic 4.2 Learning Activity

4 Electromagnetic Induction					
Skills		-	-		
Calculate the induced e.m.f in a coil given the number of turns in a coil and the rate of change of flux	KE5.3	-	-	7	Topic 4 Content Quiz Topic 4.2 Learning Activity
4.3 Applications					
Knowledge					
List the applications of electromagnetic induction	KE5.2	-	-	7	Topic 4 Content Quiz Topic 4.3 Learning Activity
Skills					
Demonstrate the principles of electromagnetic induction	KE5.2	-	-	7	Topic 4.3 Skills Practice
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Phillips, P., Electrical Principles, Cengage Learning					

5 Inductance						
Purpose:	In this topic you will learn about the concept of inductance, self-inductance and mutual inductance and their effect on the operation of a d.c. circuit.					
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 Inductors						
Knowledge						
Describe the construction of an inductor, including a bifilar winding inductor		KE6.4	-	-	7	Topic 5 Content Quiz Topic 5.1 Learning Activity
Describe the Australian Standard circuit diagram symbol for the four types of inductors		KE6.2	-	-	7	
List the effect of physical parameters on the inductance of an inductor		KE6.6	-	-	7	
List the common types of inductor cores		KE6.3	-	-	7	
List the applications of the different types of inductors		KE6.1	-	-	7	
5.2 Inductance Terms						
Knowledge						
Define self-induction, inductance and mutual inductance		KE6.5	-	-	7	Topic 5 Content Quiz Topic 5.2 Learning Activity
List the undesirable effects of self and mutual induction		KE6.9	-	PE1.1	7	
Explain how mutual induction occurs between two coils		KE6.5	-	-	7	
Describe the graphical relationship between load		KE6.7	-	-	7	

5 Inductance					
voltage, current and self-induced e.m.f. in a single d.c. circuit having inductance					
Skills					
Calculate the value of self-induced e.m.f. in a coil	KE6.7	-	-	7	Topic 5.2 Skills Practice
Apply practical applications for the effect of self and mutual induction	KE6.8	-	-	7	
5.3 RL Time Constants					
Knowledge					
Define the term 'time constant'	KE6.5	-	-	7	Topic 5 Content Quiz Topic 5.3 Learning Activity
Skills					
Draw the characteristic curve as applied to a series circuit containing an inductor and a resistor (RL circuit)	KE6.5	-	-	7	Topic 5 Content Quiz Topic 5.3 Learning Activity
Calculate the value of the time constant in an RL circuit given the values of the components	KE6.5	-	-	7	
Calculate the value of the time constant in an RL circuit to reach its final value	KE6.5	-	-	7	
Identify instantaneous values of voltage and current in an RL circuit using a universal time constant chart	KE6.5	-	-	7	
Reference Text: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning					

6 Measurement Instruments						
Purpose:	In this topic you will learn about the construction, operation, selection and use of measurement instruments.					
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
6.1 Measurement Instruments						
Knowledge						
Describe the construction and operation of moving coil meters		KE7	-	-	7	Topic 6 Content Quiz Topic 6.1 Learning Activity
Describe the construction and operation of moving iron meters		KE7	-	-	7	
Describe the construction and operation of dynamometer meters		KE7	-	-	7	
Describe the construction and operation of the two types of clamp testers		KE7	-	-	7	
Skills						
Calculate the resistance of shunts to extend the range of ammeters		KE7	-	-	7	Topic 6 Content Quiz Topic 6.1 Learning Activity
Calculate resistance of multipliers to extend the range of voltmeters		KE7	-	-	7	
6.2 Applications of Instruments						
Knowledge						
List the practical applications for moving coil, moving iron and dynamometer meter movements		KE7	-	-	7	Topic 6 Content Quiz Topic 6.2 Learning Activity
List the practical applications for both types of		KE7	-	-	7	

6 Measurement Instruments					
clamp testers					
6.3 Instrument Selection and Maintenance					
Knowledge					
List the factors (safety category) to be considered in selecting meters for a particular application	KE7	1.4	-	7	Topic 6 Content Quiz Topic 6.3 Learning Activity
Reference Text: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning					

7 Magnetic Devices						
Purpose:	In this topic you will learn about the basic construction, operating principles and applications of common electromagnetic devices.					
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
7.1 Relays and Contactors						
Knowledge						
Describe the construction, operation and applications of relays		KE8.1.2, KE8.1.3	-	-	7	Topic 7 Content Quiz Topic 7.1 Learning Activity
Describe the construction, operations and application of contactors		KE8.1.2, KE8.1.3	-	-	7	
Describe the magnetic methods used to extinguish the arc between opening contacts		KE8.2	-	-	7	
Skills						
Demonstrate the use of relays		KE8.1.2, KE8.1.3	-	-	7	Topic 7.1 Skills Practice
7.2 Magnetic Sensing Devices						
Knowledge						
Describe the construction, operation and applications of Hall Effect devices		KE8.1.1	-	-	7	Topic 7 Content Quiz Topic 7.2 Learning Activity
Describe the operation and application of magnetostriction equipment		KE8.1.1	-	-	7	
Describe the construction, operation and application of magnetic sensing devices		KE8.1.1	-	-	7	
Reference Texts:						
• Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education						

7 Magnetic Devices

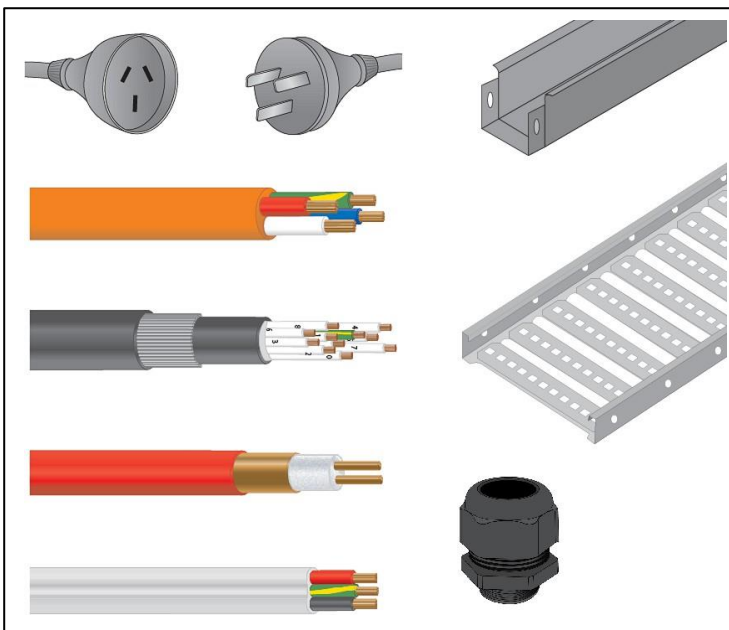
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0023 – Terminate cables, cords and accessories for low voltage circuits



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Cable Types and Terminations	5
1.1 Types of Cables	5
1.2 Cable Construction	5
1.3 Cable Terminations	6
2 Cords, Cables and Plugs	8
2.1 Selection of Flexible Cords	8
2.2 Terminating Plugs and Sockets	8
3 Flat TPS Wiring Systems	10
3.1 Flat TPS Wiring Systems	10
4 Circular TPS Wiring Systems	12
4.1 Circular TPS Wiring Systems	12
5 TPI in Non-metallic Enclosures	14
5.1 TPI in Non-metallic Enclosures	14
6 TPI in Metallic Enclosures	16
6.1 TPI in Metallic Enclosures	16
7 Fire Protection Cabling and Systems	18
7.1 Fire Protection Cabling and Systems	18
8 Steel Wire Armoured (SWA) Cables	20
8.1 Steel Wire Armoured (SWA) Cables	20
9 Trailing Cables and Catenary Systems	22
9.1 Trailing Cable Systems	22
9.2 Catenary Wiring Systems	22

A. Overview		
Competency Standard Unit (CSU)	UEEEL0023 Terminate cables, cords and accessories for low voltage circuits	
CSU Application	This unit involves the skills and knowledge required to terminate cables, cords and their conductors at accessories and current-using devices, designed to operate at voltages up to 1,000 volts (V) alternating current (a.c.) or 1,500 V direct current (d.c.). It includes working safely to industry standards, wiring systems, cable types and applications; selecting appropriate termination accessories; preparing and terminating cables and cords; terminating cables/cord conductors; and ensuring completed termination complies with industry standard requirements. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 V a.c. or 120 V d.c. Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0023	Performance Criteria
	KE-UEEEL0023	Knowledge Evidence
	PE-UEEEL0023	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 9	36 hours
	Completion of Unit Knowledge Test	1 hour 30 minutes
	Completion of Unit Skills Test	2 hours 30 minutes

	Total duration of structured learning program	40 hours
	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits	

B. Knowledge and Skills Delivery

1 Cable Types and Terminations

Purpose:	In this topic you will learn about the various types of cables and conductors used in the industry, how to terminate these cables and conductors and the applications of these cables and conductors.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Types of Cables					
Knowledge					
State the cable variants (single cables, flexible cables, flexible cords, shielded cables, armoured cables, ribbon cables, other similar and like cables).	1.3	-	-	32	Topic 1 Content Quiz Topic 1.1 Learning Activity
List the application of various cords and cable types.	1.1	-	-	32	
Skills					
Identify cords and cables by conductor size, type and rating.	1.5	1.5	5.4	32	Topic 1 Content Quiz Topic 1.1 Learning Activity Topic 1.3 Skills Practice
1.2 Cable Construction					
Knowledge					
Describe the construction of common cables.	1.4, 11	-	-	32	Topic 1 Content Quiz Topic 1.2 Learning Activity
List the structural components of cables and their purpose - conductor material, stranding, insulation type, voltage rating, screening, sheathing, armour and serving.	1.8, 11	-	-	32	

1 Cable Types and Terminations					
State the Australian and International colour standards for cords and cables.	1.2, 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7	-	-	32	
1.3 Cable Terminations					
Knowledge					
Explain the preparation and termination of cords and cables.	1.9	-	-	33	Topic 1 Content Quiz Topic 1.3 Learning Activity
Describe the types of hardware used in terminating cords, cables and conductors.	1.6	1.4, 1.5	5.4	33	
Skills					
Perform the termination of cords and cables using crimp lugs, tunnel connectors, soldering and solder less lugs.	1.9	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.2, 5.3	33	Topic 1.3 Skills Practice
Apply requirements to protect and support cables adequately - protection against mechanical damage, protection from adverse temperatures and corrosion and protection form magnetic field that may affect the performance of the cables.	1.7	1.4, 1.5	1, 2, 3, 4, 5.2, 5.3	33	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education					
Standards and Codes: AS/NZS 3000 Wiring Rules					

1 Cable Types and Terminations

Equipment:

- TPI cables
- TPS cables
- SWA cables
- Fire performance cables
- Flexible cords and cables
- Crimp lugs, tunnel connectors and solderless lugs
- Soldering iron and soft solder
- Multimeter
- Insulation resistance tester

2 Cords, Cables and Plugs					
Purpose:	In this topic you will learn about the various types of flexible cords, cables and plugs used in the industry, how to prepare and terminate these cords, cables and plugs and the applications of these cords, cables and plugs.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Selection of Flexible Cords					
Knowledge					
List the requirements of AS/NZS 3000 for flexible cords, cables and plugs.	10.1	-	-	32	Topic 2 Content Quiz Topic 2.1 Learning Activity
Skills					
Select flexible cords/cables for given applications.	2.1	1.4, 1.5	5.4	32	Topic 2 Content Quiz Topic 2.1 Learning Activity
2.2 Terminating Plugs and Sockets					
Knowledge					
Describe the techniques in fitting standard three pin plug tops to a flexible cord.	2.3, 2.4	-	-	33	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe the techniques for fitting three pin extension sockets to a flexible cord.	2.3, 2.4	-	-	33	
Skills					
Prepare cord ends for connection.	2.2	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5	1, 2, 4, 5.1, 5.3	33	Topic 2.2 Skills Practice
Connect a variety of plugs to different flexible cord types.	2.3, 2.4	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4,	1, 2, 4, 5.1, 5.2,	33	

2 Cords, Cables and Plugs

		2.5, 2.6, 2.7, 2.8, 3.1	5.3, 5.4		
Use test equipment to test flexible cords and cables, including portable appliance tester (PATs).	-	3.2	1, 3, 4, 5.5, 7	30, 45	
Use test equipment to locate various faults in flexible cords and cables.	-	3.2	1, 3, 4, 5.5, 7	30, 45	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3760 In-service safety inspection and testing electrical equipment

Equipment:

- Flexible cords
 - Flexible cables
 - Plug tops and extension sockets
 - Multimeter
 - Insulation resistance tester
 - Portable appliance tester (PAT)
-

3 Flat TPS Wiring Systems						
Purpose:	In this topic you will learn about the various types of flat thermoplastic sheathed (TPS) wiring systems used in the industry, how to prepare, terminate and support these wiring systems and the applications of these wiring systems.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
3.1 Flat TPS Wiring Systems						
Knowledge						
State the Australian Standards and requirements for the termination and protection of flat TPS cable.		10.2	-	-	35	Topic 3 Content Quiz Topic 3.1 Learning Activity
List the accessories for supporting flat TPS cables.		3.1, 3.2	-	-	36	
Skills						
Install flat TPS cable in trunking/duct for the supply of socket outlets.		3.1	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.3, 5.4, 6	33, 35, 36	Topic 3.1 Skills Practice
Use flat TPS cable for lighting looms.		3.2	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.2, 5.3, 5.4, 6	33, 35	
Perform the testing of flat TPS cable circuits to verify earth resistance, insulation resistance and polarity of installed circuits.		-	3.2	1, 3, 4, 5.5, 7	30	
Reference Text: Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill						

3 Flat TPS Wiring Systems

- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

Equipment:

- Flat TPS cables
- Cable tray
- Nylon cable ties
- Cable clips
- Socket-outlets
- Surface sockets/quick-connect sockets
- Light switches
- Mounting blocks
- Multimeter
- Insulation resistance tester

4 Circular TPS Wiring Systems						
Purpose:	In this topic you will learn about the various types of circular thermoplastic sheathed (TPS) wiring systems used in the industry, how to prepare, terminate and support these wiring systems and the applications of these wiring systems.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹			Energy Space Resources	
		KE	PC	PE		EPC
4.1 Circular TPS Wiring Systems						
Knowledge						
State the Australian Standards and requirements for the installation of circular TPS cables.		4.2, 10.2	-	-	35	Topic 4 Content Quiz Topic 4.1 Learning Activity
List the accessories for supporting circular TPS cables.		4.1, 4.2	-	-	36	
Skills						
Install circular TPS cables on cable ladder/tray.		4.1	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.2, 5.3, 5.4	33, 35, 36	Topic 4.1 Skills Practice
Install circular TPS cables in other mediums.		4.2	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.2, 5.3, 5.4	33, 35, 36	
Testing circular TPS cable circuits to ensure they are safe and operate as intended.		-	3.2	1, 3, 4, 5.5, 7	30	
Reference Text:						

4 Circular TPS Wiring Systems

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

Equipment:

- Circular TPS cables
- Cable tray
- Nylon cable ties
- Cable clips
- Socket-outlets
- Surface sockets/quick-connect sockets
- Light switches
- Mounting blocks
- Multimeter
- Insulation resistance tester

5 TPI in Non-metallic Enclosures						
Purpose:	In this topic you will learn about the various types of thermoplastic insulated (TPI) cables installed in non-metallic enclosures used in the industry, you will learn how to prepare, support and install these wiring systems and enclosures and the applications of these wiring systems.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 TPI in Non-metallic Enclosures						
Knowledge						
State the types of non-metallic enclosures used to for low voltage installations.		5.1, 5.2	-	-	36	Topic 5 Content Quiz Topic 5.1 Learning Activity
List the tools and accessories required to cut and set non-metallic enclosures.		5.1, 5.2	-	-	36	
State the Australian Standards requirements for the installation of non-metallic enclosures.		5.2, 10.3, 10.4	-	-	35	
Skills						
Perform the cutting and setting of rigid non-metallic ducting, trunking and conduit and accessories.		5.1	1.1, 1.2, 1.3, 1.4, 1.5, 2.1	1, 2	36	Topic 5.1 Skills Practice
Install circuits using TPI cables in non-metallic enclosures.		5.2	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.3, 5.4, 6	33, 35, 36	
Test circuits to ensure they are safe and operate as intended.		-	3.2	1, 3, 4, 5.5, 7	30	

5 TPI in Non-metallic Enclosures

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

Equipment:

- TPI cables
- PVC trunking
- Rigid PVC conduit
- One-way and two-way PVC conduit boxes
- Threaded conduit adaptors
- Bending spring
- Conduit saddles
- Light switches
- Mounting blocks
- Multimeter
- Insulation resistance tester

6 TPI in Metallic Enclosures						
Purpose:	In this topic you will learn about the various types of thermoplastic insulated (TPI) cables installed in metallic enclosures used in the industry, you will also learn how to prepare, install and support these enclosures and wiring systems and the applications of these wiring systems.					
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
6.1 TPI in Metallic Enclosures						
Knowledge						
State the types of metallic enclosures used to for low voltage installations.		6.1, 6.2, 6.3	-	-	36	Topic 6 Content Quiz Topic 6.1 Learning Activity
List the tools and accessories required to cut and set metallic enclosures.		6.1, 6.2, 6.3	-	-	36	
State the Australian Standards requirements for the installation of metallic enclosures.		6.3, 10.4	-	-	35	
Skills						
Perform the fitting of metallic conduit to metallic trunking and accessories.		6.1	1.1, 1.2, 1.3, 1.4, 1.5, 2.1	1, 2	36	Topic 6.1 Skills Practice
Perform the cutting, threading and setting of metallic conduits.		6.2	1.1, 1.2, 1.3, 1.4, 1.5, 2.1	1, 2	36	
Install circuits using thermoplastic insulated cables in metallic conduit, ducting and trunking.		6.3	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.3, 5.4, 6	33, 35, 36	
Apply testing procedures to circuits using TPI cables in metallic enclosures are safe and operate		-	3.2	1, 3, 4, 5.5, 7	30	

6 TPI in Metallic Enclosures

as intended.

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

Equipment:

- TPI cables
- Metallic trunking
- Rigid metallic conduit
- One-way and two-way metallic conduit boxes
- Lock rings
- Conduit bender
- Conduit saddles
- Light switches
- Mounting blocks
- Multimeter
- Insulation resistance tester

7 Fire Protection Cabling and Systems					
Purpose:	In this topic you will learn about the various types of fire protection cables and systems used in the industry, you will learn how to prepare, terminate and install these systems and the applications of these wiring systems.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Fire Protection Cabling and Systems					
Knowledge					
Describe the various types of fire protection cable types and accessories, including Pyrolex, Radox and MIMS.	7.2	-	-	32, 33	Topic 7 Content Quiz Topic 7.1 Learning Activity
State the Australian Standard requirements for the installation of fire protection cable including mineral insulated metal sheathed cables.	7.3, 10.5	-	-	35	
List the requirements used when passing a wiring system through a fire rated wall or floor.	7.1	-	-	35	
Skills					
Perform the termination of fire protection cables.	7.3	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 4, 5.1, 5.2, 5.3, 6	33, 35, 36	Topic 7.1 Skills Practice
Install circuits using fire protection cables.	7.3	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.2, 5.3, 5.4, 6	33, 35, 36	

7 Fire Protection Cabling and Systems

Perform the testing of fire protection cable circuits to ensure they are safe and operate as intended.

-

3.2

1, 3, 4,
5.5, 7

30

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

Equipment:

- Fire performance cables (MIMS, Radox, Pyrolex, Firestop etc.)
- Metallic trunking
- Rigid metallic conduit
- One-way and two-way metallic conduit boxes
- Lock rings
- Metallic inspection elbow
- Conduit saddles
- Light switches
- Mounting blocks
- Multimeter
- Insulation resistance tester

8 Steel Wire Armoured (SWA) Cables

Purpose:	In this topic you will learn about the various types of steel wire armoured (SWA) cables, you will also learn how to prepare, terminate and install these cables and the applications of these wiring systems.
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Steel Wire Armoured (SWA) Cables					
Knowledge					
Describe the various types of steel wire armoured cables.	8.1	-	-	32	Topic 8 Content Quiz Topic 8.1 Learning Activity
Describe the accessories used with SWA cables.	8.1	-	-	33	
State the Australian Standard requirements for the installation of steel wire armoured cables.	8.2, 10.6	-	-	35	
Skills					
Perform the installation of circuits using SWA cables.	8.2	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.2, 5.3, 5.4, 6	33, 35, 36	Topic 8.1 Skills Practice
Perform the testing of the SWA cables and circuits to ensure they are safe and operate as intended.	-	3.2	1, 3, 4, 5.5, 7	30	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education

Standards and Codes:

- AS/NZS 3000 Wiring Rules

8 Steel Wire Armoured (SWA) Cables

Equipment:

- Circular TPS cables
- SWA cables
- Cable tray/ladder tray
- PVC cable ties
- SWA cable glands and earth tags
- One-way metallic conduit box
- Three-way metallic conduit box
- Light fitting and switches
- Multimeter
- Insulation resistance tester

9 Trailing Cables and Catenary Systems

Purpose:	In this topic you will learn about the various types of trailing cables and catenary systems, you will also learn how to prepare, terminate and assemble/install these systems and the applications of these wiring systems
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
9.1 Trailing Cable Systems					
Knowledge					
Describe the various types of trailing cables	9.1	-	-	32, 39	Topic 9 Content Quiz Topic 9.1 Learning Activity
Describe the accessories/equipment used with trailing cables	9.1	-	-	33, 39	
State the Australian Standard requirements for the installation of trailing cables	10.7	-	-	35, 39	
Skills					
Install trailing cable systems supplying a pendant socket	9.3	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.2, 5.3, 5.4, 6	33, 35, 36, 39	Topic 9.1 Skills Practice
Perform the testing of the trailing cable system/pendant socket installation to ensure it is safe and operates as intended	-	3.2	1, 3, 4, 5.5, 7	30, 39	
9.2 Catenary Wiring Systems					
Knowledge					
Describe the various types of catenary wiring systems	9.1	-	-	32, 39	Topic 9 Content Quiz Topic 9.2 Learning Activity
Describe the accessories/equipment used with	9.1	-	-	33, 39	

9 Trailing Cables and Catenary Systems					
catenary wiring systems					
State the Australian Standard requirements for the installation of catenary wiring systems	10.7	-	-	35, 39	
Skills					
Install catenary wiring systems	9.2	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 3.1	1, 2, 3, 4, 5.1, 5.2, 5.3, 5.4, 6	33, 35, 36, 39	Topic 9.2 Skills Practice
Perform the testing of the a catenary wiring system installation to ensure it is safe and operates as intended	-	3.2	1, 3, 4, 5.5, 7	30, 39	
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education Standards and Codes: - AS/NZS 3000 Wiring Rules - AS/NZS 3760 In-service safety inspection and testing electrical equipment Equipment: - Flat/circular TPS cables - Flexible cords/cables - PVC cable ties - Jack chain - Pendant socket-outlets - Multimeter - Insulation resistance tester					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEEEL0024 – Test and connect alternating current (a.c.) rotating machines

Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Operating Principles of three phase induction motors	5
1.1 Rotating Magnetic Field	5
1.2 Induction Motor Operation	5
2 Three phase induction motor construction	7
2.1 Induction Motor Construction	7
2.2 Induction Motor Connections	7
2.3 Dismantling and Assembling a Motor	8
3 Three phase induction motor characteristics	10
3.1 Induction Motor Characteristics	10
3.2 Induction Motor Efficiency	10
4 Single phase motors – split phase	12
4.1 Single Phase Motor Construction	12
4.2 Single Phase Motor Operating Principles	12
4.3 Single Phase Motor Characteristics	13
5 Single phase motors – capacitor and shaded pole types	14
5.1 Capacitor Start Motors	14
5.2 Permanent Split Capacitor (PSC) Motors	14
5.3 Capacitor Start/Run Motors	15
5.4 Shaded Pole Motors	16
6 Single phase motors – universal	18
6.1 Universal Motor Construction and Applications	18
6.2 Universal Motor Operating Principles and Characteristics	18
7 Motor protection	20
7.1 Motor Protection Requirements	20
7.2 Motor Protection Devices and Systems	20
7.3 Motor Protection Selection	21
8 Three-phase synchronous machines	23
8.1 Synchronous Machines	23
8.2 Synchronous Alternators	23
8.3 Synchronous Motors	24
8.4 Asynchronous Machines	24
9 Alternators and generators	26
9.1 Alternator Characteristics	26
9.2 Standby Generators	26
9.3 Portable Generators	27
10 Troubleshooting Single and Three Phase Motors and Controls	29
10.1 Electrical Motor and Control Faults	29
10.2 Mechanical Motor Faults	29
10.3 Troubleshooting Three Phase Motors and Controls	30
10.4 Troubleshooting Single Phase Motors and Controls	30

A. Overview

Competency Standard Unit (CSU)	UEEEL0024 Test and connect alternating current (a.c.) rotating machines	
CSU Application	This unit involves the skills and knowledge required to test and connect alternating current (a.c.) rotating machines. It includes safe working practices, ascertaining correct operation of a.c. machines and solving problems as they apply to servicing, fault finding, installation and compliance work functions The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) a.c. or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0024	Performance Criteria
	KE-UEEEL0024	Knowledge Evidence
	PE-UEEEL0024	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 10	44 hours
	Completion of Unit Knowledge Tests	2 hours
	Completion of Unit Skills Tests	4 hours
	Total duration of structured learning program	50 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	

Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Operating Principles of three phase induction motors

Purpose: In this topic you will learn about the fundamental principles of the operation of three-phase induction motors.

Duration: This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Rotating Magnetic Field					
Knowledge					
Describe the right hand (grip) rule for conductors and solenoids and Fleming's left and right hand rules.	1.4	-	-	12	Topic 1 Content Quiz Topic 1.1 Learning Activity
List the characteristics of the magnetic field produced by a single, two and three-phase windings.	1.1	-	-	12	
Describe the factors that determine the speed of the rotating magnetic field (synchronous speed).	1.1	-	-	12	
Skills					
Apply the right hand (grip) rule for conductors and solenoids and Fleming's left and right hand rules to determine circuit operating characteristics.	1.4	-	-	12	Topic 1 Content Quiz Topic 1.1 Learning Activity Topic 1.2 Skills Practice
Calculate the speed of rotation of a rotating magnetic field (synchronous speed).	1.2	-	-	12	
1.2 Induction Motor Operation					
Knowledge					
Describe the basic principle of operation of an induction motor.	1.3	-	-	12	Topic 1 Content Quiz

1 Operating Principles of three phase induction motors

					Topic 1.2 Learning Activity
Describe the relationship between the synchronous speed, rotor speed, slip and rotor frequency.	1.2	-	-	12	
Skills					
Calculate the rotor speed, slip and rotor frequency.	1.2	-	-	12	Topic 1 Content Quiz
Reverse the direction of rotation of three phase induction motor.	1.3	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 3.2, 5	12	Topic 1.2 Learning Activity Topic 1.2 Skills Practice

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules – current edition

Equipment/Material:

- Three phase induction motors.
- Three phase supply.
- Tong testers, tachometers and phase rotation meters.
- Connection leads.

2 Three phase induction motor construction					
Purpose:	In this topic you will learn about the basic construction details of three-phase induction motors.				
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Induction Motor Construction					
Knowledge					
List the basic component parts of a three-phase induction motor.	2.1	-	-	12	Topic 2 Content Quiz Topic 2.1 Learning Activity
List the types of rotors used in three-phase induction motors.	2.2	-	-	12	
Skills				12	
Identify the basic component parts of a three-phase induction motor.	2.1	-	-	12	Topic 2 Content Quiz Topic 2.1 Learning Activity Topic 2.3 Skills Practice
2.2 Induction Motor Connections					
Knowledge					
Describe the main connection configurations (star and delta) for a three-phase induction motor and the applications for each connection configuration.	2.3	-	-	12	Topic 2 Content Quiz Topic 2.2 Learning Activity
List the basic electrical tests that need to be carried out on an induction motor.	10.1, 10.2,	-	-	12	
Skills					

2 Three phase induction motor construction					
Check the insulation resistance of a three-phase induction motor prior to connection to the supply.	10.1,	2.4, 2.5	3.7, 3.9	12	Topic 2.2 Skills Practice
Check the winding resistance (ohmic value and continuity) of a three-phase induction motor prior to connection to the supply	10.2	2.4, 2.5	3.7, 3.10	12	
Connect a three-phase induction motor in both star and delta.	2.3	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 3.1, 3.4, 5	12	
2.3 Dismantling and Assembling a Motor					
Knowledge					
List the steps for dismantling a three-phase induction motor.	-	-	-	12	Topic 2 Content Quiz Topic 2.3 Learning Activity
List the steps for assembly a three-phase induction motor.	-	-	-	12	
Skills					
Dismantle and reassemble a three phase induction motor following standard procedures.	-	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	3.8	12	Topic 2.3 Skills Practice
Reference Text:					
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning					
Equipment/Material:					
Three phase induction motors.					

2 Three phase induction motor construction

- Three phase supply.
- Insulation resistance testers.
- Ammeters, voltmeters and multimeters.
- Tong testers and tachometers.
- Connection leads.

3 Three phase induction motor characteristics

Purpose:	In this topic you will learn about the behaviour and characteristics of squirrel cage, dual (double) squirrel cage and wound rotor (slip ring) three-phase induction motors.
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Induction Motor Characteristics					
Knowledge					
List the operating characteristics of induction motors.	3.1	-	-	12	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe the relationship between torque, speed and power of three phase squirrel cage and slip ring induction motors.	3.1	-	-	12	
State the operating characteristics conditions necessary for an induction motor to produce maximum torque.	3.2	-	-	12	
Skills					
Interpreted the speed / torque characteristics of three phase squirrel cage and slip ring induction motors.	3.3	2.4	-	12	Topic 3.2 Skill Practice
Identify details from motor nameplates.	3.3	2.4	-	12	
Determine the operating characteristics of an induction motor by measurements.	3.3	2.4	1.1, 1.2, 3.3, 5	12	
3.2 Induction Motor Efficiency					
Knowledge					
State the losses that occur in an induction motor.	3.5	-	-	12	Topic 3 Content Quiz

3 Three phase induction motor characteristics

Explain how the efficiency of induction motors improves with load.	3.5	-	-	12	Topic 3.2 Learning Activity
Describe the need for induction motors to meet Minimum Energy performance Standard (MEPS).	3.4	-	4	12	
Skills					
Calculate the losses and efficiency of induction motors.	3.5	-	3.6, 4	12	Topic 3.2 Skill Practice

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Equipment/Material:

- Three phase induction motors.
- Three phase supply.
- Mechanical load.
- Ammeters, voltmeters and wattmeters.
- Tong testers and tachometers.
- Connection leads.

4 Single phase motors – split phase						
Purpose:	In this topic you will learn about the construction, operating principles, characteristics and applications of the single phase, split phase induction motors.					
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Single Phase Motor Construction						
Knowledge						
List the common types of single phase motor.		4.1	-	-	15	Topic 4 Content Quiz Topic 4.1 Learning Activity
Describe the construction of a split phase induction motor, including the methods used to disconnect the start winding.		4.3	-	-	15	
4.2 Single Phase Motor Operating Principles						
Knowledge						
Explain the principle of operation of a split phase induction motor.		4.2	-	-	15	Topic 4 Content Quiz Topic 4.2 Learning Activity
Explain how a split phase induction motor direction of rotation is reversed.		4.2	-	-	15	
Skills						
Demonstrate the operation of a split phase induction motor.		5.3	-	3.3	15	Topic Skills Practice 4.2
Connect, run and reverse a split phase induction motor.		4.3, 4.4	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 2.1, 5	15	

4 Single phase motors – split phase					
4.3 Single Phase Motor Characteristics					
Knowledge					
Describe the basic characteristics of a split phase induction motor.	4.3	-	-	15	Topic 4 Content Quiz Topic 4.3 Learning Activity
List at least three applications of split phase induction motors.	4.4	-	-	15	
Skills					
Demonstrate the characteristics of a split phase induction motor.	4.3	2.4	3.3	15	Topic 4.3 Skills Practice
Reference Text: - Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Phillips, P., Electrical Principles, Cengage Learning Equipment/Material: - Split phase motor. - Single phase supply. - Mechanical load. - Insulation resistance testers and multimeters. - Ammeters, voltmeters and wattmeters. - Tong testers and tachometers. - Connection leads.					

5 Single phase motors – capacitor and shaded pole types						
Purpose:	In this topic you will learn about construction, operating principles, characteristics and applications of the single phase, capacitor start, capacitor start/run, permanently split capacitor (PSC) and shaded pole induction motors.					
Duration:	This topic represents around 12% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 Capacitor Start Motors						
Knowledge						
Describe the construction of a capacitor start motor.		5.1	-	-	15	Topic 5 Content Quiz Topic 5.1 Learning Activity
Explain operating principle of the capacitor start motor.		5.3	-	-	15	
Describe the characteristics of a capacitor start motor.		5.4	-	-	15	
List the applications of a capacitor start motor.		5.4	-	-	15	
Skills						
Connect and run a capacitor start motor.		5.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 3.3, 5	15	Topic 5.1 Skills Practice
Reverse the direction of rotation of a capacitor start motor.		5.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 2.1, 5	15	
5.2 Permanent Split Capacitor (PSC) Motors						

5 Single phase motors – capacitor and shaded pole types					
Knowledge					
Describe the construction of a permanent split capacitor motor.	5.2	-	-	15	Topic 5 Content Quiz Topic 5.2 Learning Activity
Explain operating principle of the permanent split capacitor motor.	5.3	-	-	15	
Describe the characteristics of a permanent split capacitor motor.	5.4	-	-	15	
List the applications of a permanent split capacitor motor.	5.4	-	-	15	
Skills					
Connect and run a permanent split capacitor motor.	5.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 3.3, 5	15	Topic 5.2 Skills Practice
Reverse the direction of rotation of a permanent split capacitor motor.	5.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 2.1, 5	15	
5.3 Capacitor Start/Run Motors					
Knowledge					
Describe the construction of a capacitor start/run motor.	5.2	-	-	15	Topic 5 Content Quiz Topic 5.3 Learning Activity
Explain operating principle of the capacitor start/run motor.	5.3	-	-	15	
Describe the characteristics of a capacitor start/run motor.	5.4	-	-	15	

5 Single phase motors – capacitor and shaded pole types					
List the applications of a capacitor start/run motor.	5.4	-	-	15	
Skills					
Connect and run a capacitor start/run motor.	5.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 3.3, 5	15	Topic 5.3 Skills Practice
Reverse the direction of rotation of a capacitor start/run motors.	5.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 2.1, 5	15	
5.4 Shaded Pole Motors					
Knowledge					
Describe the construction of a shaded pole motor.	5.2	-	-	15	Topic 5 Content Quiz Topic 5.4 Learning Activity
Explain operating principle of the shaded pole motor.	5.3	-	-	15	
Describe the characteristics of a shaded pole motor.	5.4	-	-	15	
List the applications of a shaded pole motor.	5.4	-	-	15	
Skills					
Connect and run a shaded pole motor.	5.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 2.1, 5	15	Topic 5.4 Skills Practice
Reference Text: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill					

5 Single phase motors – capacitor and shaded pole types

- Phillips, P, Electrical Principles, Cengage Learning

Equipment/Material:

- Capacitor start motor.
- Capacitor start, capacitor run motor.
- Permanently split capacitor motor.
- Shaded pole motor.
- Single phase supply.
- Insulation resistance testers and multimeters.
- Ammeters, voltmeters and wattmeters.
- Tong testers and tachometers.
- Connection leads.

6 Single phase motors – universal

Purpose:	In this topic you will learn about construction, operating principles, characteristics and applications of the series universal motors.				
Duration:	This topic represents around 4% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Universal Motor Construction and Applications					
Knowledge					
List the basic components of a series universal motor.	6.2	-	-	15	Topic 6 Content Quiz Topic 6.1 Learning Activity
List the applications of universal motors.	6.3	-	-	15	
State the function of each of the basic parts of a series universal motor.	6.2	-	-	15	
Skills					
Identify the basic parts of a series universal motor.	6.2	-	-	15	Topic 6.2 Skills Practice
6.2 Universal Motor Operating Principles and Characteristics					
Knowledge					
Describe the principles of operation of a series universal motor.	6.1	-	-	15	Topic 6 Content Quiz Topic 6.2 Learning Activity
List the characteristics for a series universal motor.	6.3	-	-	15	
Skills					

6 Single phase motors – universal

Connect, run and reverse a series universal motor.	6.1	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 2.1, 5	15	Topic 6.2 Skills Practice
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning Equipment/Material: • Universal motor. • Single phase supply. • Insulation resistance testers and multimeters. • Ammeters, voltmeters and wattmeters. • Tong testers and tachometers. • Connection leads.					

7 Motor protection					
Purpose:	In this topic you will learn about the requirements for a.c. motor protection methods, the various methods used to protect single and three-phase motors.				
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
7.1 Motor Protection Requirements					
Knowledge					
State the reasons why motor protection is required.	7.1	-	-	12, 13	Topic 7 Content Quiz Topic 7.1 Learning Activity
List the requirements of the AS/NZS 3000 Wiring rules with regards to motor protection.	7.2	-	-	12, 13	
7.2 Motor Protection Devices and Systems					
Knowledge					
Describe the types of motor overload protection.	7.3	-	-	13	Topic 7 Content Quiz Topic 7.2 Learning Activity
Describe the operating principle of microtherm devices, thermal (thermal overloads and thermistors) and magnetic motor protection devices.	7.4	-	-	13	
Describe the electrical features of motor protection HRC fuses.	7.5	-	-	12, 13	
Describe the effects of under voltage and over voltage on motors and motor circuits.	7.6	-	-	12, 13	
Describe the operating principles of phase failure protection.	7.9	-	-	12,13	
Skills					

7 Motor protection					
Connect motor protections devices (thermal overloads, thermistors protection) and systems and examine the operating characteristics.	7.4	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	-	13	Topic 7.2 Skills Practice 1 Topic 7.2 Skills Practice 2
7.3 Motor Protection Selection					
Knowledge					
State the effects of repetitive starting and/or reversing on motors.	7.7	-	-	13	Topic 7 Content Quiz Topic 7.2 Learning Activity
State the special requirements for motor protection, in high humidity or moist environments, high temperature areas and explosive atmospheres.	7.8	-	-	13	
Skills					
Select suitable protective devices for a given motor and starter combination.	7.10	-	3.5	13	Topic 7.3 Skills Practice
Reference Texts: - Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education - Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Phillips, P, Electrical Principles, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules – current edition Equipment/Material: - Three phase induction motor. - DOL starter with thermal O/L protection. - Thermistor relay.					

7 Motor protection

- Contactor.
- STOP/START station.
- Decade box.
- Indicator lamps.
- Three phase supply.
- Variable three phase load.
- Tong testers and tachometers.
- Stopwatch.
- Connection leads.

8 Three-phase synchronous machines					
Purpose:	In this topic you will learn about the construction, operating principles and characteristics of three-phase synchronous and asynchronous machines.				
Duration:	This topic represents around 12% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
8.1 Synchronous Machines					
Knowledge					
Describe the power transfer diagram of an a.c. synchronous machine.	8.1	-	-	12	Topic 8 Content Quiz Topic 8.1 Learning Activity
List the main components of a synchronous machine.	8.6	-	-	12	
Describe the various methods used for excitation of a synchronous machine.	8.7	-	-	12	
Skills					
Draw the power transfer diagram of an a.c. synchronous machine.	8.1	-	-	12	Topic 8.2 Skills Practice
8.2 Synchronous Alternators					
Knowledge					
State the need for the generation of a sinusoidal waveform.	8.2	-	-	12	Topic 8 Content Quiz Topic 8.2 Learning Activity
State the principles of operation of a synchronous alternator.	8.3	-	-	12	
List the methods used to provide the excitation of a synchronous alternator.	8.7	-	-	12	

8 Three-phase synchronous machines					
Explain the purpose of an alternator voltage regulator (block diagram).	8.8	-	-	12	
State the advantages gained by the parallel operation of alternators.	8.9, 9.9, 9.10	-	-	12	
Skills					
Connect and run a synchronous alternator.	8.3	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	-	12	Topic 8.2 Skills Practice
Demonstrate the use of an alternator voltage regulator.	8.8	-	-	12	
8.3 Synchronous Motors					
Knowledge					
State the principles of operation of a synchronous motor.	8.4	-	-	12	Topic 8 Content Quiz Topic 8.3 Learning Activity
List the methods used to provide the excitation of a synchronous motor.	8.7	-	-	12	
List the starting methods of synchronous motors.	8.10	-	-	12	
Skills					
Connect and run a synchronous motor on no load and load.	8.4	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 3.3, 5	12	Topic 8.3 Skills Practice
8.4 Asynchronous Machines					
Knowledge					
State the principles of operation of an asynchronous generator (induction generator).	8.5	-	-	12	Topic 8 Content Quiz

8 Three-phase synchronous machinesTopic 8.4 Learning
Activity**Reference Texts:**

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Equipment/Material:

- Three phase synchronous alternator.
- Three phase synchronous motor.
- Three phase supply.
- d.c. exciter supply.
- a.c. voltmeter, ammeter and/or multimeter.
- d.c. ammeter.
- Tong tester and tachometer.
- Connection leads.

9 Alternators and generators					
Purpose:	In this topic you will learn about operational characteristics of alternators and the effect of varying the excitation and load on the generated voltage. You will also learn about single phase and three-phase standby and portable generators/alternators.				
Duration:	This topic represents around 8% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
9.1 Alternator Characteristics					
Knowledge					
Describe the effects on generated voltage of variations in excitation.	9.1	-	-	12	Topic 9 Content Quiz Topic 9.1 Learning Activity
Describe the effects on generated voltage of variations in load (resistive, inductive and capacitive).	9.2	-	-	12	
Describe the characteristic curves of an alternator for various load conditions.	9.3	-	-	12	
Skills					
Perform tests to determine the characteristic curves of an alternator for various load conditions.	9.3	2.4	1.1, 1.2, 3.3, 5	12	Topic 9.1 Skills Practice
9.2 Standby Generators					
Knowledge					
List the types of prime movers used with single and three phase standby generators.	9.4	-	-	12	Topic 9 Content Quiz Topic 9.2 Learning Activity
List the steps to follow for the manual operation of single and three phase standby generators.	9.5	-	-	12	
State the available range of ratings of single and three phase standby generators.	9.6	-	-	12	

9 Alternators and generators					
List the applications of single and three phase standby generators.	-	-	-	12	
Describe the construction details of single and three phase standby generators.	9.7, 9.11	-	-	12	
List the common faults found in standby generators.	9.8	-	-	12	
Skills					
Demonstrate the operation of single and three phase standby generators.	9.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 3.3, 5	12	Topic 9.2 Skills Practice
9.3 Portable Generators					
Knowledge					
List the types of prime movers used with single and three phase portable generators.	9.4	-	-	12	Topic 9 Content Quiz Topic 9.3 Learning Activity
List the steps to follow for the manual operation of single and three phase portable generators.	9.5	-	-	12	
State the available range of ratings of single and three phase portable generators.	9.6	-	-	12	
List the applications of single and three phase portable generators.	-	-	-	12	
Describe the construction details of single and three phase portable generators.	9.7	-	-	12	
List the common faults found in portable generators.	9.8	-	-	12	
Skills					

9 Alternators and generators

Demonstrate the operation of single and three phase portable generators.	9.5	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	1.1, 1.2, 3.3, 5	12	Topic 9.3 Skills Practice

Reference Texts:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Equipment/Material:

- Three phase alternator.
- Prime mover.
- d.c. exciter supply.
- Resistive load bank.
- Inductive load bank.
- Capacitive load bank.
- a.c. voltmeter, ammeter and/or multimeter.
- d.c. ammeter.
- Tong tester and tachometer.
- Connection leads.

10 Troubleshooting Single and Three Phase Motors and Controls						
Purpose:	In this topic you will learn about the various faults found in single and three phase motors and control circuits and the methods used to find and repair these faults using troubleshooting techniques.					
Duration:	This topic represents around 12% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
10.1 Electrical Motor and Control Faults						
Knowledge						
List the causes of electrical faults in single and three phase motors including: open circuit winding, partially open circuit winding, short and partially short circuit winding, open and partially open circuit rotor, burnt out winding, and coil shorted to frame.		13.1, 13.2, 13.3, 13.4, 13.5	-	-	14, 54	Topic 10 Content Quiz Topic 10.1 Learning Activity
List the reasons for a thermal overload trip and how often these can be reset before investigating a cause.		10.8	-	-	14	
10.2 Mechanical Motor Faults						
Knowledge						
Describe internal mechanical faults and their consequences including: bearings, fans, bent shaft, locked rotor, blocked air vents, centrifugal switches and environmental factors.		11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7	-	-	14	Topic 10 Content Quiz Topic 10.2 Learning Activity
List faults on driven loads and couplings and their consequences including: slipping belts, poorly aligned coupling (shims), vibration, loads bearing failing, and load stalling.		12.1, 12.2, 12.3, 12.4, 12.5	-	-	14	

10 Troubleshooting Single and Three Phase Motors and Controls					
10.3 Troubleshooting Three Phase Motors and Controls					
Knowledge					
List the causes of three phase motor faults from supplied symptoms and circuit diagrams.	13.1, 13.2, 13.3, 13.4, 13.5	-	-	14, 54	Topic 10 Content Quiz Topic 10.3 Learning Activity
Describe techniques for locating faults in three phase induction motors and their controls.	10.1, 10.2, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9	-	-	14, 54	
Skills					
Identify faults in three phase induction motors and their controls.	10.1, 10.2, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	3.8	14, 54	Topic 10.3 Skills Practice
10.4 Troubleshooting Single Phase Motors and Controls					
Knowledge					
List the causes of single phase motor faults from supplied symptoms and circuit diagrams.	13.1, 13.2, 13.3, 13.4, 13.5	-	-	54	Topic 10 Content Quiz Topic 10.4 Learning Activity
Describe techniques for locating faults in single phase motors and their controls.	10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9, 11.6	-	-	54	
Skills					

10 Troubleshooting Single and Three Phase Motors and Controls

Identify faults in single phase motors and their controls.	10.1, 10.2, 10.3, 10.4,10.5, 10.6, 10.7, 10.8, 10.9, 11.6	1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 3.1, 3.2	3.8	54	Topic 10.4 Skills Practice

Reference Texts:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules – current edition
- AS/NZS 3017 Verification guidelines – current edition

Equipment/Material:

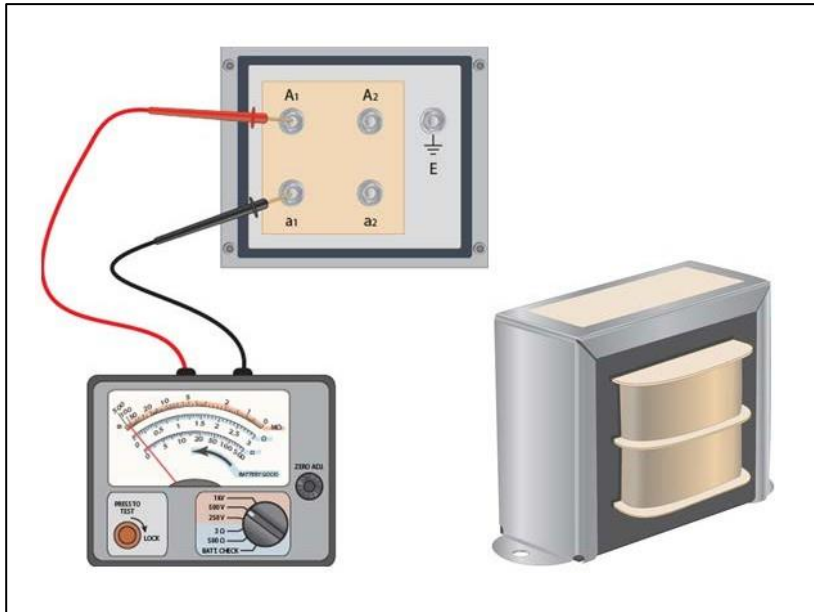
- Three phase squirrel-cage induction motors.
- Three phase motor power and control circuits with fault switches.
- Split phase motor.
- Capacitor start motor.
- PSC motor.
- Capacitor start, capacitor run motor.
- Universal motor.
- Single phase motor circuits with fault switches
- Variety of test equipment (e.g. IR testers, multimeters)
- Hand tools
- PPE

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities required for licensing

Unit Learning Plan

UEEEL0025 – Test and connect transformers



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Transformer Construction	5
1.1 Transformer Construction	5
1.2 Transformer Basic Testing	6
1.3 Transformer Auxiliary Equipment	6
2 Transformer Operation	8
2.1 Transformer Principles	8
2.2 Transformer Phasor Diagrams	8
2.3 Transformer Safety and Applications	9
3 Transformer Losses, Efficiency and Cooling	10
3.1 Transformer Losses	10
3.2 Transformer Efficiency	10
3.3 Transformer Cooling	11
4 Transformer Voltage Regulation and Percent Impedance	13
4.1 Transformer Voltage Regulation	13
4.2 Transformer Impedance	13
5 Parallel Operation of Transformers	15
5.1 Transformer Polarity	15
5.2 Parallel Operation	15
6 Autotransformers and Instrument Transformers	17
6.1 Autotransformers	17
6.2 Voltage Transformers	17
6.3 Current Transformers	18

A. Overview		
Competency Standard Unit (CSU)	UEEEL0025 Test and connect transformers	
CSU Application	This unit involves the skills and knowledge required to solve problems in transformers. It includes safe working practices, ascertaining correct operation of transformers and solving problems as they apply to servicing, fault finding, installation and compliance work functions. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0025	Performance Criteria
	KE-UEEEL0025	Knowledge Evidence
	PE-UEEEL0025	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 6	27 hours
	Completion of Unit Knowledge Tests	1 hour 15 minutes
	Completion of Unit Skills Tests	1 hour 45 minutes
	Total duration of structured learning program	30 hours
	Note 1: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur	

	before competence can be determined. Note 2: This unit contains mandatory requirements for the collection of workplace evidence to satisfy the Performance Evidence items listed in the Assessment Requirements.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0021 Solve problems in magnetic and electromagnetic devices • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Transformer Construction

Purpose:	In this topic you will learn about the construction of single and three phase transformers and the basic tests to ensure functionality and safety of a transformer. You will also learn about the various transformer auxiliary equipment including bushings, cable boxes, surge diverters, tap-changers and temperature indicators.
Duration:	This topic represents around 16.7% of the knowledge and skills specification contents, and should take the learner approximately 5 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Transformer Construction					
Knowledge					
Describe the construction of the various types of lamination style and core construction used in single phase, three phase, auto transformers and instrument transformers.	KE4	-	-	18	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the different winding styles/types used in transformers.	KE2	-	-	18	
State the methods used to insulate low and high voltage transformers.	KE2	-	-	18	
Describe the construction of transformer tanks for distribution transformers.	KE7	-	-	18	
List the types of information stated on transformer nameplates.	KE3	-	-	18	
Skills					
Identify the different winding styles/types used in transformers.	KE2	-	-	18	Topic 1 Content Quiz Topic 1.1 Learning Activity

1 Transformer Construction					
1.2 Transformer Basic Testing					
Knowledge					
List the basic electrical tests and the type of equipment required to check transformers serviceability (insulation resistance, continuity and winding identification tests).	KE1	1.7	PE1.2, PE7	19	Topic 1 Content Quiz Topic 1.2 Learning Activity
Skills					
Perform basic insulation resistance, continuity and winding identification tests on double wound transformers.	KE1	1.1, 1.2, 1.3, 1.7, 2.1, 2.5	PE1.2, PE7	19	Topic 1.2 Skills Practice
1.3 Transformer Auxiliary Equipment					
Knowledge					
Describe the construction and function of bushings used on high-voltage transformers.	KE7	-	-	18	Topic 1 Content Quiz Topic 1.3 Learning Activity
Describe the construction and operation of surge-diverters used on transformers.	KE7	-	-	18	
List the types of tap-changers used on transformers.	KE7	-	-	18	
Describe the basic operation of each type of tap-changer.	KE7	-	-	18	
Describe the construction and function of hot-oil and hot-winding indicators.	KE7	-	-	18	
Describe the construction and operation of breathing equipment used on transformers.	KE7	-	-	18	
Describe the construction and operation of a Buchholz relay.	KE7	-	-	18	
Reference Text:					
• Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education					

1 Transformer Construction

- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules – current edition

Equipment/Material:

- Double wound transformers.
- Insulation resistance testers.
- Multimeters.

2 Transformer Operation					
Purpose:	In this topic you will learn about the operation and electrical characteristics of single and three phase transformers and the safety and applications of single and three phase transformers.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Transformer Principles					
Knowledge					
Describe the principle of mutual inductance of a transformer.	KE11.1	-	-	18	Topic 2 Content Quiz Topic 2.1 Learning Activity
List the factors that determine the induced voltage in a transformer secondary winding.	KE11.2	-	-	18	
Explain the value of a transformers secondary voltage and current given one winding's electrical details and turns ratio.	KE11.3	-	-	18	
Skills					
Calculate the value of a transformers secondary voltage and current given one winding's electrical details and turns ratio.	KE11.3	2.4	PE2.1	18	Topic 2.1 Skills Practice
Connect a transformer and measure the primary and secondary values.	KE11.3, KE11.7	2.4	PE2.1	18	
2.2 Transformer Phasor Diagrams					
Knowledge					
Describe the voltage and current components of a phasor diagram for a transformer on no-load.	KE11.4	-	-	18	Topic 2 Content Quiz Topic 2.2 Learning Activity
Describe how power is transferred from the primary to secondary when a load is connected	KE11.5	-	-	18	

2 Transformer Operation					
using a phasor diagram neglecting impedance drops.					
Skills					
Identify the voltage and current components of a phasor diagram for a transformer on no-load.	KE11.4	-	-	18	Topic 2 Content Quiz Topic 2.2 Learning Activity Topic 2.2 Skills Practice
Identify the voltage and current components of a phasor diagram for a transformer under load conditions.	KE11.4	-	-	18	
2.3 Transformer Safety and Applications					
Knowledge					
State the reason any particular transformer is used in a specific application.	KE6	-	PE6	19	Topic 2.3 Skills Practice
Describe the safety features specified in AS/NZS 3000 with respect to transformers (including isolating transformers).	KE1, KE6, KE11.6	-	PE2.5	19	
Skills					
Select transformers for specific applications.	KE6	-	PE6	19	Topic 2 Content Quiz Topic 2.3 Learning Activity Topic 2.3 Skills Practice
Perform the specified safety features in AS/NZS 3000 with respect to transformers and isolating transformers.	KE1, KE6, KE11.6	2.5	PE2.5	19	
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning					
Standards and Codes: • AS/NZS 3000 Wiring Rules – current edition					

3 Transformer Losses, Efficiency and Cooling					
Purpose:	In this topic you will learn about the factors that affect transformer losses and efficiency, and the methods used to cool transformers.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 Transformer Losses					
Knowledge					
Describe the power losses which occur in a transformer.	KE12.2	-	-	-	Topic 3 Content Quiz Topic 3.1 Learning Activity
Describe the tests which allow the power losses of a transformer to be determine.	KE12.3	-	-	-	
Skills					
Carry out tests which allow the power losses of a transformer to be calculated.	KE12.3	-	-	-	Topic 3.1 Skill Practice
Calculate transformer losses using test results.	KE12.3	-	-	-	
3.2 Transformer Efficiency					
Knowledge					
List the factors that determine the transformer efficiency including the condition to achieve maximum efficiency.	KE12.2	-	PE2.4	-	Topic 3 Content Quiz Topic 3.2 Learning Activity
Define the all-day efficiency of a transformer.	KE12.2	-	PE2.4		
Describe the need for transformers to meet Minimum Energy performance Standard (MEPS).	KE12.2	2.6	PE2.4, PE8	-	
Skills					
Carry out tests which allow the efficiency of a	KE12.2	-	PE2.4	-	Topic 3.2 Skill Practice

3 Transformer Losses, Efficiency and Cooling					
transformer to be calculated.					
Calculate transformer efficiency using test results.	KE12.2	-	PE2.4	-	
Calculate the all-day efficiency of a transformer.	KE12.2	-	PE2.4	-	
3.3 Transformer Cooling					
Knowledge					
Describe the relationship between transformer cooling and rating.	KE12.4	2.6	-	18	Topic 3 Content Quiz Topic 3.3 Learning Activity
List methods used for natural and forced cooling of transformers.	KE12.1	2.6	-	18	
List the properties of transformer oil.	KE12.4	2.6	-	18	
Describe the tests conducted on transformer oil.	KE12.4	2.6	-	18	
Skills					
Perform tests on transformer oil.	KE12.4	2.6	-	18	Topic 3.3 Skill Practice
Reference Text: • Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education • Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill • Phillips, P, Electrical Principles, Cengage Learning Standards and Codes: • AS/NZS 3000 Wiring Rules – current edition Equipment/Material: • Single phase double wound transformer. • Variable a.c. supply. • Variable resistive load. • Ammeters, voltmeters and wattmeters. • Connection leads. • Oil-immersed transformer.					

3 Transformer Losses, Efficiency and Cooling

- Transformer oil sample kit.
- Transformer oil dielectric strength tester.
- Oil waste container.

4 Transformer Voltage Regulation and Percent Impedance					
Purpose:	In this topic you will learn about transformer impedance and voltage regulation for single and three phase transformers.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
4.1 Transformer Voltage Regulation					
Knowledge					
Define the term voltage regulation as applicable to a transformer.	KE13.2	-	-	18	Topic 4 Content Quiz Topic 4.1 Learning Activity
Explain the reasons for voltage variation in the output of a transformer.	KE13.1	-	-	18	
Skills					
Calculate the voltage regulation of a transformer using no load and load voltage values.	KE13.2	2.4	PE2.1	18	Topic 4.2 Skills Practice
4.2 Transformer Impedance					
Knowledge					
Define the term percentage impedance as applied to transformers.	KE14.1	-	-	18	Topic 4 Content Quiz Topic 4.2 Learning Activity
Describe the test used to determine the percent impedance.	KE14.2	-	-	18	
Skills		-	-		
Identify the percent impedance of a transformer by using test results.	KE14.2	2.4	PE2.1	18	Topic Skills Practice 4.2
Calculate the percent impedance of a transformer.	KE14.2	2.4	PE2.1	18	
Draw the equivalent circuit of a transformer.	KE14.2	2.4	PE2.1	18	

4 Transformer Voltage Regulation and Percent Impedance

Calculate the voltage regulation of a transformer from percentage impedance values.

KE13.2

2.4

PE2.1

18

Reference Text

- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Phillips, P., Electrical Principles, Cengage Learning

Standards and Codes

- AS/NZS 3000 Wiring Rules (current edition)

5 Parallel Operation of Transformers					
Purpose:	In this topic you will learn about the need and requirements for operating single phase and three phase transformers in parallel.				
Duration:	This topic represents around 13.3% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
5.1 Transformer Polarity					
Knowledge					
Describe the methods used to identify the polarity of single phase double wound transformer windings.	KE15.4	-	PE3	19	Topic 5 Content Quiz Topic 5.1 Learning Activity
Skills					
Add polarity markings to an unidentified single phase double wound transformer.	KE15.4	2.5	PE3	19	Topic 5.2 Skills Practice 1
5.2 Parallel Operation					
Knowledge					
Explain the need for parallel operation of transformers.	KE15.1	-	-	19	Topic 5 Content Quiz Topic 5.2 Learning Activity
List the conditions required before two transformers can be connected in parallel.	KE15.3	-	PE2.2	19	
Describe the consequences/effect of an incorrect connection when connecting transformers in parallel.	KE15.4	-	-	19	
Skills					
Calculate load sharing of transformers connected in parallel.	KE15.2	2.5	PE2.2	19	Topic 5.2 Skills Practice 1

5 Parallel Operation of Transformers

Connect transformers in parallel to supply a single load.

KE15.2

2.5

PE2.2

19

Topic 5.2 Skills Practice 2

Reference Text

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Standards and Codes

- AS/NZS 3008.1.1 (current edition)

Equipment/Material

- Double wound transformers.
- Variable a.c. supply.
- Variable resistive load.
- Multimeters and voltmeters.
- Insulation resistance testers.
- Connection leads.

6 Autotransformers and Instrument Transformers

Purpose:	In this topic you will learn about the construction, operation and application of auto-transformers and instrument transformers.
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Autotransformers					
Knowledge					
Describe the construction of an autotransformer.	KE10.1	-	-	18	Topic 6 Content Quiz Topic 6.1 Learning Activity
List the advantages and disadvantages of an autotransformer.	KE10.1	-	-	18	
State the AS/NZS 3000 requirements with respect to autotransformers.	KE1	-	-	18	
List the applications for autotransformers.	KE10.4	-	-	18	
Skills					
Identify autotransformers from their winding diagrams.	KE10.1	-	-	18	Topic 6.1 Skills Practice 1 Topic 6.1 Skills Practice 2
Connect autotransformer to a load and measure the input and output voltages and currents.	KE10.1	-	-	18	
Calculate the voltage and current in the windings of an autotransformer.	KE10.1	-	PE5	18	
6.2 Voltage Transformers					
Knowledge					
Describe the construction of voltage transformers.	KE8	-	-	18	Topic 6 Content Quiz Topic 6.2 Learning Activity
State the ratings of voltage transformers.	KE9	-	-	18	
State the AS/NZS 3000 requirements with respect	KE1	-	-	18	

6 Autotransformers and Instrument Transformers					
to voltage transformers.					
List the precautionary measures taken to connect and disconnect voltage transformers.	KE10.2	-	-	18	
List the applications for voltage transformers.	KE10.4	-	-	18	
Skills					
Identify voltage transformers from their winding diagrams.	KE8	-	-	18	Topic 6.3 Skills Practice
Complete connection diagrams for voltage transformers.	KE10.3	-	-	18	
6.3 Current Transformers					
Knowledge					
Describe the construction of current transformers.	KE10.5	-	-	18	Topic 6 Content Quiz Topic 6.3 Learning Activity
State the ratings of current transformers.	KE10.6	-	-	18	
State the AS/NZS 3000 requirements with respect to current transformers.	KE1	-	-	18	
List the precautionary measures taken to connect and disconnect instrument current transformer.	KE10.2	-	-	18	
List the applications for current transformers.	KE10.4	-	-	18	
Skills					
Identify current transformers from their winding diagrams.	KE10.5	-	-	18	Topic 6.3 Skills Practice
Demonstrate the use of precautionary measures when connecting and disconnecting instrument transformers.	KE10.2	-	PE2.5	18	
Complete connection diagrams for current transformers.	KE10.3	-	-	18	
Connect a current transformer and measure the input and output currents.	KE10.3	-	-	18	

6 Autotransformers and Instrument Transformers

Reference Text:

- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill
- Phillips, P, Electrical Principles, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules – current edition

Equipment/Material:

- Autotransformers.
- Instrument transformers.
- Variable a.c. supply.
- Variable resistive load.
- Ammeters, voltmeters and wattmeters.
- Connection leads.

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities required for licensing

Unit Learning Plan

UEEEL0039 – Design, install and verify compliance and functionality of general electrical installations

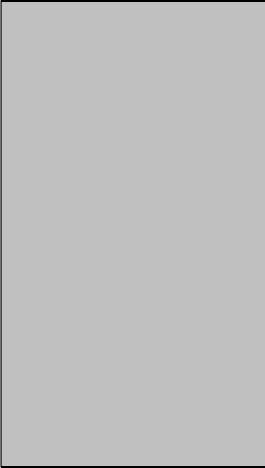
Contents

Contents	2
A. Overview	4
B. Knowledge and Skills Delivery	7
1 Work, Health and Electrical Safety	7
1.1 Occupational Safety and Health	7
1.2 Personal Safety in the Workplace	7
1.3 Workplace Hazards and Control Measures	8
1.4 Live Panel Rescue	8
1.5 Electric Shock Victim First Aid	8
1.6 Electrical Isolation	9
2 Electrical Diagrams	11
2.1 Electrical Diagrams	11
2.2 Electrical Documentation	11
3 Electrical Circuit Principles	13
3.1 Effects of Electric Current	13
3.2 Single Path Practical Circuits	13
3.3 Single Source Multiple Path Circuits	13
4 Alternating Current Principles	15
4.1 Single Phase Alternating Current (a.c.)	15
4.2 Three Phase Alternating Current (a.c.)	15
5 a.c. Machines and Controls	17
5.1 Motor and Starter Selection	17
5.2 Motor and Starter Connections	17
5.3 Transformer Safety Requirements	17
6 Electrical Installation and Operational Safety	19
6.1 Fundamental Safety Principles	19
6.2 Commissioning Procedures	20
6.3 Decommissioning Procedures	20
7 Electrical Installation Control and Protection	22
7.1 Protective and Functional Earthing	22
7.2 MEN Earthing System	22
7.3 Control and Protection of installations and equipment	23
7.4 SELV and PELV Systems	24
7.5 Location of switchboards, arrangement of equipment	24
8 Cable Selection and Coordination	26
8.1 Maximum Demand	26
8.2 Cables and Installation Methods	26
8.3 Voltage Drop	27
8.4 Earth Fault Loop Impedance	27
8.5 Short Circuit Performance	27
9 Special Installations and Situations	29
9.1 Damp Situation Installations	29
9.2 Construction and Demolition Sites	29
9.3 Hazardous Area Installation Requirements	30
9.4 High Voltage Equipment and Systems	30
10 Cable Installations	32

10.1 Cable Termination and Installation	32
10.2 Final Subcircuit Wiring and Connection	32
10.3 Aerial and Underground Wiring Systems	33
10.4 Consumer's Mains Installation Requirements	34
11 Testing Electrical Installations	37
11.1 Visual Inspection	37
11.2 Mandatory Testing	37
11.3 Earth Resistance/Continuity Testing	38
11.4 Insulation Resistance Testing	38
11.5 Polarity and Correct Circuit Connections	38
11.6 Earth Fault Loop Impedance and RCD Operation	39
11.7 Optional Tests	39
11.8 Rectification of Non-Compliance Defects	40
11.9 Legislated regulations and documentation	40
12 Electrical Equipment and Fault Diagnosis and Repair	42
12.1 Types of Faults	42
12.2 Electrical Circuits and Equipment Faults	42

A. Overview	
Competency Standard Unit (CSU)	UEEEL0039 Design, install and verify compliance and functionality of general electrical installations
CSU Application	This unit involves the skills and knowledge required to design, install, inspect and test to verify an electrical installation is safe and complies with regulatory requirements. It includes working safely; designing, installing, commissioning and fault finding of electrical installations; visual inspections and mandatory testing; following workplace procedures; and completing mandatory reporting requirements. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations. Those holding an 'Unrestricted Electrician's Licence' or equivalent issued in an Australian state or territory meet the requirements of this unit and its prerequisite requirements. A 'licensed electrician' who requires this unit to demonstrate currency for regulatory purposes may be required to undertake this unit to demonstrate their currency with verification of compliance requirements. In this case they are deemed to have met the prerequisites for this unit provided that they hold a current 'electricians licence' or its equivalent issued in an Australian state or territory; and, have recently been in employment as a licensed electrician sufficient to evidence current knowledge of applicable standards and regulations.
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.

Unit aspects addressed in this ULP	PC-UEEEL0039	Performance Criteria
	KE-UEEEL0039	Knowledge Evidence
	PE-UEEEL0039	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 12	30 hours
	Completion of Unit Knowledge Tests	3.5 hours
	Completion of Unit Skills Tests	6.5 hours
	Total duration of structured learning program	40 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • HLTAID001 Provide cardiopulmonary resuscitation • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, dismantle and assemble utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEECD0016 Document and apply measures to control WHS risks associated with electrotechnology work • UEEEL0003 Arrange circuits, control and protection for general electrical installations • UEEEL0020 Solve problems in low voltage a.c. circuit • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits • UEEEL0018 Select wiring systems and cables for low voltage general electrical installations • UEEEL0005 Develop and connect electrical control circuits • UEEEL0047 Identify, shut down and restart systems with alternate supplies • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in electromagnetic devices • UEEEL0014 Isolate, test and troubleshoot low voltage electrical circuits • UEEEL0008 Evaluate and modify low voltage heating equipment and controls • UEEEL0009 Evaluate and modify low voltage lighting circuits, equipment, and controls • UEEEL0010 Evaluate and modify low voltage socket outlets circuits	

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- UEEEL0024 Solve problems in alternating current (a.c.) rotating machines
 - UEEEL0025 Test and connect transformers
 - UEEEL0012 Install low voltage wiring, appliances, switchgear and associated accessories
 - UETTDRRF06 Perform rescue from a live LV panel
- and**
- UEECD0043 Solve problems in direct current circuits
- or**
- UEECD0044 Solve problems in multiple path circuits
 - UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Work, Health and Electrical Safety

Purpose:	In this topic you will revise the critical essential performance capabilities (EPCs) 31, 42, 43, 44, 46 and 47 covering the areas of the various work, health and electrical safety requirements, personal safety in the workplace, rescue from live electrical panel procedures, electric shock victim first aid and the electrical isolations procedures.				
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Occupational Safety and Health					
Knowledge					
List the basics of Work Health and Safety (Occupational Safety and Health) regulations.	2.1	-	-	42	Topic 1 Content Quiz Topic 1.1 Learning Activity
State the legal responsibilities for employers and employees.	2.8	-	-	42	
Explain the employers' and employees' own "duty of care" requirements.	2.10	-	-	42	
Explain the role of workplace safety committees.	2.11	-	-	42	
1.2 Personal Safety in the Workplace					
Knowledge					
State the purpose and use of Safe Work Method Statements (SWMS) or Job Safety Analysis (JSA).	2.5, 2.12	-	-	43	Topic 1 Content Quiz Topic 1.2 Learning Activity
State the purpose and process of reporting WHS/OHS incidents.	2.13	-	-	43	
State the safety procedures for working with electrical systems, circuits and equipment.	1.1, 2.9, 2.14	-	1	43	
List the regulations for the supervision of	2.16	-	-	43	

1 Work, Health and Electrical Safety					
apprentices and trainees.					
1.3 Workplace Hazards and Control Measures					
Knowledge					
Describe the process for identifying potential workplace hazards	2.2	-	-	44	Topic 1 Content Quiz Topic 1.3 Learning Activity
List the procedures for undertaking safety checks	2.3	-	-	44	
Describe the process to identify effective hazard control methods both individually and in groups.	2.4	-	-	44	
Describe the techniques for the identification, control and reporting of hazardous substances and materials	2.6	-	-	44	
Describe the situations and the reporting of asbestos, silica and hazardous gases	2.7	-	-	44	
1.4 Live Panel Rescue					
Knowledge		-	-		
State the process for rescuing a person in contact with live electrical conductors or equipment and the primary importance of the safety of the rescuer.	3.1, 3.2, 3.3	-	-	46	Topic 1 Content Quiz Topic 1.4 Learning Activity
1.5 Electric Shock Victim First Aid					
Knowledge					
State the application of emergency first aid requirements for an electric shock victim including the following steps: ○ Calling for help. ○ Applying cardiopulmonary resuscitation (CPR). ○ Selection and use of fire extinguishers to	1.5, 1.6, 2.17, 4.1, 4.2, 4.3	-	-	47	Topic 1 Content Quiz Topic 1.5 Learning Activity

1 Work, Health and Electrical Safety					
control electrical fire at accident site.					
1.6 Electrical Isolation					
Knowledge					
List the steps to perform effective safe isolation of any equipment: ○ Preparation of a 'safe work method statement' (SWMS) or Job Safety Analysis (JSA) for effective safe isolation. ○ Safe methods for identifying source of supply to be isolated. ○ Switching-off, lock-out and tagging procedures. ○ Safe methods for confirming effective and safe isolation.	1.2, 1.3, 2.15, 11.1, 11.2, 11.3, 11.4, 11.5, 11.6	-	3.1, 3.2, 3.3, 3.4	31	Topic 1 Content Quiz Topic 1.6 Learning Activity
Skills					
Perform the isolation and lockout procedure of an electrical circuit.	2.15	1.6, 1.7,	3.1, 3.2, 3.3, 3.4	31	Topic 1.6 Skills Practice
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: • AS/NZS 3000 Wiring Rules. • AS/NZS 4836 Safe working on or near low-voltage and extra-low voltage electrical installations and equipment. • AS 1470 Health and safety at work - Principles and practices. • AS 2444 Portable fire extinguishers and fire blankets – selection and location. Equipment/Material:					

1 Work, Health and Electrical Safety

- Multimeter or voltmeter.
- Lock-out device, padlock and key.
- Danger tag.
- PPE.

2 Electrical Diagrams					
Purpose:	In this topic you will revise the critical essential performance capability (EPC) 40, relating to electrical diagrams and electrical documentation.				
Duration:	This topic represents around 2.5% of the knowledge and skills specification contents, and should take the learner approximately 1 hour to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Electrical Diagrams					
Knowledge					
Purpose and characteristics of schematic, block and wiring diagrams, plans and schedules.	10.2	-	-	40	Topic 2 Content Quiz Topic 2.1 Learning Activity
Skills					
Read and interpret schematic, block and wiring diagrams, plans and schedules.	10.2	1.9	-	40	Topic 2.1 Skills Practice
Sketch electrical diagrams using conventional symbols.	10.3	-	-	40	
2.2 Electrical Documentation					
Knowledge					
Conventions used in documenting electrical information.	10.1	-	-	40	Topic 2 Content Quiz Topic 2.2 Learning Activity
Skills					
Extract and interpret information from electrical documentation.	10.1	1.9	-	40	Topic 2.2 Skills Practice
Reference Text:					
Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill					

2 Electrical Diagrams

- Jenneson, J., Harper, B, Electrical Principles for the Electrical Trades, McGraw-Hill, Volume 2.
- Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education.
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning.

Standards and Codes:

- AS/NZS 1102 (Series) Graphical Symbols for Electrotechnology documentation

Equipment/Material:

- Topic 2.2 Skills Practice Companion Document: Standard Electrical Specification for Water & Sewer Pump Stations.
- NATSPEC Worksections:
 - 0902 Electrical design and install.
 - 0911 Cable support and duct systems.
 - 0921 Low voltage power systems.
 - 0941 Switchboards – proprietary.
 - 0943 Switchboards – components.
 - 0951 Lighting.

3 Electrical Circuit Principles						
Purpose:	In this topic you will revise the critical essential performance capabilities (EPCs) 2 and 5, relating to effects of electric current, single path practical circuits and single source multiple path d.c. circuits.					
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
3.1 Effects of Electric Current						
Knowledge						
List the physiological effects of current.		6.1	-	-	2	Topic 3 Content Quiz Topic 3.1 Learning Activity
Explain the basic principles by which an electric current can produce heat, light, motion and a chemical reaction.		6.2	-	-	2	
3.2 Single Path Practical Circuits						
Knowledge						
Explain the arrangement of energy source, protection device, switch and load in a single path practical circuit.		7.1	-	-	5	Topic 3 Content Quiz Topic 3.2 Learning Activity
State the purpose of each component in a single path practical circuit.		7.2	-	-	5	
Explain the consequences of an open-circuit, closed-circuit and short-circuit in a practical circuit.		7.3	-	-	5	
3.3 Single Source Multiple Path Circuits						
Knowledge						
State the various circuit configurations and connection of single source multiple path circuits.		8.1	-	-	5	Topic 3 Content Quiz Topic 3.3 Learning Activity
Explain the relationship between the parameters of		8.2	-	-	5	

3 Electrical Circuit Principles

voltage, current, resistance and power dissipation in the whole or any part of multiple path circuit.					
List the safety measures and the parameters for the whole or any part of the multiple path circuit.	8.3	-	-	5	
Skills					
Connect a single source multiple path d.c. circuit to determine the circuit behaviour for variation in any of the parameters from measured and calculated values.	8.1, 8.2, 8.3	-	2	5	Topic 3.3 Skill Practice

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades. McGraw-Hill, Volume 1
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Phillips, P., Electrical Principles, Cengage Learning

Equipment/Material:

- d.c. power supply.
- Resistors.
- Connection leads.
- Test equipment (multimeter, analogue voltmeter, analogue ammeter).
- Control switch.
- Fuse.
- PPE.

4 Alternating Current Principles						
Purpose:	In this topic you will revise the critical essential performance capability (EPC) 8, relating to alternating current principles, both single and three phase.					
Duration:	This topic represents around 2.5% of the knowledge and skills specification contents, and should take the learner approximately 1 hour to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Single Phase Alternating Current (a.c.)						
Knowledge						
Explain the principles of generating a single phase sinusoidal voltage waveform and resulting current flow.		9.1	-	-	8	Topic 4 Content Quiz Topic 4.1 Learning Activity
Explain the following terms in relation to a single phase sinusoidal waveform: ○ Period ○ Maximum value. ○ Peak-to-peak value. ○ Instantaneous value. ○ Average value. ○ Root-mean-square (r.m.s.) value. ○ Frequency.		9.2	-	-	8	
4.2 Three Phase Alternating Current (a.c.)						
Knowledge						
Explain the principles of generating three phase sinusoidal waveforms.		9.3	-	-	8	Topic 4 Content Quiz Topic 4.2 Learning Activity
State the relationship between the phase voltages generated in a three phase alternator and the conventions for identifying each.		9.4	-	-	8	

4 Alternating Current Principles

List the method for determining the phase sequence or phase rotation of a three phase supply.	9.5	-	-	8	
List the methods for determining power and energy supplied by three phase circuits.	9.6	-	-	8	

Reference Text:

- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades, McGraw-Hill
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Phillips, P., Electrical Principles, Cengage Learning

5 a.c. Machines and Controls						
Purpose:	In this topic you will revise the critical essential performance capability (EPC) 13 and 19, relating to the selection of motors and starters, the connections of three phase motors, the protection methods used and safety requirements when working on transformers.					
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 Motor and Starter Selection						
Knowledge						
List the types of motor enclosures suitable for given environmental conditions.		30.1	-	-	13	Topic 5 Content Quiz Topic 5.1 Learning Activity
List the types of overload protection methods (thermal, magnetic and thermistor) used for motor protection.		30.4	-	-	13	
Criteria for selecting motor starters and overload protection.		30.2	-	-	13	
5.2 Motor and Starter Connections						
Knowledge						
Types and connection arrangements for direct-on-line and reduced voltage starters.		30.3	-	1	13	Topic 5 Content Quiz Topic 5.2 Learning Activity
Skills						
Connect three phase motors and starter power and control circuits.		30.3	-	1	13	Topic 5.2 Skills Practice
5.3 Transformer Safety Requirements						
Knowledge						

5 a.c. Machines and Controls

State the risks and safety control measures associated with connection and disconnection of instrument transformers.	29.1	-	-	19	Topic 5 Content Quiz Topic 5.3 Learning Activity
State the safe working procedures when connecting and testing transformers.	29.2	-	-	19	
Describe the AS/NZS 3000 requirements and restriction on the installation and use of transformers.	29.3	-	-	19	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Jenneson, J., Harper, B., Electrical Principles for the Electrical Trades, McGraw-Hill
- Hampson, J., Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education
- Phillips, P., Electrical Principles, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules.

Equipment/Material:

- Three phase supply.
- Three phase induction motors.
- Electronic soft starter.
- DOL motor starter.
- Star/delta motor starter.
- Associated cabling/wiring.
- Hand tools.
- PPE.

6 Electrical Installation and Operational Safety						
Purpose:	In this topic you will revise the critical essential performance capabilities (EPCs) 10 and 50, relating to the safety principles fundamentals as stated in AS/NZS 3000 Part 1 and the commissioning and decommissioning methods and procedures for electrical equipment and installations.					
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
6.1 Fundamental Safety Principles						
Knowledge						
Define the terms used in AS/NZS 3000 Part 1 (Section 1) and deemed-to-comply solution given in Part 2 for the fundamental safety principles.		12.1	-	-	10	Topic 6 Content Quiz Topic 6.1 Learning Activity
State the fundamental safety principles of protection against: ○ Direct and indirect contact with live parts. ○ Thermal effects. ○ Overcurrent. ○ Earth faults. ○ Abnormal voltages. ○ Spread of fire. ○ Mechanical injury. ○ External influences.		12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8, 12.9, 12.10	-	-	10	
Explain the fundamental principles of: ○ Installation design. ○ Selection and installation of equipment. ○ Means of compliance (including alterations, additions and repairs). ○ Verification of compliance.		12.11	-	-	10	

6 Electrical Installation and Operational Safety					
6.2 Commissioning Procedures					
Knowledge					
State the reasons to carryout commissioning of electrical equipment and installations.	35.1	-	-	50	Topic 6 Content Quiz Topic 6.2 Learning Activity
List the commissioning safety procedures.	35.1	-	1	50	
Explain the methods used to test circuit voltage.	35.1.1	-	1	50	
Explain the methods used to carryout phase rotation checks.	35.1.2	-	1	50	
State the functional testing requirements.	35.1.4	-	1	50	
List the instrument and control parameter settings.	35.1.5	-	1	50	
Skills		-	-		
Commission an item of LV electrical equipment using approved procedures.	35.1		1	50	Topic 6.2 Skills Practice
6.3 Decommissioning Procedures					
Knowledge					
State the reasons to carryout decommissioning of electrical equipment and installations.	35.2	-	-	50	Topic 6 Content Quiz Topic 6.3 Learning Activity
List the decommissioning safety procedures.	35.2	-	1	50	
State the methods used for the identification of circuits with their control and protection devices.	35.2.1	-	1	50	
State the impact of isolation on other parts of an installation.	35.2.2, 35.2.3	-	-	50	
Outline the tagging, testing and earthing procedures.	35.2.4, 35.2.5, 35.2.6	-	1	50	
State the methods for safe removal of equipment.	35.2.7, 35.2.8	-	1	50	
Skills					

6 Electrical Installation and Operational Safety

Decommission an item of LV electrical equipment using approved procedures.	35.2	-	1	50	Topic 6.3 Skills Practice

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Electrotechnology Practice, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules.
- AS/NZS 3017 Electrical Installations - Verification guidelines.
- AS/NZS 4836 Safe working on or near low-voltage and extra-low voltage electrical installations and equipment.

Equipment/Material:

- Low voltage circuit/equipment.
- Three phase motor and starter circuit (suggested).
- Test equipment (multimeter/voltmeter, IR tester, clamp meter).
- Lock-out device, padlock and key.
- Danger tag.
- PPE.

7 Electrical Installation Control and Protection						
Purpose:	In this topic you will revise the critical essential performance capabilities (EPCs) 16, 17, 20, 23 and 24, relating to protective and functional earthing, MEN earthing system, overvoltage and abnormal voltage protection, basic and fault protection, electrical installation control and protection and switchboards.					
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
7.1 Protective and Functional Earthing						
Knowledge						
State the purpose of protective and functional earthing.		13.2	-	-	16	Topic 7 Content Quiz Topic 7.1 Learning Activity
List the parts of a protective earthing system.		13.3	-	-	16	
Explain the earthing arrangements, earthing of equipment and equipotential bonding.		13.4	-	-	16	
State the methods of determining the maximum fault loop impedance for a circuit.		13.5	-	7	16	
List the alternate earthing systems required by local regulatory authorities.		13.6	-	-	16	
Skills						
Select protective earthing conductor and active conductor sizes for circuits to ensure earth-fault loop impedance is sufficiently low to operate the circuit protective device.		13.1, 14	2.2	7, 9	16	Topic 7.1 Skills Practice
7.2 MEN Earthing System						
Knowledge						
State the roles of the protective earthing (PE) and neutral (N) conductors in a consumer’s installation		15.1	-	-	17	Topic 7 Content Quiz

7 Electrical Installation Control and Protection					
and their relationship to the protective earth neutral (PEN) conductor in the electricity distributor's system or sub-main to an outbuilding using a MEN system.					Topic 7.2 Learning Activity
State the importance of the MEN link when a fault occurs.	15.2	-	-	17	
Explain the likely consequences of the absence of the MEN link or high impedance in the PEN conductor when a fault occurs.	15.3	-	-	17	
Outline the requirements for installation of a MEN link in an installation and an outbuilding.	15.4	-	-	17	
Skills		-	-		
Arrange and connect a MEN earthing system	15.4	2.4	-	17	Topic 7.2 Skills Practice
7.3 Control and Protection of installations and equipment					
Knowledge					
State the minimum fault levels specified by electricity distributors and the method for assessing prospective short circuit current.	16.2, 33.4	-	-	23	Topic 7 Content Quiz Topic 7.3 Learning Activity
Explain the methods, devices and arrangement for protection against short-circuit currents and overload currents.	16.3, 16.4, 16.5	-	-	23	
Explain the reasons why coordination of overload and short-circuit protection devices is required.	16.6	-	-	23	
Explain the coordination between conductors and overload protection devices.	16.7	-	-	23	
State the causes of over and undervoltage.	16.8	-	-	23	
List the device/s and requirements for protection against over and undervoltage.	16.9	-	-	23	

7 Electrical Installation Control and Protection					
Explain the use of RCDs for additional protection.	16.10	-	-	23	
List the limitation of an RCD to protect against contact with live parts.	16.11	-	-	23	
State the AS/NZS 3000 requirements for use of RCDs.	16.1, 16.10	-	-	23	
List the devices used for the functions of: - Isolation. - Emergency switching. - Mechanical maintenance. - Functional control.	16.12	-	5	23	
7.4 SELV and PELV Systems					
Knowledge					
State the purpose and configuration of SELV and PELV systems.	16.1, 17.1	-	-	20	Topic 7 Content Quiz Topic 7.4 Learning Activity
Explain the earthing requirements and testing of SELV and PELV circuits.	17.2	-	-	20	
7.5 Location of switchboards, arrangement of equipment					
Knowledge					
List the accessibility and restricted locations of switchboards.	28.1, 28.2	-	-	24	Topic 7 Content Quiz Topic 7.5 Learning Activity
Explain the identification of main switchboards.	28.1, 28.3	-	-	24	
Explain the construction requirements of switchboards.	28.1, 28.4	-	-	24	
List the arrangement and identification of switchboard equipment.	26.4, 28.1, 28.5	-	-	24	
List the arrangement and installation of metering equipment.	28.1, 28.6	-	-	24	

7 Electrical Installation Control and Protection

Explain switchboard wiring and fire –protective measures.	26.5, 26.6, 28.1, 28.7	-	-	24	
Explain the methods used for the protection against switchboard internal arc faults.	28.1, 28.8	-	-	24	

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Electrotechnology Practice, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3008.1.1 Electrical installations: Selection of cables.

Equipment/Material:

- Main, distribution and outbuilding switchboards.
- Earth cables.
- Crimp lugs.
- Hand tools.
- PPE.

8 Cable Selection and Coordination						
Purpose:	In this topic you will revise the critical essential performance capabilities (EPCs) 21 and 22, relating to the cable selection of mains, sub-mains and final sub-circuits using AS/NZS 3000 and AS/NZS 3008 Australian Standards.					
Duration:	This topic represents around 7.5% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
8.1 Maximum Demand						
Knowledge						
State the acceptable methods of determining maximum demand of mains and submains.		18.3	-	-	21	Topic 8 Content Quiz Topic 8.1 Learning Activity
State the methods used to determine the maximum demand of final sub-circuits.		19.3	-	-	22	
Skills						
Determine the maximum demand on mains, submains and final subcircuits.		18.1, 18.3	2.1, 2.2	4	21, 22	Topic 8.5.1 Skills Practice Topic 8.5.2 Skills Practice
8.2 Cables and Installation Methods						
Knowledge						
List the types of cables typically used for mains and submains.		18.4.1	-	-	21	Topic 8 Content Quiz Topic 8.2 Learning Activity
List the types of cables typically used for final subcircuits.		19.4.1	-	-	22	
State the installation methods and external influences affecting cable current-carrying capacity.		18.4.2, 18.7, 19.4.2	-	-	21, 22	
Skills						

8 Cable Selection and Coordination					
Select cables for single and three phase mains and submains for single and multiple installations based on current carrying capacity.	18.2, 18.6	2.1, 2.2	4	21	Topic 8.5.1 Skills Practice Topic 8.5.2 Skills Practice
Select cables for final sub-circuits based on current carrying capacity.	19.1, 19.2	2.1, 2.2	4	22	
8.3 Voltage Drop					
Knowledge					
State the voltage drop limitation.	18.8	-	-	21, 22	Topic 8 Content Quiz Topic 8.3 Learning Activity
State the effect of voltage drop limitations on circuit route length.	18.8, 19.5	-	-	21, 22	
Skills					
Determine voltage drop in single and three phase circuits.	18.1, 18.8	2.1, 2.2	4	21, 22	Topic 8.5.1 Skills Practice Topic 8.5.2 Skills Practice
Select cables to satisfy voltage drop limitations.	18.8	2.1, 2.2	4	21, 22	
8.4 Earth Fault Loop Impedance					
Knowledge					
State the effect of earth-fault loop impedance on circuit route length.	18.5	-	4, 6	21, 22	Topic 8 Content Quiz Topic 8.4 Learning Activity
Skills					
Determine the earth fault loop impedance in various installations and conditions.	18.5	2.1, 2.2	4, 6	21, 22	Topic 8.5.1 Skills Practice Topic 8.5.2 Skills Practice
Select cables to satisfy earth fault loop impedance limitations.	18.5	2.1, 2.2	4, 6	21, 22	
8.5 Short Circuit Performance					
Knowledge					
List the short-circuit performance considerations	18.9	-	4	21, 22	Topic 8 Content Quiz

8 Cable Selection and Coordination					
for cable selection.					Topic 8.5 Learning Activity
Skills					
Select cables to satisfy short-circuit performance requirements.	18.2, 18.9	2.1, 2.2	4	21, 22	Topic 8.5.1 Skills Practice Topic 8.5.2 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice. McGraw-Hill, Volume 2 - Hampson, J., Electrotechnology Practice, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and codes: - AS/NZS 3000 Wiring Rules. - AS/NZS 3008.1.1 Electrical installations – Selection of cables.					

9 Special Installations and Situations						
Purpose:	In this topic you will revise the critical essential performance capabilities (EPCs) 25, 26, 28 and 48, relating to the various electrical requirements for special electrical installations such as damp situations, construction and demolition sites, hazardous areas and high voltage equipment and systems.					
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
9.1 Damp Situation Installations						
Knowledge						
State the limitation of installation of equipment in classified zones.		20.1, 20.2, 20.3	-	-	25	Topic 10 Content Quiz Topic 10.1 Learning Activity
State the requirements for the selection and location of equipment suitable for installation in given classified zones.		20.1, 20.4	-	-	25	
State the additional protection by RCD provided to a circuit.		20.1, 20.5	-	-	25	
List the requirements for equipotential bonding in showers and bathrooms and swimming and spa pools.		20.1, 20.6	-	-	25	
9.2 Construction and Demolition Sites						
Knowledge						
State the requirements for the installation, modification and testing of electrical equipment for construction and demolition sites, complying with AS/NZS 3012 and applicable workplace safety legislation.		21.2, 21.4, 21.5, 21.6, 21.7	-	-	26	Topic 10 Content Quiz Topic 10.2 Learning Activity
List the supply and installation requirements for construction and demolition sites.		21.1	-	-	26	

9 Special Installations and Situations					
State the requirements for the protection of circuits on construction and demolition sites.	21.3	-	-	26	
State the initial and periodic inspection and testing of electrical equipment on construction and demolition sites.	21.10	-	-	26	
Describe the requirements (including documentation) for testing and tag portable tools on construction and demolition sites in accordance with AS/NZS 3760.	21.8, 21.9	-	-	26	
9.3 Hazardous Area Installation Requirements					
Knowledge					
State the AS/NZS 3000 requirements for electrical installations in hazardous areas.	23.1	-	-	28	Topic 10 Content Quiz Topic 10.3 Learning Activity
List the types of areas classified as a hazardous area.	23.2	-	-	28	
State the Standards to which the selection, installation and maintenance of electrical equipment shall comply.	23.3	-	-	28	
Describe the additional training required to work competently with electrical equipment for hazardous areas.	23.4	-	-	28	
9.4 High Voltage Equipment and Systems					
Knowledge					
State the dangers of high voltage equipment and distribution systems.	5.4	-	-	48	Topic 10 Content Quiz Topic 10.4 Learning Activity
Explain step, touch and induced voltages.	5.1	-	-	48	
List potential sources of induced voltage and stored energy.	5.2	-	-	48	
Explain creepage and clearance requirements.	5.3	-	-	48	

9 Special Installations and Situations

Explain the safe working procedures for working in the vicinity of HV equipment.

5.4

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48

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Electrotechnology Practice, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and codes:

- AS/NZS 3000 Wiring Rules.
- AS/NZS 3012 Electrical installations – Construction and demolition sites.
- AS/NZS 3008.1.1 Electrical installations – Selection of cables.

10 Cable Installations						
Purpose:	In this topic you will revise the critical essential performance capabilities (EPCs) 27, 35, 37 and 38, relating to the methods and AS/NZS 3000 requirements for the termination and installation of various cables, including aerial and underground wiring systems. It also covers the distributor’s requirements for the installation of consumer’s mains.					
Duration:	This topic represents around 7.5% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
10.1 Cable Termination and Installation						
Knowledge						
State the typical cable routes through buildings, structures and premised	24.1, 24.2	-	-	35	Topic 10 Content Quiz Topic 10.1 Learning Activity	
List the application of wiring accessories	24.1, 24.3	-	-	35		
Explain the methods used for drawing-in, placing and fixing of cables	24.1, 24.4	-	-	35		
List the various cables and conductor terminations	24.1, 24.5	-	-	35		
Explain how to maintain the fire rating integrity	24.1, 24.6	-	-	35		
State the application of flat thermoplastic sheathed (TPS), circular thermoplastic sheathed (TPS), steel wired armoured (SWA), fire rated and flexible cables.	24.1, 24.7	-	-	35		
10.2 Final Subcircuit Wiring and Connection						
Knowledge						
Explain the interconnection between switchgear, protection devices and links	KE26.1	-	-	37	Topic 10 Content Quiz Topic 10.2 Learning Activity	
List the methods for the preparation for fitting and connection of electricity network operator equipment	KE26.2	-	-	37		

10 Cable Installations					
Explain the reasons for using adequately sized cables	KE26.3	-	-	37	
Explain the methods used for marking of equipment	KE26.4	-	-	37	
Explain the methods used to identify the circuit neutral conductors	KE26.5	-	-	37	
Explain the testing method to identify correct polarity and the identification of circuit neutral conductors.	KE26.6	-	-	37	
Skills		-	-		
Install final sub-circuit wiring into switchboards and connect to switchboard equipment in accordance with AS/NZS 3000 and electricity distributor's requirements.	23.4, 23.5, 23.6, 24.4, 24.5, 24.6, 26.1, 26.2, 26.3, 27	3.1, 3.2, 3.3, 3.4	10.1, 10.3, 10.4, 10.5, 10.6, 10.7	35, 37	Topic 10.2 Skills Practice
10.3 Aerial and Underground Wiring Systems					
Knowledge					
State the AS/NZS 3000 requirements for the installation of aerial conductors and underground wiring.	22.1	-	-	27	Topic 10 Content Quiz Topic 10.3 Learning Activity
List the types and application of aerial conductors.	22.2	-	-	27	
State the aerial span limitations and required clearances.	22.3	-	-	27	
List the requirements for selection of aerial supporting poles/post and struts for a given application.	22.4	-	-	27	
State the use and requirements of catenary support systems.	22.5	-	-	27	
List the acceptable cable types and protection for underground wiring categories.	22.6	-	-	27	

10 Cable Installations					
State the underground wiring depth layer and protection.	22.7	-	-	27	
State the underground wiring clearances from other services.	22.8	-		27	
10.4 Consumer's Mains Installation Requirements					
Knowledge					
List the requirements for the installation of underground and overhead consumers mains	25.1, 25.2	-	-	38	Topic 10 Content Quiz Topic 10.4 Learning Activity
Explain the requirements for terminating consumers mains at pillars, pits, main connection boxes and consumers switchboard	25.1, 25.3	-	-	38	
List the requirements for the installation of unprotected consumers mains to minimize short-circuit fault currents	25.1, 25.4	-	-	38	
Explain the requirements for installing bonding conductors.	25.1, 25.5	-	-	38	
State the testing methods to ensue correct polarity	25.1, 25.6	-	-	38	
Skills					
Install and connect unprotected overhead consumer mains	25.1, 25.2, 25.3, 25.4, 25.5, 25.6	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4	8.1, 8.2, 8.3, 8.4, 8.5	27, 38	Topic 10.4.1 Skills Practice
Install and connect unprotected underground	25.1, 25.2,	1.1, 1.2,	8.1, 8.2,	27, 38	Topic 10.4.2 Skills

10 Cable Installations

consumer mains	25.3, 25.4, 25.5, 25.6	1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4	8.3, 8.4, 8.5		Practice

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education
- Berry, R., Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Wiring Rules
- AS/NZS 3008.1.1 Electrical installations – Selection of cables
- Local Service and Installation Rules (SIR)

Equipment/Material:

- Metallic switchboard enclosures.
- Electrical appliances.
- Appliance control devices (isolators, functional switches).
- PVC conduit and conduit saddles
- Cable tray and cable ties.
- Cable (TPI, TPS, SWA, ABC, XLPE).
- Insulation piercing connectors (IPCs).
- Test equipment (multimeter, IR tester).
- Service pole/post.
- Ladder/EWP.
- Service pillar and associated connectors.

10 Cable Installations

- Hand tools.
 - PPE.
-

11 Testing Electrical Installations						
Purpose:	In this topic you will revise the critical essential performance capabilities (EPCs) 30, relating to the requirement to undertake a visual inspection of a LV electrical installation and the mandatory and optional tests that are specified in AS/NZS 3000 for a LV electrical installation including how to find and rectify non-compliance faults in an electrical installation. You will also learn about the various legislative/regulations requirements and the relevant documentation requirements for the installation of LV wiring systems.					
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 8 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
11.1 Visual Inspection						
Knowledge						
State the requirements for a visual inspection of an electrical installation to determine whether the installation complies with the Wiring Rules and applicable specific installation standards.		32.1, 32.2	-	11	30	Topic 11 Content Quiz Topic 11.1 Learning Activity
Skills						
Carryout a visual inspection of an electrical installation and complete a report using the checklist in Section 8 AS/NZS 3000.		32.1, 32.2	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7	11	30	Topic 11.1 Skills Practice
11.2 Mandatory Testing						
Knowledge						
List the mandatory tests required to verify compliance and functionality of an electrical installation in accordance with AS/NZS 3000.		32.3	-	-	30	Topic 11 Content Quiz Topic 11.2 Learning Activity
Identify a suitable sequence for mandatory testing in accordance with AS/NZS 3000.		32.3	-	-	30	

11 Testing Electrical Installations					
11.3 Earth Resistance/Continuity Testing					
Knowledge					
List the appropriate tools and test equipment necessary to carry out earth resistance/continuity tests on an electrical installation.	1.4	-	12.2	30	Topic 11 Content Quiz Topic 11.3 Learning Activity
Describe techniques for verifying the resistance/continuity of the main earth, equipotential bonding conductors and protective earthing conductors.	33.1	-	12.2	30	
Skills					
Select tools and test equipment for earth resistance/continuity testing.	1.4	5.8	12.2	30	Topic 11.6 Skills Practice
Carry out earth resistance/continuity tests on an electrical installation following guidance given in AS/NZS 3017.	33.1	5.8, 6.1, 6.2	12.2	30	
11.4 Insulation Resistance Testing					
Knowledge					
List the appropriate tools and test equipment necessary to carry out insulation resistance tests on an electrical installation.	1.4	-	12.1	30	Topic 11 Content Quiz Topic 11.4 Learning Activity
Describe techniques for verifying insulation resistance.	33.1	-	12.1	30	
Skills					
Select tools and test equipment for insulation resistance testing.	1.4	5.8	12.1	30	Topic 11.6 Skills Practice
Carry out insulation resistance tests on an electrical installation following guidance given in AS/NZS 3017.	33.1	5.8, 6.1, 6.2	12.1	30	
11.5 Polarity and Correct Circuit Connections					

11 Testing Electrical Installations					
Knowledge					
List the appropriate tools and test equipment necessary to carry out tests to verify correct polarity and circuit connections.	1.4	-	12.3, 12.4	30	Topic 11 Content Quiz Topic 11.5 Learning Activity
Describe techniques for verifying correct polarity and circuit connections.	33.1, 33.2, 33.3	-	12.3, 12.4	30	
Skills					
Select tools and test equipment for testing correct polarity and circuit connections.	1.4	5.8	12.3, 12.4	30	Topic 11.6 Skills Practice
Carry out polarity and circuit connections tests on an electrical installation following guidance given in AS/NZS 3017.	33.1, 33.2, 33.3	5.8, 6.1, 6.2	12.3, 12.4	30	
11.6 Earth Fault Loop Impedance and RCD Operation					
Knowledge					
List the appropriate tools and test equipment necessary to carry out tests to verify earth fault loop impedance and operation of RCDs.	1.4	-	12.5, 12.6	30	Topic 11 Content Quiz Topic 11.6 Learning Activity
Describe techniques for verifying earth fault loop impedance and operation of RCDs.	33.1	-	12.5, 12.6	30	
Skills					
Select tools and test equipment for testing earth fault loop impedance and operation of RCDs.	1.4	5.8	12.5, 12.6	30	Topic 11.6 Skills Practice
Carry out earth fault loop impedance and RCD operation tests on an electrical installation following guidance given in AS/NZS 3017.	33.1	5.8, 6.1, 6.2	12.5, 12.6	30	
11.7 Optional Tests					
Knowledge					
Explain optional test that show all circuits and	33.3	-	-	30	Topic 11 Content Quiz

11 Testing Electrical Installations					
devices operate as intended such as ○ Apparatus calibration. ○ Load current of appliance/apparatus. ○ Appliance/apparatus performance characteristics tests.					Topic 11.7 Learning Activity
Skills					
Perform optional tests to determine the correct operation of circuits and devices.	33.3	5.5, 6.1, 6.2	-	30	Topic 11.7 Skills Practice
11.8 Rectification of Non-Compliance Defects					
Knowledge					
Describe the types of test results associated with the mandatory tests that would indicate the presence of non-compliance defects.	33.1	-	13	30	Topic 11 Content Quiz Topic 11.8 Learning Activity
Skills					
Perform tests on an installation to identify and document non-compliant results and faults.	33.1	6.1, 6.2, 6.3	13	30	Topic 11.8 Skills Practice
Make suitable recommendations for the rectification of non-compliance defects.	33.1	6.1, 6.2, 6.4	13, 14	30	
11.9 Legislated regulations and documentation					
Knowledge					
State the relevant commonwealth, state/territory legislation and regulations that require installations and equipment to be inspected and tested to ensure they are safe.	31.1	-	-	30	Topic 11 Content Quiz Topic 11.9 Learning Activity
List the person/bodies responsible for the various aspects of ensuring electrical installations are safe.	31.2	-	-	30	
Explain the test results that show an electrical installation is safe for connection to the supply as	31.3, 34.1, 34.2	-	-	30	

11 Testing Electrical Installations					
required by the local network provider.					
List the documents of periodic testing and inspection of electrical equipment including tagging requirements to show that the electrical equipment is safe to use.	31.1, 34.4	-	-	30	
Skills					
Complete the relevant documentation as required by the local network distributor.	31.3, 34.2	6.5	-	30	Topic 11.6 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education - Berry, R., Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - AS/NZS 3000 Wiring Rules - AS/NZS 3017 Verification guidelines. - AS/NZS 4836 Safe working on or near low-voltage and extra-low voltage electrical installations and equipment. Equipment/Material: - Electrical installation (for inspection). - Electrical installation (for mandatory testing). - Test equipment – multimeter, IR tester, phase rotation meter, fault loop impedance tester. - Other test equipment (e.g. series test lamps, voltmeter, trailing lead). - Lock-out device, padlock and key. - Danger tag. - Hand tools and PPE. - Certificate of Electrical Safety/Compliance.					

12 Electrical Equipment and Fault Diagnosis and Repair						
Purpose:	In this topic you will revise the critical essential performance capability (EPC) 54, relating to the techniques in diagnosing and rectifying faults in electrical apparatus and associated circuits.					
Duration:	This topic represents around 5% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
12.1 Types of Faults						
Knowledge						
Explain the various types of faults, including: ○ Open-circuit. ○ Short-circuit. ○ Incorrect connections. ○ Insulation failure. ○ Unsafe condition. ○ Apparatus/component failure. ○ Related mechanical failure.		36.1	-	14	54	Topic 12 Content Quiz Topic 12.1 Learning Activity
12.2 Electrical Circuits and Equipment Faults						
Knowledge						
State the types of faults and symptoms occurring in apparatus including: ○ Control devices. ○ Fixed appliances/accessories. ○ Lighting. ○ Electrical machines motors and controls. ○ Socket outlets. ○ Transformers. ○ Protection.		36.1	-	14	54	Topic 12 Content Quiz Topic 12.2 Learning Activity

12 Electrical Equipment and Fault Diagnosis and Repair					
○ Metering equipment.					
State the types of faults and symptoms occurring in circuits including those supplying: ○ Fixed appliances. ○ Lighting. ○ Socket outlets. ○ Motors and controls circuits. ○ Transformers. ○ Electronic or computer based equipment.	36.1	-	14	54	
Skills		-			
Undertake fault finding activities on electrical apparatus and associated circuits.	36.2, 36.3	6.1, 6.2, 6.3	14	54	Topic 12.2 Skills Practice
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practice, Pearson Education • Berry, R., Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: • AS/NZS 3000 Wiring Rules • AS/NZS 3017 Verification guidelines. • AS/NZS 4836 Safe working on or near low-voltage and extra-low voltage electrical installations and equipment. Equipment/Material: • Socket-outlets circuits. • Lighting circuits. • Fixed appliance circuits. • Motor circuits. • Control circuits. • Installation panels with fault switches (recommended). • Test equipment (e.g. multimeter, IR tester, phase rotation meter, fault loop impedance tester, series test lamps, clamp					

12 Electrical Equipment and Fault Diagnosis and Repair

meter, cathode-ray oscilloscope, trailing lead).

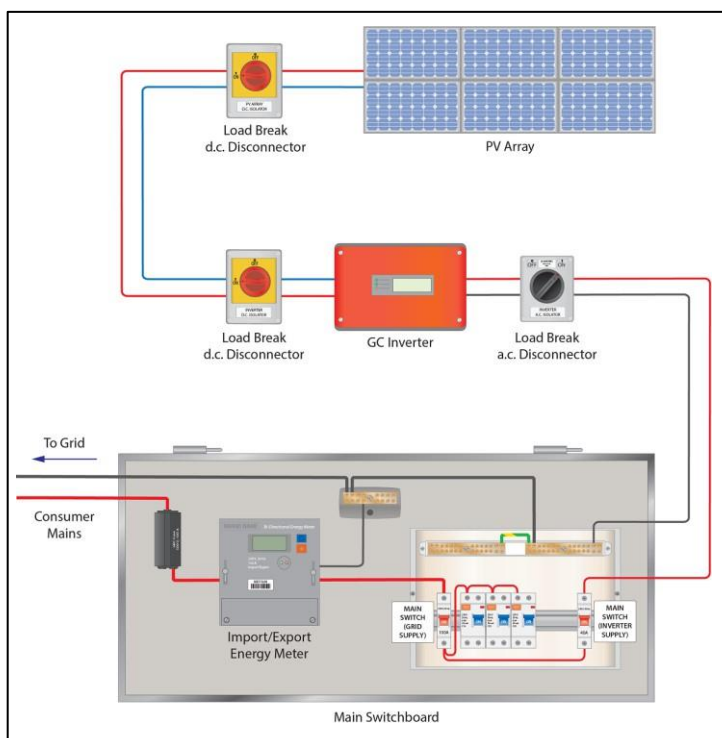
- Lock-out device, padlock and key.
- Danger tag.
- Hand tools.
- PPE.

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capability for Electrical Licensing

Unit Learning Plan

UEEEL0047 – Identify, shut down and restart systems with alternate supplies



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	5
1 Alternative Supply Systems	5
1.1 Types of Alternative Supplies	5
1.2 Standalone Power Systems (SAPS)	6
1.3 Standards and Requirements	6
2 Generating Sets	8
2.1 Generator Supply Arrangements	8
2.2 Generator Requirements	8
3 Photovoltaic (PV) Systems	10
3.1 PV Power Systems	10
3.2 PV System Requirements	10
4 Battery Systems	12
4.1 Battery Storage	12
4.2 Uninterruptable Power Supplies (UPS)	12
4.3 Battery System Requirements	13
5 Inverters	15
5.1 Introduction to Inverters	15
5.2 Grid-Connect Inverters	15
5.3 Inverter System Requirements	16
6 Working Safely with Alternative Supplies	17
6.1 Safety Considerations	17
6.2 Shut-Down and Isolation Procedures	17

A. Overview		
Competency Standard Unit (CSU)	UEEEL0047 Identify, shut down and restart systems with alternate supplies	
CSU Application	This unit involves the skills and knowledge required to identify, shut down and restart systems with alternate supplies. It includes identifying the system configuration, working safely with electricity generation systems and inverters, identifying hazards and controlling the associated risks, isolation and testing for de-energisation, reinstating the system after isolation, and completing relevant documentation. The skills and knowledge described in this unit require a licence or permit to practice in the workplace where work is carried out on electrical installations which are designed to operate at voltages greater than 50 volt (V) alternating current (a.c.) or 120 V direct current (d.c.). Competency development activities in this unit are subject to regulations directly related to licensing. Where a licence or permit to practice is not held, a relevant contract of training, such as an Australian Apprenticeship, may be required. Additional and/or 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 work health and safety (WHS)/occupational health and safety (OHS) regulations.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEEEL0047	Performance Criteria
	KE-UEEEL0047	Knowledge Evidence
	PE-UEEEL0047	Performance Evidence
Suggested Durations	Completion of ULP topics 1 to 6	18 hours
	Completion of Unit Knowledge Test	1 hour
	Completion of Unit Skills Test	1 hour
	Total duration of structured learning program	20 hours

	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • UEECD0007 Apply work health and safety regulations, codes and practices in the workplace • UEECD0019 Fabricate, assemble and dismantle utilities industry components • UEECD0020 Fix and secure electrotechnology equipment • UEECD0051 Use drawings, diagrams, schedules, standards, codes and specifications • UEEEL0003 Arrange circuits, control and protection for general electrical installations • UEEEL0020 Solve problems in low voltage a.c. circuits • UEEEL0023 Terminate cables, cords and accessories for low voltage circuits • UEEEL0019 Solve problems in direct current (d.c.) machines • UEEEL0021 Solve problems in magnetic and electromagnetic devices and • UEECD0043 Solve problems in direct current circuits or • UEECD0044 Solve problems in multiple path circuits • UEECD0046 Solve problems in single path circuits

B. Knowledge and Skills Delivery

1 Alternative Supply Systems

Purpose: In this topic you will learn about the different types of alternative supplies commonly found in electrical installations, their common arrangements and configurations, and the Australian Standards to which they must comply.

Duration: This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Types of Alternative Supplies					
Knowledge					
List the various types and purpose of alternative supplies commonly found in electrical installations, including: - Standby generators. - Photovoltaic (PV) arrays. - Battery systems. - Uninterruptible power supplies (UPS).	2	-	-	55	Topic 1 Content Quiz Topic 1.1 Learning Activity
Explain the different operating modes of alternative supply systems.	2, 4.3	-	-	55	
Explain the arrangement and configuration of alternative supplies within an installation, including: - Changeover switches. - Main switches. - Switchboard wiring.	2, 3.1, 3.8	-	-	55	
Skills					
Identify alternative supply arrangements and configurations from electrical drawings and specifications.	2	1.1	4, 5	55	Topic 1.3 Skills Practice

1 Alternative Supply Systems					
1.2 Standalone Power Systems (SAPS)					
Knowledge					
Explain the arrangement and fundamental requirements for standalone power systems (SAPS).	2, 3.1, 3.8, 3.9, 7.5	-	-	55	Topic 1 Content Quiz Topic 1.2 Learning Activity
1.3 Standards and Requirements					
Knowledge					
Provide an overview of the Wiring Rules requirements for electricity generation systems.	7.1	-	-	55	Topic 1 Content Quiz Topic 1.3 Learning Activity
List the relevant Australian Standards covering the selection, installation and maintenance of different alternative supply systems, including: - AS/NZS 4777 (series) Grid connection of energy systems via inverters - AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays - AS/NZS 3010 Electrical installations - generating sets - AS/NZS 4509 (series) Stand-alone power systems - AS 3011 Electrical installations - Secondary batteries installed in buildings - AS/NZS 5139 Electrical installations - Safety of battery systems for use with power conversion equipment	7.2, 7.3, 7.4, 7.5, 7.6, 7.7	-	-	55	
Skills					
Identify local supply authority requirements for alternative supplies.	3.2	1.1	4	55	Topic 1.3 Skills Practice
Apply Wiring Rules requirements for alternative	7.1	1.1	4	55	

1 Alternative Supply Systems

supplies.

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Electrical installations (Wiring Rules)
- AS/NZS 4777(series) Grid connection of energy systems via inverters
- AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays
- AS/NZS 3010 Electrical installations - generating sets
- AS/NZS 4509 (series) Stand-alone power systems
- AS 3011 Electrical installations - Secondary batteries installed in buildings
- AS/NZS 5139 Electrical installations - Safety of battery systems for use with power conversion equipment

2 Generating Sets					
Purpose:	In this topic you will learn about the characteristics and requirements for generating sets used as alternative supplies in electrical installations.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
2.1 Generator Supply Arrangements					
Knowledge					
Explain the typical application of generating sets as an alternative supply.	2	-	-	55	Topic 2 Content Quiz Topic 2.1 Learning Activity
List the main components and arrangement of a standby generator.	2	-	-	55	
Skills					
Identify the arrangement of a generator used as an alternative supply in an electrical installation, including identification of all isolation points.	2	1.1	4, 5	55	Topic 2.2 Skills Practice
2.2 Generator Requirements					
Knowledge					
Provide an overview of AS/NZS 3010 and Wiring Rules requirements for generating sets, including earthing considerations.	3.9, 7.4	-	-	55	Topic 2 Content Quiz Topic 2.2 Learning Activity
Outline the general maintenance procedures for generator systems/equipment and the importance of replacing components like-for-like.	3.5	-	-	55	
Skills					
Apply relevant sections of AS/NZS 3000 and AS/NZS 3010 to generator installations.	7.4	1.1	8	55	Topic 2.2 Skills Practice

2 Generating Sets

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Electrical installations (Wiring Rules)
- AS/NZS 3010 Electrical installations - generating sets
- AS/NZS 4509 (series) Stand-alone power systems

3 Photovoltaic (PV) Systems					
Purpose:	In this topic you will learn about the characteristics and requirements for photovoltaic (PV) systems used as alternative supplies in electrical installations.				
Duration:	This topic represents around 10% of the knowledge and skills specification contents, and should take the learner approximately 2 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
3.1 PV Power Systems					
Knowledge					
Explain the typical application of PV systems as an alternative supply.	2	-	-	55	Topic 3 Content Quiz Topic 3.1 Learning Activity
List the main components and arrangement of a photovoltaic (PV) power system.	2	-	-	55	
Skills					
Identify the arrangement of a PV system used as an alternative supply in an electrical installation, including identification of all isolation points.	2	1.1	4, 5	55	Topic 3.2 Skills Practice
3.2 PV System Requirements					
Knowledge					
Provide an overview of AS/NZS 5033 requirements for PV power systems, including d.c. polarity, switchgear ratings, and earth fault interrupters and alarms.	3.4, 4.4, 4.5, 7.3	-	-	55	Topic 3 Content Quiz Topic 3.2 Learning Activity
Outline the general maintenance procedures for PV power systems and the importance of replacing components like-for-like.	3.5	-	-	55	
Skills					
Apply relevant sections of AS/NZS 3000 and	3.4, 4.4,	1.1	8	55	Topic 3.2 Skills Practice

3 Photovoltaic (PV) Systems

AS/NZS 5033 to PV power systems.

7.1, 7.3

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill
- Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning

Standards and Codes:

- AS/NZS 3000 Electrical installations (Wiring Rules)
- AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays

4 Battery Systems						
Purpose:	In this topic you will learn about the characteristics and requirements for battery systems and UPS used as alternative supplies in electrical installations.					
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
4.1 Battery Storage						
Knowledge						
List the main components of a battery storage system.		6	-	-	55	Topic 4 Content Quiz Topic 4.1 Learning Activity
Explain the arrangement of a battery system as an alternative supply within an electrical installation.		2, 6	-	-	55	
List the types of batteries commonly used in alternative supply battery systems.		6	-	-	55	
Describe the configuration of battery banks and the effect of connecting batteries in series and parallel.		2, 6	-	-	55	
Skills						
Identify the arrangement of a battery system used as an alternative supply in an electrical installation, including identification of all isolation points.		2, 6	1.1	4, 5	55	Topic 4.3 Skills Practice
4.2 Uninterruptable Power Supplies (UPS)						
Knowledge						
List the main types and characteristics of uninterruptible powers supplies (UPS).		3.3	-	-	55	Topic 4 Content Quiz Topic 4.2 Learning Activity
Explain the arrangement of a UPS within an electrical installation.		2, 3.3	-	-	55	

4 Battery Systems					
4.3 Battery System Requirements					
Knowledge					
Provide an overview of AS/NZS 5139 and AS 3011 requirements for battery systems.	3.4, 7.6, 7.7	-	-	55	Topic 4 Content Quiz Topic 4.3 Learning Activity
Outline the types of general maintenance and safety procedures for battery systems and the importance of replacing components like-for-like.	1, 3.5	-	-	55	
List the general hazards and safe working practices that should be observed whilst working with batteries.	1	-	-	55	
Skills					
Apply relevant sections of AS/NZS 5139 and AS 3011 to battery systems installations.	7.6, 7.7	1.1	8	55	Topic 4.3 Skills Practice
Apply safe methods to check the integrity of a battery storage system for compliance with standards, regulatory and manufacturer requirements, including: • Correct isolation devices. • Adequate ventilation. • Installation location.	2, 6, 7.6, 7.7	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.7, 2.8, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 8, 9	55	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					
Standards and Codes: • AS/NZS 3000 Electrical installations (Wiring Rules) • AS/NZS 5139 Electrical installations - Safety of battery systems for use with power conversion equipment • AS 3011 Electrical installations - Secondary batteries installed in buildings					

4 Battery Systems

Equipment:

- Battery storage system with manufacturer manual / instructions and appropriate signage and labelling
 - PPE – safety glasses etc.
-

5 Inverters						
Purpose:	In this topic you will learn about the purpose and basic operation of inverters. You will also have the opportunity to connect an inverter and measure the input and output parameters.					
Duration:	This topic represents around 15% of the knowledge and skills specification contents, and should take the learner approximately 3 hours to achieve the topic requirements.					
Knowledge and Skills Specification Content Areas		Unit Mapping ¹				Energy Space Resources
		KE	PC	PE	EPC	
5.1 Introduction to Inverters						
Knowledge						
Describe the basic function of an inverter.		3.6	-	-	55	Topic 5 Content Quiz Topic 5.1 Learning Activity
Explain the basic principle of operation of a single phase inverter (using switch analogue).		3.6	-	-	55	
Explain the operation of an inverter bridge and half-bridge configuration.		3.6	-	-	55	
Explain the principles of pulse width modulation (PWM) in relation to square wave, modified square wave and synthesised sine wave inverters.		3.6	-	-	55	
Skills						
Draw the Australian standard symbol for a low voltage inverter.		3.6	-	-	55	Topic 5.2 Skills Practice
5.2 Grid-Connect Inverters						
Knowledge						
List the different types of inverters used in alternative supply systems.		3.6	-	-	55	Topic 5 Content Quiz Topic 5.2 Learning Activity
List the characteristics that distinguish grid-connect inverters from standard inverters.		3.6, 4.6	-	-	55	
State the six (6) essential inverter specifications.		3.6, 4.6	-	-	55	

5 Inverters					
Skills					
Draw a simple block diagram of a grid-connect inverter.	3.6	-	-	55	Topic 5.2 Skills Practice
5.3 Inverter System Requirements					
Knowledge					
Provide an overview of the AS/NZS 4777 series requirements for grid-connected inverter systems.	3.4, 3.6, 7.2	-	-	55	Topic 5 Content Quiz Topic 5.3 Learning Activity
Skills					
Connect an inverter and measure the input and output parameters for various loads.	3.6	1.1, 1.2, 1.3, 1.4, 1.5	1, 2, 3, 4, 5	55	Topic 5.3 Skills Practice
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill - Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Standards and Codes: - AS/NZS 3000 Electrical installations (Wiring Rules) - AS/NZS 4777(series) Grid connection of energy systems via inverters Equipment: - Inverter (grid-connect model recommended) - d.c. supply - Variable a.c. load - Alternative supply (PV array recommended) - Test equipment – d.c. voltmeter, d.c. ammeter, a.c. voltmeter, a.c. ammeter, cathode ray oscilloscope (CRO) - PPE, hand tools and connection leads					

6 Working Safely with Alternative Supplies

Purpose:	In this topic you will learn about the safe working practices for working in an installation with alternative supplies. You will also practice the safe shut-down, isolation and start-up of an alternative supply system.
Duration:	This topic represents around 20% of the knowledge and skills specification contents, and should take the learner approximately 4 hours to achieve the topic requirements.

Knowledge and Skills Specification Content Areas	Unit Mapping ¹				Energy Space Resources
	KE	PC	PE	EPC	
6.1 Safety Considerations					
Knowledge					
State the hazards and risks posed by working on installations with alternative supplies, including the potential for circuits to remain energised due to islanding.	1, 4.1	-	-	55	Topic 6 Content Quiz Topic 6.1 Learning Activity
State the safe working practices required to reduce the risks posed by alternative supplies.	1	-	-	55	
Describe the types of site and regulatory documentation required for electrical installations with alternate supply systems, including labelling and identification requirements for grid-connected inverter systems.	3.7, 5, 8	-	-	55	
Skills					
Undertake a job safety/hazard analysis (JSA/JHA) for performing routine maintenance on alternative supply equipment.	1	1.1, 1.2, 1.3, 1.4, 1.5	1, 2	55	Topic 6.1 Skills Practice Topic 6.2 Skills Practice
6.2 Shut-Down and Isolation Procedures					
Knowledge					
State the hazards and particular considerations for isolating alternative supply systems, including:	4.2, 4.5, 4.7,	-	-	55	Topic 6 Content Quiz

6 Working Safely with Alternative Supplies					
• Need for no-load conditions. • Need to isolate at multiple points. • Avoiding automatic changeover/starting of alternative supply equipment. • Possibility of voltage rise.					Topic 6.2 Learning Activity
Describe the general procedures for safe shut-down and isolation of alternative supply systems in accordance with AS/NZS 4836 (current version).	1, 4.8, 4.9	-	-	55	
Describe the general procedures for safely restarting alternative supply systems.	1	-	-	55	
Skills					
Shut-down and isolate circuits supplied by both grid and alternative supplies in accordance with safe work methods stated in AS/NZS 4836.	1, 3.7, 5, 4.7, 4.8, 4.9, 8	2.1, 2.2, 2.3, 2.4, 2.5, 2.6	1, 2, 3, 4, 5, 6, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10.1, 7.10.2, 7.11, 7.12	55	Topic 6.2 Skills Practice
Visually inspect the isolated system to verify compliance with relevant standards.	3.2, 3.4, 3.9, 6	2.7, 2.8	1, 2, 8, 9, 11	55	
Safely restart an alternative supply system after isolation.	1	2.9, 3.1, 3.2, 3.3	10	55	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J., Hanssen, S., Electrotechnology Practical, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning					

6 Working Safely with Alternative Supplies

Standards and Codes:

- AS/NZS 4836 Safe working on or near low-voltage and extra-low voltage electrical installations and equipment
- AS/NZS 3000 Electrical installations (Wiring Rules)
- AS/NZS 4777 (series) Grid connection of energy systems via inverters
- AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays
- AS/NZS 3010 Electrical installations - generating sets
- AS/NZS 4509 (series) Stand-alone power systems
- AS 3011 Electrical installations - Secondary batteries installed in buildings
- AS/NZS 5139 Electrical installations - Safety of battery systems for use with power conversion equipment

Equipment:

- Alternative supply system with two alternative energy sources, one being a battery system
- Test Equipment – multimeter
- Safety glasses
- Lock-out devices
- Personal danger tags
- PPE

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities

Unit Learning Plan

UEERE0001 – Apply environmentally and sustainable procedures
in the energy sector



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	4
1 Sustainable Work Practices	4
1.1 Sustainability	4
1.2 Environmental Risk Management	4
1.3 Greenhouse Effect	5
1.4 Environmental Legislation	5
1.5 Sustainable Work Practices	6
2 Reduction of Carbon Based Energy Sources	8
2.1 Sustainable Energy	8
2.2 Energy Efficient Retrofits	9
2.3 Renewable Energy Technologies	9

A. Overview		
Competency Standard Unit (CSU)	UEERE0001 Apply environmentally and sustainable procedures in the energy sector	
CSU Application	This unit involves the skills and knowledge required to apply environmentally sustainable procedures in the energy sector. It includes identifying and applying sustainable methods of work practice that minimise energy and material usage and to apply energy reduction strategies in the energy sector workplace. No licensing, legislative or certification requirements apply to this unit at the time of publication.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UEERE0001	Performance Criteria
	KE-UEERE0001	Knowledge Evidence
	PE-UEERE0001	Performance Evidence
Suggested Durations	Completion of ULP topics 1 and 2	18 hours
	Completion of Unit Knowledge Test	30 minutes
	Completion of Unit Skills Test	1.5 hours
	Total duration of structured learning program	20 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: • Nil	

B. Knowledge and Skills Delivery

1 Sustainable Work Practices

Purpose:	In this topic you will learn about the concept and importance of environmental risk management; environmental protection legislation; greenhouse effect, its causes and the effect of increasing the concentration of greenhouse gases in the atmosphere and about applying sustainable work practices in the energy sector.			
Duration:	This topic represents around 66% of the knowledge and skills specification contents, and should take the learner approximately 12 hours to achieve the objectives.			
Knowledge and Skills Specification Content Areas	Unit Mapping ¹			Energy Space Resources
	KE	PC	PE	
1.1 Sustainability				
Knowledge				
Explain the term 'environmental sustainability'.	1.5	1.5	6	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe the importance and scope of sustainable work practices.	1.5	1.5	6	
Explain the consequences of failing to participate in sustainable work practices and the consequences of not doing so.	1.2	-	-	
Explain the economic benefits of sustainable initiatives.	1.1	-	-	
1.2 Environmental Risk Management				
Knowledge				
Give reasons energy sector organisations need to consider environmental management as an integral part of their operation.	2.1, 4	-	-	Topic 1 Content Quiz Topic 1.2 Learning Activity
List typical environmental risks faced by energy companies in Australia.	2.1, 4	1.5	6	
Explain why energy companies need to develop	2.1, 4	-	-	

1 Sustainable Work Practices				
and maintain an Environmental Management System (EMS).				
Describe the role of a typical EMS within the energy sector and its relationship to the ISO 14001 standard.	2.1, 4	1.5	6	
1.3 Greenhouse Effect				
Knowledge				
Explain the meaning of the term 'greenhouse effect' as it applies to life on Earth	1.6	1.5	6	Topic 1 Content Quiz Topic 1.3 Learning Activity
List at least four greenhouse gases in order of their contribution to the greenhouse effect	1.6	1.5	6	
Describe the main human activities that are increasing greenhouse gas concentrations	1.6	1.5	6	
Identify the role of the Intergovernmental Panel on Climate Change (IPPC) in assessing climate change.	1.3, 1.7	-	-	
Outline the actions currently being taken in Australia to reduce greenhouse gas emissions	1.3	-	-	
1.4 Environmental Legislation				
Knowledge				
Outline the role of Australian Government environmental legislation.	1.7, 5	-	-	Topic 1 Content Quiz Topic 1.4 Learning Activity Topic 1.4 Skills Practice
Identify the environmental legislation that applies to a particular Australian state or territory.	1.4	-	-	
List at least eight environmental issues covered by state/territory environmental legislation.	1.4	1.5	6	
Outline the responsibilities environmental legislation imposes on individuals and corporations.	1.4	-	-	

1 Sustainable Work Practices				
Identify the role local Councils typically have in administering environmental protection legislation and regulations.	1.7	-	-	
List the types of environmental policies and procedures that apply to an energy sector company.	2.1, 3	1.5	6	
1.5 Sustainable Work Practices				
Knowledge				
Define the term 'sustainable work practice'.	1.5, 7	1.5	6	Topic 1 Content Quiz Topic 1.5 Learning Activity
Identify typical environmental and resource saving issues associated with an outdoors worksite.	2.1, 3, 4, 7	1.5	6	
Identify typical environmental and resource saving issues associated with a typical electrotechnology workshop.	2.1, 3, 4, 7	1.5	6	
Outline methods to reduce waste products.	2.1, 3, 4, 7	1.5	6	
Outline ways of reducing on-the-job energy usage (where reductions are possible).	2.1, 3, 4, 7	1.5	6	
Skills				
Use relevant state/territory government information to classify waste products and determine their method of disposal.	2.1, 3, 4, 7	1.3, 1.5	2, 5, 6	Topic 1.5 Skills Practice
Identify recyclable waste products typically produced by an energy sector organisation.	2.1, 3, 4, 7	1.3, 1.5	2, 5, 6	
Carry out a sustainability/environmental audit to identify areas to minimise waste and risks.	2.1, 3, 4, 5, 6, 7	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 6, 7, 8.3, 8.4	

1 Sustainable Work Practices

Reference Text:

- Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill, Seventh Edition, Volume 1, 2010 (Chapter 1)
- Hampson, J. and Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Third Edition, 2013 (Section 10)
- Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 2)
- Introduction to Renewable Energy Technologies: Resource Book, 2003, Renewable Energy Centre, Brisbane and North Point TAFE, QLD. UNIT 1 and 5
- CAT004A Basics of Renewable Energy Student Workbook, 2006, Centre for Appropriate Technology Inc. Alice Springs, NT

Standards and Codes:

- ISO 14001 Environmental Management Systems

2 Reduction of Carbon Based Energy Sources					
Purpose:	In this topic you will learn about ways of reducing energy consumption and the role of renewable energy sources in achieving a goal of sustainable energy.				
Duration:	This topic represents around 33% of the knowledge and skills specification contents, and should take the learner approximately 6 hours to achieve the objectives.				
Knowledge and Skills Specification Content Areas		Unit Mapping ¹			Energy Space Resources
		KE	PC	PE	
2.1 Sustainable Energy					Topic 2 Content Quiz Topic 2.1 Learning Activity
Knowledge					
Explain the term 'sustainable energy'.		2.3	-	-	
Explain why some items of electrical equipment are required to display an energy rating label, and the overall role of Minimum Energy Performance Standards in reducing energy consumption.		1.4, 3	-	-	
Describe the general techniques for reducing carbon based energy sources and greenhouse gasses by minimising waste, recycling and using retrofitting technologies.		2.1, 2.2, 3	-	-	
Outline the role the Australian Building Codes Board has in determining the energy efficiency of homes and commercial buildings.		1.4, 1.7	-	-	
Outline how state/territory energy efficiency and sustainability regulations are applied to new developments.		1.4, 1.7	-	-	
Outline the role of Australian Government programs aimed at increasing energy efficiency in industry.		1.3	-	-	
Explain the terms 'network demand', 'maximum		2.1	-	-	

2 Reduction of Carbon Based Energy Sources				
demand', 'peak demand' and 'tariff' as applied to electrical energy.				
Skills				
Carry out an energy audit to identify areas to minimise carbon based energy requirements.	2.1, 3, 4, 5, 6, 7	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3	1, 2, 3, 4, 5, 6, 7, 8.1, 8.2, 8.4	Topic 2.1 Skills Practice
2.2 Energy Efficient Retrofits				
Knowledge				
When undertaking retrofits in the electrotechnology areas describe appropriate techniques that can be used to save energy (overview).	2.2	1.5	6	Topic 2 Content Quiz Topic 2.2 Learning Activity
2.3 Renewable Energy Technologies				
Knowledge				
List methods used to generate power from renewable energy sources.	2.3	1.5	6	Topic 2 Content Quiz Topic 2.3 Learning Activity
Reference Text: - Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill, Seventh Edition, Volume 1, 2010 (Chapter 1) - Hampson, J. and Hanssen, S., Electrical Trade Principles a Practical Approach, Pearson Education, Third Edition, 2013 (Section 10) - Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning, Second Edition, 2015 (Chapter 2) - Introduction to Renewable Energy Technologies: Resource Book, 2003, Renewable Energy Centre, Brisbane and North Point TAFE, QLD. UNIT 1 and 5 - CAT004A Basics of Renewable Energy Student Workbook, 2006, Centre for Appropriate Technology Inc. Alice Springs, NT				

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria		

Unit Learning Plan

UETDRRF004 – Perform rescue from a live LV panel



Contents

Contents	2
A. Overview	3
B. Knowledge and Skills Delivery	4
1 Live LV Rescue Procedures	4
1.1 Risk of Electric Shock	4
1.2 Prepare for Live LV Rescue	4
1.3 Electric Shock Rescue	5

A. Overview		
Competency Standard Unit (CSU)	UETDRRF004 Perform rescue from a live LV panel	
CSU Application	This unit covers the performance of rescue procedures from live low voltage (LV) apparatus, not including overhead lines and underground cables in the workplace. It specifies the mandatory requirements of rescue from a live LV panel and how they apply in the context of transmission, distribution or rail work functions. It encompasses responsibilities for health, safety and risk management processes at all operative levels and adherence to safety practices as part of the normal way of doing work. The application of the skills and knowledge described in this unit may require a licence/registration to practice in the workplace subject to regulations for undertaking of electrical work. Other conditions may apply under state and territory legislative and regulatory licensing requirements which must be confirmed prior to commencing this unit.	
Purpose of ULP	The purpose of the Unit Learning Plan (ULP) is to define the depth and breadth of the knowledge and skills required to address the Competency Standard Unit (CSU) Assessment Requirements. It also indicates the recommended sequence and duration for the structured learning program, and provides a list of resources suitable for the delivery of the material using a blended approach. In the context of this ULP, the term 'structured learning program' encompasses both the imparting of knowledge and skills and the completion of evidence gathering activities designed to address the Assessment Requirements. The structured learning program is generally undertaken off-the-job in a controlled learning environment.	
Unit aspects addressed in this ULP	PC-UETDRRF004	Performance Criteria
	KE-UETDRRF004	Knowledge Evidence
	PE-UETDRRF004	Performance Evidence
Suggested Durations	Completion of ULP topic 1	18 hours
	Completion of Unit Knowledge Test	30 minutes
	Completion of Unit Skills Test	1.5 hours
	Total duration of structured learning program	20 hours
	Note: These durations do not include the necessary workplace experience and final assessment of all evidence that must occur before competence can be determined.	
Sequence	Before undertaking this ULP a learner is to have completed the following Competency Standard Units or equivalent: HLTAID009 Provide cardiopulmonary resuscitation	

B. Knowledge and Skills Delivery

1 Live LV Rescue Procedures

Purpose:	In this topic you will learn about the risks associated with working around low voltage equipment and the procedures to prepare for and undertake rescue from a live low voltage situation.				
Duration:	This topic represents around 90% of the knowledge and skills specification contents, and should take the learner approximately 18 hours to achieve the topic requirements.				
Knowledge and Skills Specification Content Areas	Unit Mapping				Energy Space Resources
	KE	PC	PE	EPC	
1.1 Risk of Electric Shock					
Knowledge					
State the effects that electric shock can cause to the human body.	1.2	-	-	2	Topic 1 Content Quiz Topic 1.1 Learning Activity
Describe common causes of electrical accidents.	1.2	-	-	43, 45	
Describe the hazards and risks posed to the rescuer, victim and others in the vicinity of an electrical accident.	1.2	-	-	43, 45	
1.2 Prepare for Live LV Rescue					
Knowledge					
State the safe approach distances (SAD) applicable to low voltage rescue procedures.	1.4, 2.2, 2.3	-	-	46	Topic 1 Content Quiz Topic 1.2 Learning Activity
Describe the correct placement and contents of a low voltage rescue kit, including: - Rubber gloves. - Torch. - Rescue hook. - Isolation signage. - Fire blanket.	2.1, 2.2	-	-	46	

1 Live LV Rescue Procedures					
Burns dressings.					
Explain the need to inspect a low voltage rescue kit for serviceability.	1.1	-	-	46	
Explain the need to identify and label point(s) of isolation.	1.3, 2.2	-	-	46	
Skills					
Undertake a risk assessment for performing live rescue from a low voltage panel.	1.2, 2.2	1.1	1	46	Topic 1.3 Skill Practice
Identify and label point(s) of isolation.	1.3, 2.2	1.2	1, 3	46	
Inspect the equipment in a low voltage rescue kit for serviceability.	1.1, 2.2	1.3	1, 2	46	
Correctly place low voltage rescue kit in preparation for live rescue procedures.	2.1, 2.2	2.1	1, 2	46	
1.3 Electric Shock Rescue					
Knowledge					
Describe the process to safely remove an electric shock victim from a live electrical situation, including: - Checking for danger to yourself and others. - Isolating the supply where possible. - Using an insulated rescue hook. - Moving victim to a safe place. - Administering First Aid. - Contacting emergency services. - Securing the area to reduce risk to others.	1.3, 1.4, 1.5, 2.2, 2.3, 2.4	-	-	46	Topic 1 Content Quiz Topic 1.3 Learning Activity
Explain the correct and safe techniques for administering CPR on an adult.	-	-	-	47	
Describe the procedures for reporting electrical	-	-	-	46	

1 Live LV Rescue Procedures					
accidents/incidents and the features of associated documentation.					
Skills					
Demonstrate an appropriate method of removing an electric shock victim from a (simulated) live electrical situation.	1.3, 1.4, 1.5, 2.2, 2.3, 2.4	2.1, 2.2, 2.4	1, 4	46	Topic 1.3 Skill Practice
Demonstrate the correct procedure for administering CPR.	-	2.3	1, 4	47	
Complete documentation and reporting of an electrical accident.	-	3.1	4	46	
Reference Text: • Pethebridge, K. and Neeson, I., Electrical Wiring Practice, McGraw-Hill • Hampson, J. and Hanssen, S., Electrotechnology Practice, Pearson Education • Berry, R. and Chadwick, P., Electrical Trade Practices, Cengage Learning Equipment: • Low voltage rescue kit • Practice mannequin for CPR					

Legend:

KE	Knowledge Evidence	PE	Performance Evidence
PC	Performance Criteria	EPC	Essential Performance Capabilities