GOVERNMENT OF WESTERN AUSTRALIA

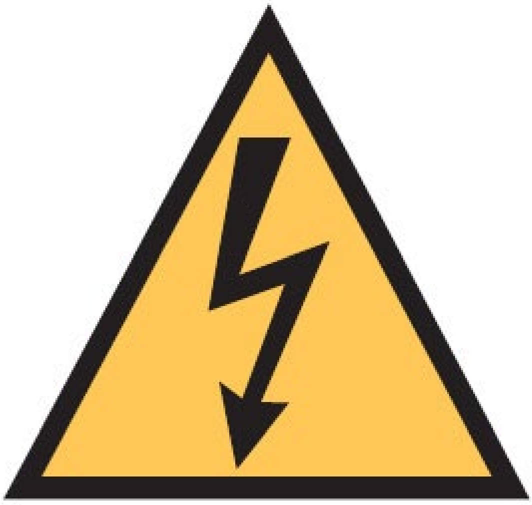
TAFE WA North Metropolitan

RTO Code: 52786

Portfolio of evidence

UEECD0044

Solve problems in multiple path circuits



UEE Training Package Support Material

Based on:
National Electrotechnology Industry Standards

North Metropolitan TAFE
V2 May 2023

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Assessment Task 3 Portfolio of Evidence

Qualification national code and title	UEE30820 Certificate III in Electrotechnology Electrician
Unit/s national code/s and title/s	UEECD0044 - Solve problems in multiple path circuits

Student Name		**Assessment Type**	☐	Questioning (Oral / Written)
Student ID			☒	Portfolio
Lecturer Name		**Competent**	**Yes / No**	
Student Result (S/NYS)				

By completing and submitting this signed form to my lecturer, I am stating that:

a. The attached submission is completely my own work
b. I have correctly cited all sources of information used in this work (if required)
c. I understand a copy of my assessment will be kept by the NMTAFE for their records
d. I understand my assessment may be selected for use in the NMTAFE's validation and audit process to ensure student assessment meets requirements

Student Signature		**Date**	

Assessment type (☑):

☐ Questioning (Oral/Written)
☐ Practical Demonstration
☐ 3rd Party Report
☒ Other – Project/Portfolio *(please specify)*

Assessment Resources:

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Resources the assessor is to provide:

- Classroom setting as the venue.
- Test paper
- Graph paper

Resources the candidate is to provide:

- Black or Blue pen
- Pencil and eraser
- Scientific calculator (non-programmable)
- Maths drawing set
- AS/NZS 3000: current edition
- AS/NZS 3008.1.1 current edition
- WA Electrical Requirements current edition

Assessment Instructions:

Task description:

The following Portfolio Assessment relates to the knowledge requirements and performance evidence of the unit. Make sure you complete all questions and practical activities

- To be deemed ***Satisfactory*** you are required to achieve a mark of **100%**
- The following **Knowledge Assessment** is an open book assessment and does not need to be completed under supervision
- The following **Practical Activities** must be completed under supervision in a simulated workplace environment
- If ***Not Yet Satisfactory*** you will be required to re-attempt the **Knowledge Questions** that are marked ***not satisfactory*** and/or any **Practical Activity** marked as **Not Yet Satisfactory**

Student Instructions:

Ensure you have access to all the resources required for this assessment as described below.

1. Read the **Questions** section. If you are not clear about a question, ask your assessor for further information.
2. You may be able to complete the questions verbally. This would need to be negotiated with your assessor.

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3. Your assessor will provide feedback on your answers, including any questions that may require a further response.
4. If you have specific needs that you would like considered during this assessment, please discuss this with your assessor to identify any possible reasonable adjustments **prior** to commencing the assessment.
5. All diagrams must be neat, labelled and in pencil.
6. All calculations and numerical answers must be shown correct to two decimal places and include both the unit of measurement and metric prefix if applicable.

Complete all Knowledge Questions.

Question 1	Two copper conductors of equal length, carrying the same amount of current, one 2.5mm² and the other 6mm². Which of these will have the greater voltage drop?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 2	Calculate the Current drawn by each conductor: a) a 1.5mm² conductor with a Resistance of 5Ω with a 30volt supply. b) a 6mm² conductor with a Resistance of 2Ω with a 30volt supply.	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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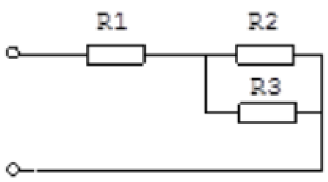
Question 3	In the following circuit, what effect would it have on the Total Current, the Total Resistance, the Total Power of the circuit and the Voltage Drop across R3, if R1 became open circuited?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 4	What is an advantage and disadvantage of the following meters		
Answer	**Meter Type**	**Advantage**	**Disadvantage**
	Digital Voltmeter		
	Analogue Voltmeter		
	Digital Ammeter		
	Analogue Ammeter		
	Digital IR Tester		
	Analogue IR Tester		
Feedback		☐ Satisfactory ☐ Not satisfactory	

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Question 5	Before connecting an Ohmmeter to a circuit, what safety steps should be taken?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 6	What type of meter and on what setting would you use to perform **Continuity** and an **Insulation Resistance Tests**?		
Answer	**Meter Type**	**Measurement Range**	**Purpose**
Feedback			☐ Satisfactory ☐ Not satisfactory

Question 7	What voltage settings are on most IR Testers?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 8	Where and why would you use the following meters?		
Answer	**Meter**	**Where**	**Why**
	Ohmmeter		
	IR tester		
Feedback		☐ Satisfactory ☐ Not satisfactory	

Question 9	According to the **AS/NZS 3000**, what parts of an electrical installation should be tested for Insulation Resistance and at what voltage is this performed?	
Answer	**Voltage Setting**	**Part of Installation**
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 10	Why should you have your Resistance Testers calibrated?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 11	How would you test your Resistance Tester for the correct reading?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 12	Draw the symbols for a trimmer and a polarised capacitor.		
Answer	**Trimmer**		
	Polarised		
Feedback			☐ Satisfactory ☐ Not satisfactory

Question 13	What is Capacitance and in what unit is it measured?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 14	With reference to Capacitance, in what quantity is Charge measured and what is the symbol?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 15	What is the Hazard when working with capacitors and how can you avoid it?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 16	What is the recommended method for discharging a capacitor?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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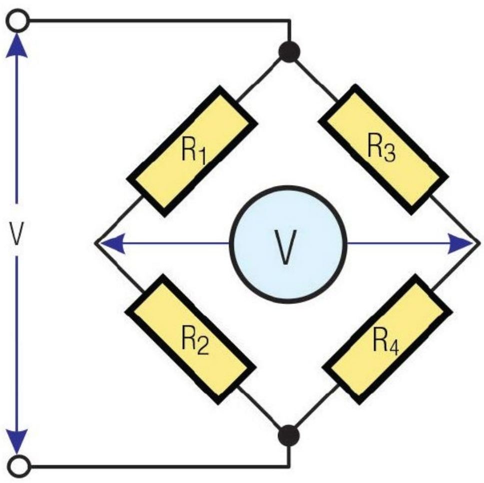
Question 17	Calculate the voltage that would appear on the voltmeter. R1 = 100Ω, R2 = 200Ω, R3 = 20Ω, R4 = 10Ω V_T = 12v	6 Marks
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Practical Activities Overview

1. Identify the internal components of a typical three phase magnetically operated DOL starter.

2. Develop, connect and test a single direct-on-line (DOL) magnetic starter circuit for a 415 volt three phase squirrel cage induction (SCI) motor.

3. Develop, connect and test a direct-on-line (DOL) magnetic starter circuit which controls a 415 volt three phase squirrel cage induction (SCI) motor from either of two stop-start stations.

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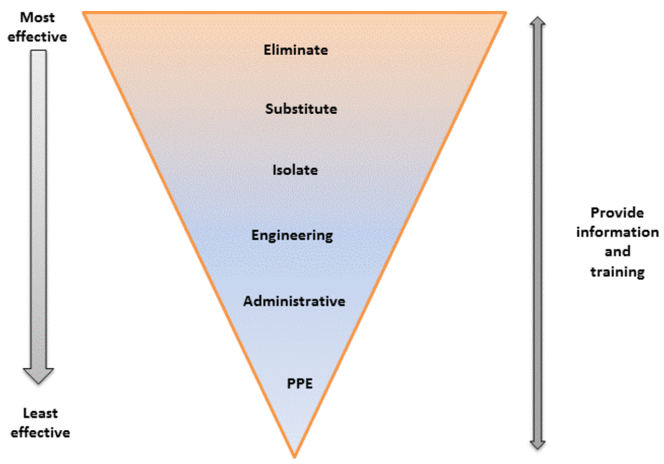
Risk assessment

Consequence		1 **Rare** The event may occur in exceptional circumstances	2 **Unlikely** The event could occur sometimes	3 **Moderate** The event should occur sometimes	4 **Likely** The event will probably occur in most circumstances	5 **Almost Certain** The event is expected to occur in most circumstances
1	**Insignificant** No injuries or health issues	LOW	LOW	LOW	LOW	MODERATE
2	**Minor** First aid treatment	LOW	LOW	MODERATE	MODERATE	HIGH
3	**Moderate** Medical treatment, potential LTI	LOW	MODERATE	HIGH	HIGH	CRITICAL
4	**Major** Permanent disability or disease	LOW	MODERATE	HIGH	CRITICAL	CATASTROPHIC
5	**Extreme** Death	MODERATE	HIGH	CRITICAL	CATASTROPHIC	CATASTROPHIC

1. **Eliminate** – if it is possible, the hazard should be removed completely. For example, get rid of dangerous machines.
2. **Substitute** – replace something that produces the hazard with something that does not produce a hazard. For example, replacing solvent based paint with water based paint. Risk assessment on the substitution must be conducted to ensure that it will not pose another hazard.
3. **Engineering control** – isolate a person from the hazard by creating physical barrier or making changes to process, equipment or plant to reduce the hazard. For example, install ventilation systems.
4. **Administrative control** – change the way a person works by establishing policies and procedures to minimise the risks. For example, job scheduling to limit exposure and posting hazard signs.
5. Use **personal protective equipment** (PPE) – protect a person from the hazard by wearing PPE. For example, wearing gloves, safety glasses, hard hats and high-visibility clothing. PPE must be correctly fitted, used and maintained to provide protection.



Hierarchy of control

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Safe Work Method Statement

Task Step #	Task Steps	Hazards	Risk Rating	Hazard Control Measures	Revised Risk Rating

Student Signature………………………

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Practical Activity 1

Resistance Measurement

Objective

Take measurements of resistance using different types of instruments.

Equipment

Analogue multimeter
Digital multimeter
Insulation resistance tester (megger)
Typical electrical devices incorporating Heating elements and windings;
e.g. Appliances, Power Tools, Hotplates, Transformers, Motors, resistors, etc.
Personal Danger Tag (Danger- Do Not Operate)

Instructions

Task Procedure

1. Ensure the item to be tested has been isolated from the supply

2. Check no parallel paths are present that may cause false readings.

3. Under instruction from your Lecturer, take measurements using both digital and analogue type instruments, taking care to avoid *parallax error*.

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Measuring Resistance using multimeters

4. Measure the resistance across the connection terminals of the four given devices with a digital multimeter and an analogue multimeter. Record the results in the Results Table.

Results Table – Measured Resistance

Device Number	Measured Resistance (Analogue Multimeter)	Measured Resistance (Digital Multimeter)
1.		
2.		
3.		
4.		

5. Have your results checked by your lecturer.

6. Briefly explain how to avoid Parallax Error when using an Analogue meter type.

____

7. Use the measured resistance value of an appliance that incorporates a heating element and calculate its power rating.

Satisfactory:			Not Satisfactory:	

Lecturer: ____ Date: _______________

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Practical Activity 2

Measuring Insulation Resistance

Objective

Determine the insulation resistance between all live conductors and the frame (earth) of 240V Mains powered appliances.

Equipment

Analogue or Digital IR (Insulation Resistance) Tester
Assorted mains powered Class 1 type appliances

Instructions

Task Procedure

1. Set the IR Tester on the 500VDC Range

2 Check IR tester leads by touching together and pressing the Test button, instrument should read Zero ohms.

3. Connect one of the IR Tester leads to the metal frame of the appliance, then place the other lead across both live pins and press the test button. If the appliance incorporates an on/off switch, make sure it is in the "on" position.

4. Observe the reading indicated on the IR Tester and write down the result in the table below.

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Results Table – Measured Insulation Resistance Values

Appliance Type	Measured Insulation Resistance(Meg-ohms)	Condition (Pass/ Fail)

2. Have your results checked by your lecturer.

3. According the Wiring Rules, what is the minimum permissible insulation resistance between the live conductors and earth?

____

4. For appliances that contain ***sheathed*** heating elements, is there an exception to the value required for the above question?

Yes/ No.

What is the allowable value?

____

Satisfactory:		Not Satisfactory:	

Lecturer: ____ Date: ________________

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Practical Activity 3

Measuring Voltage and Current

Objective

To measure voltage and current using appropriate measuring instruments.

Equipment

Analogue multimeter
Digital multimeter
Resistor project board (with SPST switch)
Fixed DC voltmeters
Fixed DC ammeter (0-5 A DC)
Variable power supply - up to 50 volts DC
Personal Danger Tag (Danger- Do Not Operate)

Instructions

Task Procedure

1. Follow the steps for Part A - Measuring Voltage.
2. Follow the steps for Part B - Measuring Current.
3. Answer the questions.

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Part A - Measuring Voltage

DANGER TAG PROCEDURE REQUIRED

1. Set up the variable power supply using the danger tag procedure (do not plug it into the supply). Identify the appropriate output terminals.
2. Set the variable power supply to any voltage up to 50 volts d.c.
3. Set the analogue multimeter to an appropriate range and scale.
4. Have your settings checked by your lecturer.
5. Plug the power supply into the outlet and switch it on. Measure the voltage at the output terminals for any 3 positions of the output voltage control. Record the results in the Results Table.
6. Measure the voltage at the same 3 settings with a digital multimeter and record the results in the Results Table.
7. Select a suitable fixed voltmeter and measure the voltage at any one of the settings used for the multimeters. Record the results in the Results Table.

Results Table – Measured Voltage

Voltage Settings	Measured Voltage (Analogue Multimeter)	Measured Voltage (Digital Multimeter)	Fixed Voltmeter

8. Switch the circuit off and remove the plug from the outlet. Attach your danger tag to the plug top.
9. Have your results checked by your lecturer.

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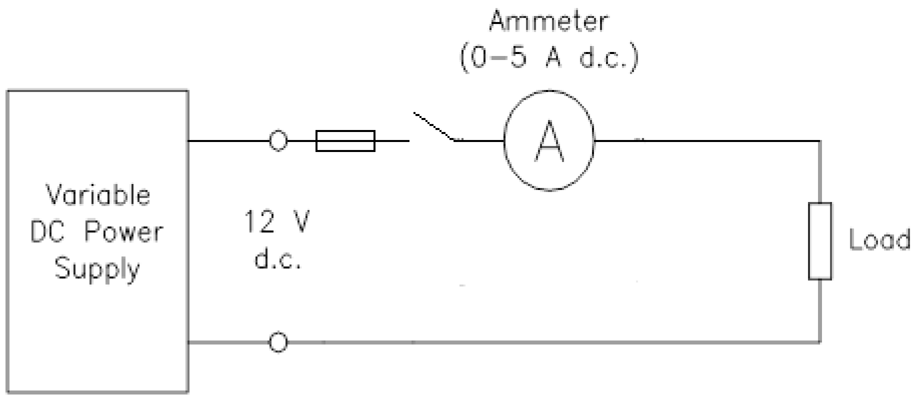
Part B - Measuring Current

1. Identify the DC output terminals on the power supply.
2. Set the variable power supply to 12 volts DC (with the power supply switched OFF).
3. Examine the resistor project board and identify the resistor which has a resistance of approximately 4 ohms (use a multimeter if necessary).
4. Connect the components according to the following circuit diagram:



________Ω Resistor

5. Check your circuit for short circuits with an analogue multimeter set to the ohms times 1 range.
6. Have your connections checked by your lecturer.
7. Plug the power supply into the outlet and switch it on. Measure the current and record the value in the Results Table.
8. Close the switch and record the reading on the ammeter.
9. Switch the circuit off and remove the plug from the outlet. Attach your danger tag to the plug top.

Results Table – Measuring Current

Resistance Of R1	Measured Current (S1 open)	Measured Current (S1 closed)

10. Have your results checked by your lecturer.

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Questions

1. What are the five most common electrical quantities that may be measured by a typical multimeter?

____

2. How did the measured values of voltage compare using both types of multimeter? Was there a notable difference and why?

____

____

3. What fault would be present if the ammeter indicated negative or if the needle moved to the left when the circuit was energised? How could this fault be corrected?

____

4. Calculate much power is being dissipated by the resistor in this circuit? Show your working out.

Satisfactory:	

Not Satisfactory:	

Lecturer: _______________________________ Date: ______________

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Practical Activity 4

Parallel Circuits

Objective

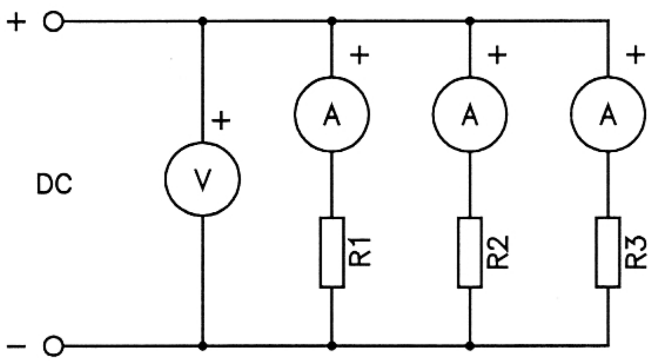
To connect the given resistors in parallel to a suitable DC supply and verify the readings by calculation.

Equipment

Parallel resistor project board
Connecting leads
Ammeters and voltmeters as required
Multimeter
ELV direct current supply

Instructions

Circuit



Danger Tag Procedure *Danger Tag procedure will be followed during this activity*

Task Procedure

1. 1. Check to see that the project board is isolated from the supply. **Measure the resistance of each of the resistors on the project board with a multimeter before connecting** them. Record the resistances in the Results Table.

2. Use "Ohm's Law" to calculate the voltage and current using the **measured values** of resistance, **not the nominal values.** Compile your results in the Results Table.

3. Connect the circuit according to the circuit diagram given above. **Do not connect** your circuit to the supply yet.

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4. Ensure your multimeter is working correctly, set it to read ohms and then set it on the lowest ohms range to **record the total resistance of the circuit**. Record the amount here.

____

5. Connect your circuit to the supply but do not energise it until you have the Lecturer's approval.

   Lecturer Initials. Safe to energise? YES/NO

6. Take all voltage and current readings, enter the values where appropriate in the results table and compare your measured values with that of your calculated values.

7. Switch the circuit off and remove the plug from the outlet. **Do not disconnect/ dismantle** your circuit until the lecturer says you can.

8. Submit your results to your Lecturer for comment and discussion. The lecturer will advise if you can pack away your equipment and return it to its proper place.

Results Table – Parallel Circuit

	Resistance (Ω)		**Volts (V)**		**Current (A)**	
	Nominal	Measured	Calculated	Measured	Calculated	Measured
R1						
R2						
R3						
Total (Calculated)		$R_1 \| R_2 \| R_3$	Supply V		$I_{R1} + I_{R2} + I_{R3}$	
Total (Measured)		Multimeter reading		Supply V		Ammeter Reading

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1. Questions

1. What general statement can be made about the current through each component in a PARALLEL circuit in relation to line current?

Answer: ____

2. What general statement can be made about the voltage across each component in a parallel circuit in relation to the line voltage?

Answer: ____

3. Is it possible for the current in any one of the resistors in a parallel circuit to exceed the line current?

Answer: ____

4. What general statement can be made about the total resistance in a parallel circuit in relation to the resistance of any single resistor in the circuit?

Answer: ____

5. If ONE of the components in a parallel circuit is disconnected, what effect would it have on the current flowing through the other resistors of the circuit?

Answer: ____

6. What is the general relationship between the resistance of each resistor and the expected current flowing through it?

Answer: ____

Satisfactory:			Not Satisfactory:	

Lecturer: ______________________________ Date: ________________

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Practical Activity 5

Series/Parallel Circuits

Objective

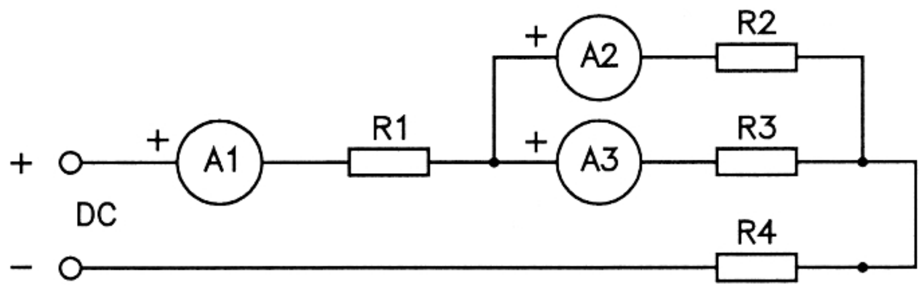
To connect the given resistors in series/parallel to a suitable DC supply and verify the readings by calculation.

Equipment

Series/Parallel resistor project board
Connecting leads
Ammeters and voltmeters as required
Multimeter
ELV direct current supply

Instructions

Circuit



Danger Tag Procedure: *Danger Tag Procedure will be followed during this activity.*

Task Procedure

1. Check to see that the project board is isolated from the supply. Measure the resistance of each of the resistors on the project board with a multimeter. Record the resistances in the Results Table.

2. Calculate the values required to complete the Calculations (Calc.) section of the Results Table. (The Line values are the TOTAL values, but not necessarily the total of the values in that column).

3. Connect the circuit according to the circuit diagram given above.

4. Set your multimeter to the ohms x 1 range and check for short circuits between the two incoming line terminals. Check the checker before and after the test, and switch it off when you have finished using it.

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5. Have your wiring checked by your Lecturer.
6. Ask your Lecturer for permission to switch the circuit on, then check it for correct operation. Record the instrument readings in the Results Table. Take all voltmeter readings with a multimeter set to an appropriate voltage scale.
7. Switch the circuit off and remove the plug from the outlet.
8. Submit your results to your Lecturer for comment and discussion.
9. Disconnect your wiring and return all of the equipment to its proper place.

Results Table – Series/Parallel Circuit

	Resistance (Ω)		**Volts (V)**		**Current (A)**	
	Nominal	**Measured**	**Calculated**	**Measured**	**Calculated**	**Measured**
R1						
R2						
R3						
R4						
Re						
Line values						

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Questions

1. Calculate the total POWER dissipated by the series/parallel circuit.

----

2. Calculate the total POWER which would be dissipated in the circuit if the line voltage was doubled. What would be the percentage increase in power?

----

3. If the resistor R2 became open circuited due to a circuit fault, would the line current increase or decrease? Show your calculations.

Satisfactory:			Not Satisfactory:	

Lecturer: ______________________________ Date: ________________

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Practical Activity 6

Capacitor Identification

Objective

To identify various common types of capacitor and determine the capacity and voltage rating of each

Equipment

Capacitor identification board (with visible capacity and voltage markings)
Manufacturers' data sheets

Instructions

Task Procedure

1. Examine the capacitor project board and record the type, capacity and voltage rating for each component.

Results Table

Component	Type	Capacity	V Rating
Capacitor 1			
Capacitor 2			
Capacitor 3			
Capacitor 4			
Capacitor 5			
Capacitor 6			
Capacitor 7			
Capacitor 8			

2. Submit your results to your Lecturer for comment.

3. Return all of the equipment to its proper place.

Satisfactory:		Not Satisfactory:	

Lecturer: ______________________________ Date: ______________

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Practical Activity 7

RC Time Constants

Objective

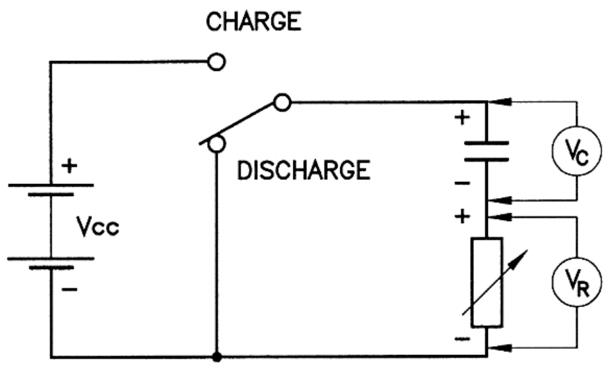
To observe the effects of the time constant in DC circuits consisting of resistance and capacitance in series.

Equipment

Capacitor time constant project board
Connecting leads
Multimeter (with a high DC voltage sensitivity)
Direct current supply (0-12 volt or similar)
Stopwatch

Instructions

General Circuit



Task Procedure

1. Check to see that the project board is isolated from the supply. Examine the RC time constant project board and record the values of R and C in the Results Table.
2. Calculate the time constant for each RC circuit and record the results in the Results Table.
3. Set the applied DC voltage (Vcc) to about 10 volts and confirm the voltage by measurement. Record the value of Vcc and calculate the value of 63% of Vcc. Switch the power supply off at the selected setting.
4. Discharge all capacitors on the project board by temporarily short circuiting the capacitor terminals (do not leave the short circuit connected).
5. Connect the multimeter across the capacitor.

6. Have your connections checked by your Lecturer.
7. Energise the circuit and start the stopwatch at the same instant. Observe the voltage rise across the capacitor and stop the stopwatch at 63% of the measured value of Vcc and record the time in the results table below.
8. Switch the circuit off and repeat Step 7 with the remaining RC circuits on the project board.
9. Have your results checked by your Lecturer.
10. Return all of the equipment to its proper place.

Results Table

Applied Voltage (Vcc) ________________ 63% of Vcc _______

			Time (in Seconds)		
Circuit	**R**	**C**	**τ(Calc)**	**τ(Measured)**	**Fully Charged**
Circuit A					
Circuit B					
Circuit C					
Circuit D					
Circuit E					

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Assessment Task 3 Portfolio of Evidence

Qualification national code and title	UEE30820 Certificate III in Electrotechnology Electrician
Unit/s national code/s and title/s	UEECD0044 - Solve problems in multiple path circuits

Questions

1. Calculate the time which would be required for the capacitor to be fully charged for each of the RC combinations in the Results Table & write your results in the full charged column.

____

2. Why was 63% of Vcc used as the value of one time constant?

____

3. How many time constants must elapse before the capacitor is regarded as fully charged?

____

4. Draw a neat freehand pencil sketch showing the approximate shape of curves for the voltage across the capacitor (Vc) and the voltage across the resistor (Vr) for a time equivalent to 5 time constants after switch on and switch off any RC time constant circuit.

Satisfactory:		Not Satisfactory:	

Lecturer: ____ Date: ________________

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Practical Activity 8

Capacitor Testing

Objective

To test power capacitors for serviceability.

Equipment

Sample power capacitors (with and without bleed resistors)
Connecting leads
Digital multimeter (Capacitance test function)
Analogue Multimeter

Instructions

Task Procedure

1. Test the given power capacitors for serviceability and record your results in the Results Table.

Results Table

	Analogue Multimeter on the highest ohm setting		Digital Multimeter on the capacitance test function	
Component	**Resistance Reading**	**Servicable, Short or Open**	**Capacitance Reading**	**Servicable, Short or Open**
Capacitor 1				
Capacitor 2				
Capacitor 3				

2. Submit your results to your Lecturer for comment and assessment.

3. Return all of the equipment to its proper place.

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Questions

1. Calculate the charge which would be stored in a capacitor which has 5µf capacitance at the full rated voltage of 20v?

____

2. What is the resistance of the bleed resistor across a typical 3.5 microfarad capacitor in a 36 watt fluorescent lighting fitting?

____

3. What is the capacitance of the largest power capacitor which may be installed without a discharge path according to the Wiring Rules? (State the clause)

____

4. What are the three most common faults which can occur in typical power capacitors?

____

5. What problem is indicated if a typical 5 microfarad 240 volt power capacitor gives a reading of zero ohms between the terminals when measured with an analogue multimeter set to the 'ohms times 1' range ?

____

Satisfactory:	

Not Satisfactory:	

Lecturer: ______________________________ Date: ________________

Practical Activity 1

Assessment Task 3 Portfolio of Evidence

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Reasonable Adjustment			
Adjustment Required	☐ **Yes**	☐ **No**	
Describe the adjustments that have been made to the assessment:			
Assessor name and signature		**Date**	
Student name and signature		**Date**	

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Assessment Outcome Knowledge Questions	☐ **Satisfactory**	☐ **Not Satisfactory**
Assessment Outcome Practical Activities	☐ **Satisfactory**	☐ **Not Satisfactory**
Knowledge Questions / Practical Activity Feedback: **Actions Required if Not Satisfactory:**		

Assessor name and signature		**Date**	
Student name and signature		**Date**	