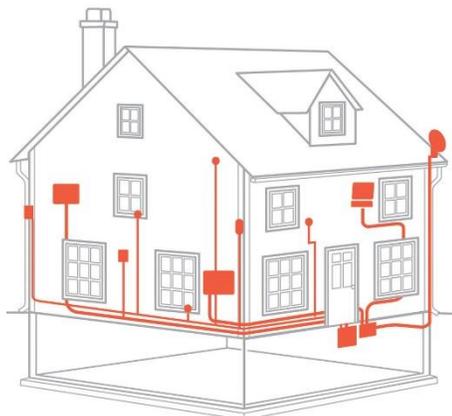
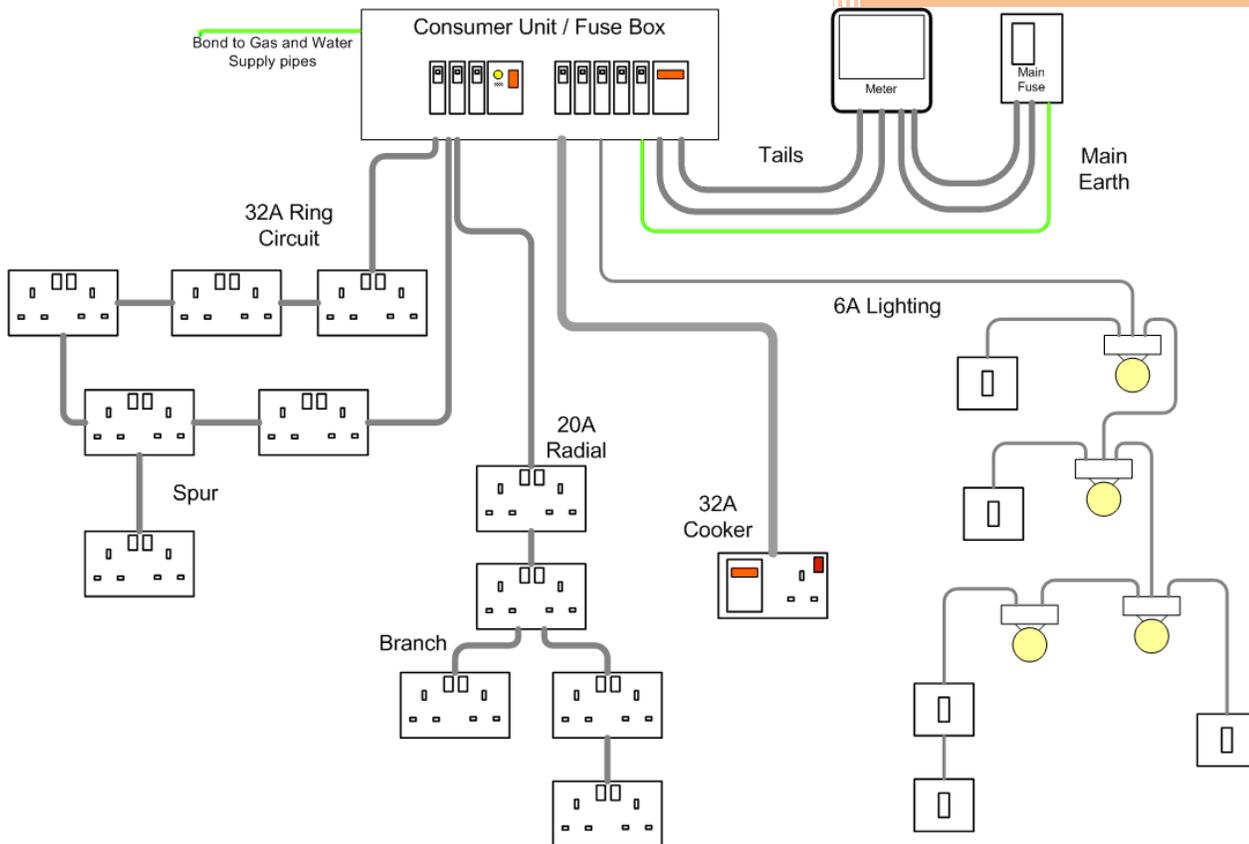




KEMENTERIAN PENGAJIAN TINGGI

DET10022 - ELECTRICAL WIRING



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First Edition, August 2020

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Diterbitkan oleh: Politeknik Port Dickson (PPD).
Alamat: KM 14, Jalan Pantai,
71050 SiRusa, Port Dickson,
Negeri Sembilan

PREFACE

In the name of Allah, the Almighty who give us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad S.A.W fot guiding us to straight path.We thank to Allah s.w.t for giving us the strength to write this book.May Allah s.w.t give us the ability to continue our good deeds to the community in this field.

This book is written to provide basic knowledge of ectrical wiring,focusing only on single phase wiring for electrical and electronic students,especially in polytechnics and other technical institutes.Students can apply the concept and principle of electrical safety and regulation in performing electrical wiring according to MS IEC 60364 standard.

We hope that this book will be very useful to the readers,students as well as lecturers in all respects.We welcome constructive comments on the book and will be grateful for any suggestions for its further improvement.

Hairol Samsol Bin Ithnin
Mohd Yuzi Bin Abdul Kadir
03 Ogos 2020
Port Dickson

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SYNOPSIS:

This course exposes students to the various aspects of wiring installation according to the MS IEC 60364 standard. Students will be able to relate theoretical aspect in practical work on electrical wiring during workshop sessions.

This course also provides students with the knowledge and skill in doing different types of wiring installation, wiring protection, wiring inspection, wiring testing and sustainable energy practices in electrical wiring.



KEMENTERIAN PENGAJIAN TINGGI



ELECTRICAL ENGINEERING DEPARTMENT

PRACTICAL WORK BOOK

CODE COURSE	DET10022
NAME COURSE	ELECTRICAL WIRING
LECTURER'S NAME	
GROUP NO :	
STUDENT NAME	
& ID	

PREPARED BY:	VERIFIED BY:



PROSEDUR KENDALIAN STANDARD (Standard Operating Procedure) AM DI BENGKEL/MAKMAL

1. Mendapatkan kebenaran daripada pensyarah sebelum menggunakan mesin/peralatan.
2. Memastikan diri bersedia untuk melakukan aktiviti bengkel/makmal. JIKA kesihatan tidak memuaskan, sila laporkan kepada pensyarah dengan serta merta.
3. Memastikan segala mesin/peralatan dan kelengkapan di dalam keadaan yang baik dan selamat sebelum digunakan.
4. Setiap pengguna WAJIB menggunakan alat perlindungan diri (*PPE-Personal Protective Equipment*) yang bersesuaian semasa mengguna mesin/peralatan.
5. Memastikan tempat kerja bebas daripada segala kekotoran, mempunyai cahaya yang cukup terang, peredaran udara yang baik dan laluan keluar masuk bebas daripada segala halangan.
6. Memastikan alat kawalan dan perlindungan elektrik di bengkel/makmal berfungsi dengan baik.
7. Melaporkan segala kerosakan pada mesin/peralatan kepada pensyarah dengan kadar segera sebelum memulakan sebarang aktiviti.
8. Memastikan Risalah Data Keselamatan Kimia (*SDS: Safety Data Sheet*) bagi bahan yang berkaitan di fahami dan diselenggara dgn baik.
9. Memastikan penggunaan dan penyimpanan bahan kimia dalam keadaan yang baik dan selamat sebelum digunakan.
10. Memastikan segala bentuk sisa hasil aktiviti di bengkel/makmal diuruskan dengan baik.
11. Menggunakan mesin/peralatan dengan cara yang betul, selamat dan mengikut Prosedur Kendalian Standard (*SOP-Standard Operating Procedure*) dan semua punca kuasa elektrik dan suis dimatikan selepas digunakan.
12. Menggunakan peralatan tangan dan kelengkapan bengkel/makmal dengan cara yang betul tanpa mendatangkan kemudaratan kepada diri sendiri dan orang lain.
13. Membersihkan dengan serta merta sebarang tumpahan dan kebocoran pada mesin/peralatan dengan cara yang betul dan berkesan.
14. Menggunakan alat pemadam api yang disediakan sekiranya berlaku kebakaran kecil.
15. Melaporkan kemalangan atau situasi yang berbahaya kepada pensyarah dengan segera.
16. Membersihkan mesin/peralatan dan kelengkapan daripada segala kekotoran selepas digunakan.
17. Menyimpan/menyusun alat ganti, peralatan dan kelengkapan di tempat yang disediakan dengan kemas dan teratur.
18. Memastikan persekitaran bengkel/makmal di dalam keadaan bersih, kemas dan teratur sebelum, semasa dan selepas digunakan.
19. Meninggalkan bengkel/makmal dengan seberapa segera ke tempat berkumpul apabila berlaku kecemasan atau amaran loceng kebakaran berbunyi.



En Roslee Bin Yahya
Pengarah Politeknik Port Dickson:

Tarikh Akhir Kajian Semula: 02 Nov 2018



KEMENTERIAN PENGAJIAN TINGGI



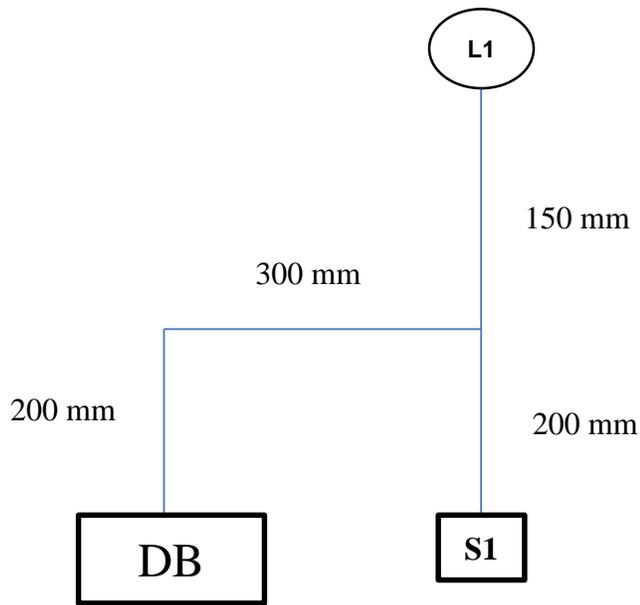
Department of Electrical Engineering
DET 10022 – ELECTRICAL WIRING
 MINI PROJECT

1. PRACTICAL WORK ASSESSMENT (PLO5, CLO2, P4)				
COMPETENCY SKILL	ATTAINMENT			
<i>Student able to identify, construct and handle the Practical Work and project base on criteria below :</i>	Refer list of students			
	S1	S2	S3	S4
1. Continuity Test				
2. Functional Circuit (Lamp Circuit)				
3. Earthing				
4. Circuit Polarity				
5. Cable Termination				
6. Accessories Installation / Neatness Wiring				
7. Measurement $\pm 30mm$				
8. Clip Method				
9. Extra Cable / Spare Cable (connection for terminal box)				
10. Wiring Diagram				
Score (100)				
Percentage Practical Skill (100%)				

NO.	REG. NO.	NAME GROUP MEMBERS	PRACTICAL WORK ASSESSMENT	TOTAL 100%
			COMPETENCY SKILL ASSESSMENT (100%)	
S1				
S2				
S3				
S4				

**DET 10022-ELECTRICAL WIRING
MINI PROJECT**

1. Construct a single-phase domestic wiring, wiring inspection & testing and below. Attach the picture of your project. **(CLO 2P,P4)**



L1 – Lamp

S1 – One Way Switch

DB – Distribution Board



KEMENTERIAN PENGAJIAN TINGGI



ELECTRICAL ENGINEERING DEPARTMENT

DET 10022 – WIRING INSTALLATION

PROGRAMME :
 PRACTICAL WORK NO : 1
 TITLE : Wiring Protection (Distribution Board)
 DATE :
 LECTURER'S NAME :

1. PRACTICAL WORK ASSESSMENT						
COMPETENCY SKILL		ATTAINMENT				TOTAL PERCENTAGE 100%
<i>Student able to identify, construct and handle the Practical Work and project base on criteria below :</i>		Refer list of students				
		S1	S2	S3	S4	
1. Functional Circuit (Lamp Protection)						
2. Functional Circuit (Power Protection)						
3. Earthing						
4. Circuit Polarity						
5. Cable Selection						
6. Cable Installation						
7. Accessories Sequence / Accessories Installation						
8. MCB Rating						
9. Wiring Diagram						
10. Discussion						
Percentage Practical Skill (100%)						

NO.	REG. NO.	NAME GROUP MEMBERS	COMPETENCY SKILL ASSESSMENT (100%)
S1			
S2			
S3			
S4			

PRACTICAL SKILLS RUBRIC (PLO5, CLO2, P4)					
10	8	6	4	2	0
Student can complete all tasks assigned without errors	Student can complete all tasks assigned with a few errors	Student can complete all tasks assigned with more errors	Student can complete partial tasks assigned without errors	Student can complete partial tasks assigned with a few errors	Student shows no response / task not attempted

LABORATORY REPORT RUBRIC (PLO5, CLO2, P4)					
Report Component	Excellent	Very Good	Good	Fair	Unsatisfactory
	10	8	6	4	2
Analysis /Discussion Ability to present, interpret and analyze result.	All point of discussion on the results obtained covered and elaborated	Most point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and but not properly elaborated	Very few point of discussion on the results obtained covered and elaborated
Conclusion Provide answer to objective stated earlier.	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiments.	The closing paragraph summarizes and draw a sufficient conclusion	The closing paragraph attempts to summarize but draws a weak conclusion	The closing paragraph do not attempts to summarize the experiment OR shows little effort and reflection	The closing paragraph does not relate with experiment

GENERIC SKILLS RUBRIC (PLO8, CLO3, A3)						
Attribute	Subattribute	VERY WEEK (1 mark)	WEEK (2 marks)	FAIR (3 marks)	GOOD (4 marks)	VERY GOOD (5 marks)
Ethics And Profesionalism	Work Responsibility	Does not perform assigned tasks within by the scope of work even with close supervision	Perform assigned tasks within by the scope of work with close supervision	Perform assigned tasks within by the scope of work and meets expectation	Perform assigned tasks within by the scope of work and exceeds expectation	Perform assigned tasks beyond the scope of work and beyond expectation

Electrical Engineering Department
DET 10022 - Electrical Wiring
Practical Work 1

TOPIC	Wiring Protection (Consumer Unit - Distribution Board)
LAB LEARNING OUTCOME	At the end of this practical work, students should be able to: 1. Construct single-phase installation of distribution board. 2. Able to construct wiring installation for different types of final circuit. 3. Perform inspection and testing a completed consumer circuit wiring installation according to MSIEC 60364 requirement. 4. Perform practical work as a team within the stipulated time frame.
ACCESSORIES	1. Neutral link 2. Service/Cut-off fuse 3. KWH meter 4. Main Fuse 5. Earth Leakage Circuit Breaker (ELCB) 6. Miniature Circuit Breaker 6A,16A & 20A 7. Distribution Board 8. Neutral Bar 9. Earth Bar 10. Pin Type Bus Bar
ELECTRICAL TOOLS	1. Screwdriver flat/philip 2. Combination Plier 3. Test Pen 4. Cable Cutter

THEORY:

SAFE ELECTRICAL INSTALLATIONS

The provision of a safe electrical system is fundamental to the whole concept of using electricity in and around buildings safely.

The electrical installation as a whole must be protected against overload and short circuit damage and the people using the installation must be protected against electric shock.

An installation that meets the requirements of the MS IEC 60364 Wiring Regulations – Requirements for Electrical Installations, will be so protected.

The method most universally used in the Malaysia to provide for the safe use of electrical energy is protective equipotential bonding coupled with automatic disconnection of the supply by fuses or miniature circuit breakers (MCBs).

The consumer's mains equipment is normally fixed close to the point at which the supply cable enters the building.

To meet the requirements of the MS IEC 60364 Regulations it must provide:

- i. Protection against electric shock

ii. Protection against overcurrent

iii. Isolation and switching

Protection against electric shock, both ‘ basic protection ’ and ‘ fault protection’ is provided by insulating and placing live parts out of reach in suitable enclosures, earthing and bonding metal work and providing fuses or circuit breakers so that the supply is automatically disconnected under fault conditions.

To provide overcurrent protection it is necessary to provide a device which will disconnect the supply automatically before the overload current can cause a rise in temperature which would damage the installation.

A fuse or MCB would meet this requirement.

An isolator is a mechanical device which is operated manually and is provided so that the whole of the installation, one circuit or one piece of equipment may be cut off from the live supply.

In addition, a means of switching off for maintenance or emergency switching must be provided.

A switch may provide the means of isolation, but an isolator differs from a switch in that it is intended to be opened when the circuit concerned is not carrying current. Its purpose is to ensure the safety of those working on the circuit by making dead those parts which are live in normal service.

One device may provide both isolation and switching provided that the characteristics of the device meet the Regulations for both functions.

The switching of electrically operated equipment in normal service is referred to as functional switching.

Circuits are controlled by switchgear which is assembled so that the circuit may be operated safely under normal conditions, isolated automatically under fault conditions, or isolated manually for safe maintenance.

These requirements are met by good workmanship carried out by competent persons and the installation of approved Malaysia Standard materials such as switches, isolators, fuses or circuit breakers.

The equipment belonging to the supply authority is sealed to prevent unauthorized entry, because if connection were made to the supply before the meter, the energy used by the consumer would not be recorded on the meter.

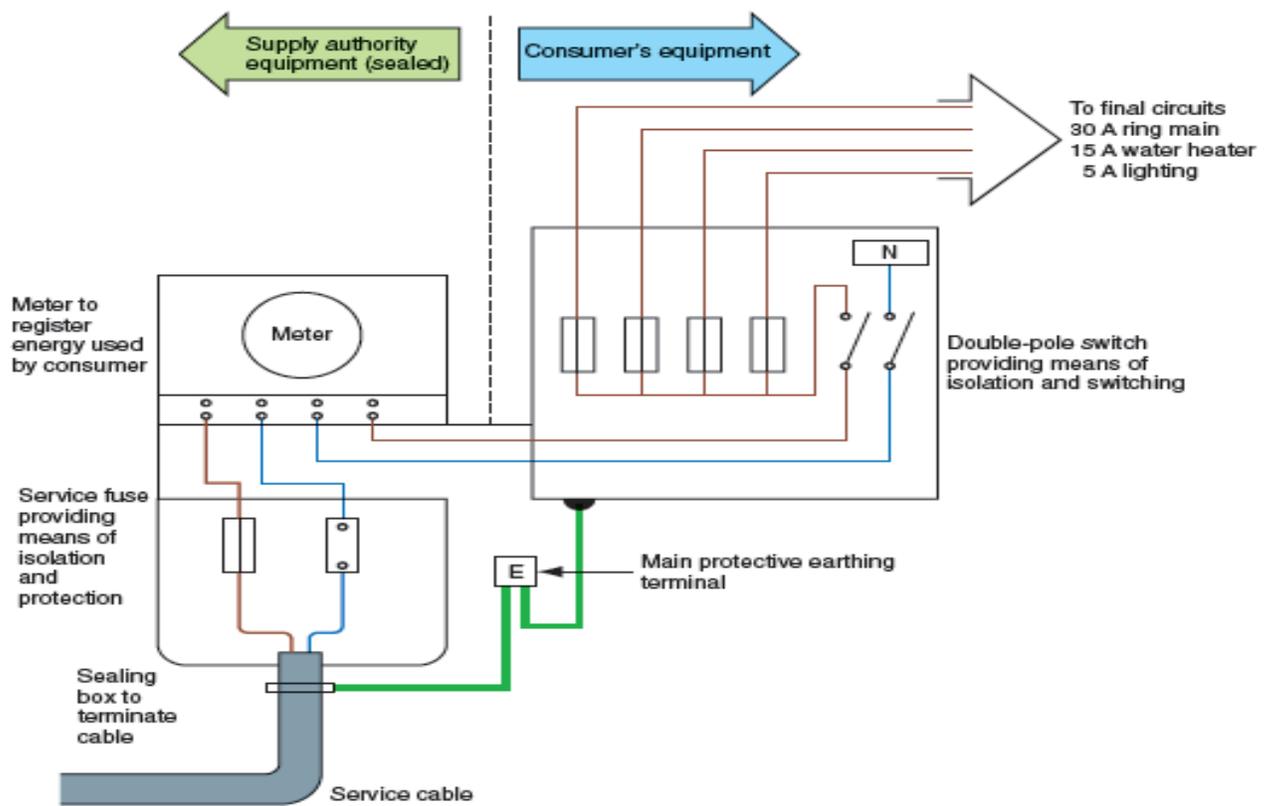
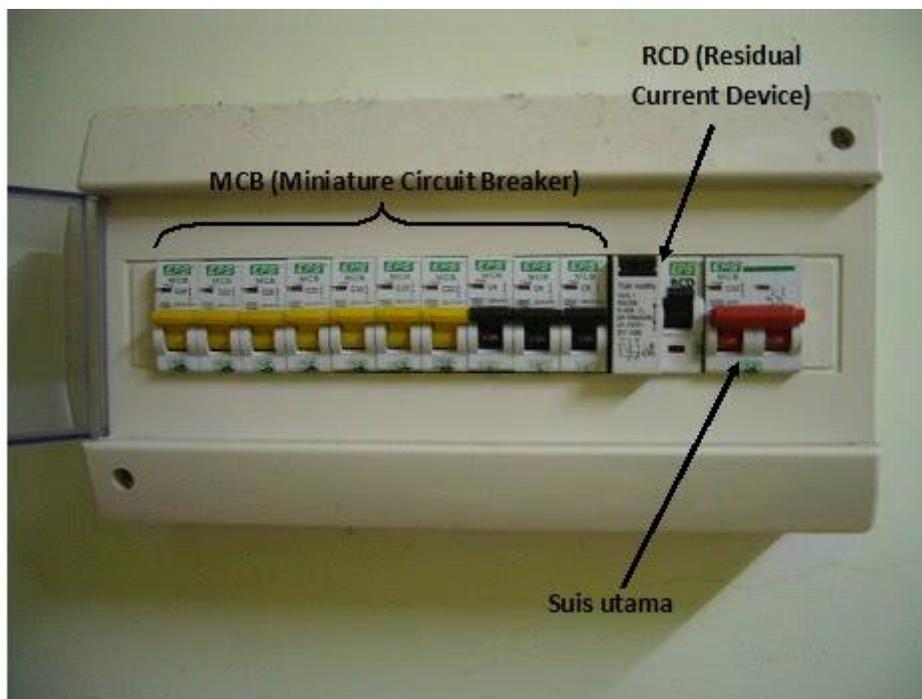


Figure 1

Figure 1 shows the connections and equipment at a domestic service position.



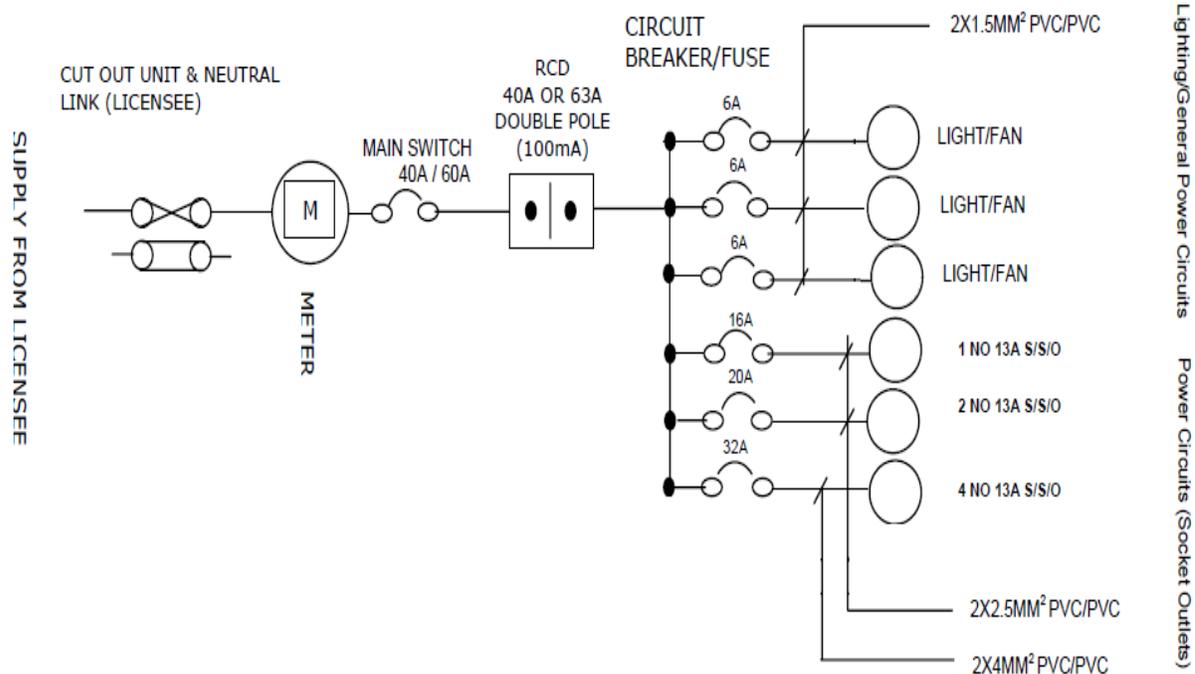


Figure 2 shows a Single Phase Consumer Electrical Wiring (Distribution Board)

Procedure:

1. Connect all accessories require in distribution board according to it sequence regarding to MSIEC 60364 standard.
2. Draw the wiring connection for all accessories involved during wiring process.
3. Connect the distribution board according to final circuit given in Figure 2.
4. Make an inspection and test the connection for the distribution board.

QUESTIONS AND REPORT (CLO2)

1. Draw wiring diagram as in the circuit diagram.



Wiring Diagram

Conclusion



KEMENTERIAN PENGAJIAN TINGGI

ELECTRICAL ENGINEERING DEPARTMENT
DET 10022 – WIRING INSTALLATION

PROGRAMME :
PRACTICAL WORK NO : 2
TITLE : Industrial Wiring Installation (PVC- Conduit Pipe)
DATE :
LECTURER'S NAME :

1. PRACTICAL WORK ASSESSMENT (PLO5, CLO2, P4)

COMPETENCY SKILL	ATTAINMENT				TOTAL PERCENTAGE 100%
<i>Student able to identify, construct and handle the Practical Work and project base on criteria below :</i>	Refer list of students				
	S1	S2	S3	S4	
1. Functional Circuit (Lamp Circuit)					
2. Functional Circuit (Power Circuit)					
3. Earthing					
4. Circuit Polarity					
5. Bend 90°					
6. 135° off set					
7. Measurement ± 30mm					
8. Cable Termination / Spare Cable					
9. Wiring Diagram					
10. Discussion					
Percentage Practical Skill (100%)					

2. GENERIC SKILL ASSESSMENT (PLO8, CLO3, A3)

		ATTAINMENT			
		S1	S2	S3	S4
Work Responsibility					
Work Relation					
Work Ethics					
Integrity					
Score (20)					
Score (100%)					

NO.	REG. NO.	NAME GROUP MEMBERS	COMPETENCY SKILL ASSESSMENT (100%)
S1			
S2			
S3			
S4			

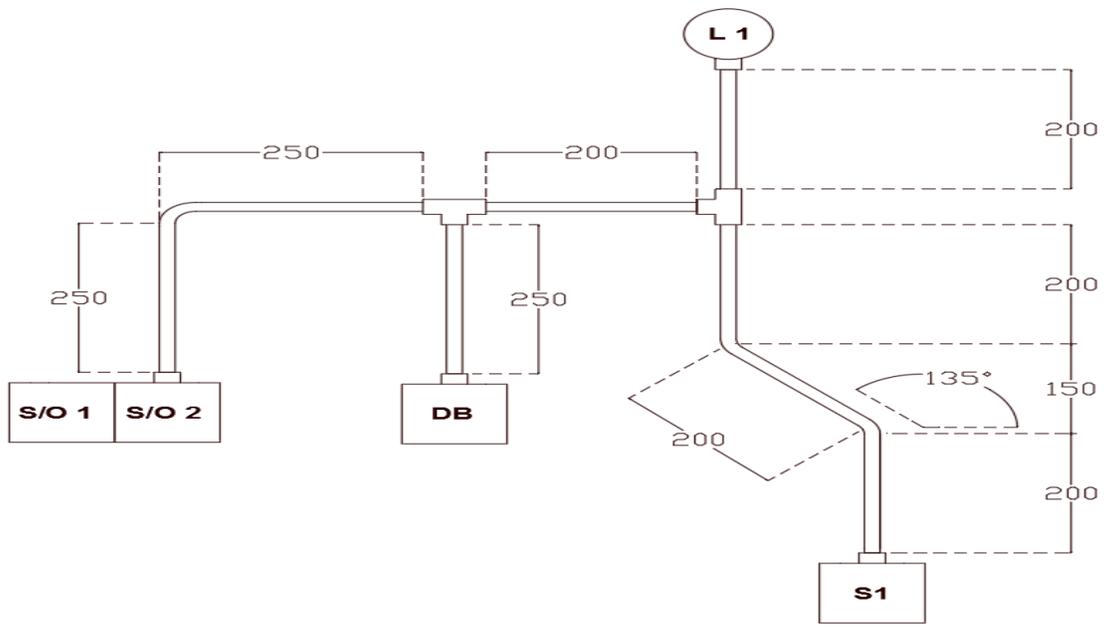
PRACTICAL SKILLS RUBRIC (PLO5, CLO2, P4)					
10	8	6	4	2	0
Student can complete all tasks assigned without errors	Student can complete all tasks assigned with a few errors	Student can complete all tasks assigned with more errors	Student can complete partial tasks assigned without errors	Student can complete partial tasks assigned with a few errors	Student shows no response / task not attempted

LABORATORY REPORT RUBRIC (PLO5, CLO2, P4)					
Report Component	Excellent	Very Good	Good	Fair	Unsatisfactory
	10	8	6	4	2
Analysis /Discussion Ability to present, interpret and analyze result.	All point of discussion on the results obtained covered and elaborated	Most point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and but not properly elaborated	Very few point of discussion on the results obtained covered and elaborated
Conclusion Provide answer to objective stated earlier.	Conclusion includes wheather the findings supported the hypothesis,possible sources of error, and what was learned from the experiments.	The closing paragraph summarizes and draw a sufficient conclusion	The closing paragraph attempts to summarize but draws a weak conclusion	The closing paragraph do not attempts to summarize the experiment OR shows little effort and reflection	The closing paragraph does not relate with experiment

GENERIC SKILLS RUBRIC (PLO8, CLO3, A3)						
Attribute	Subattribute	VERY WEEK (1 mark)	WEEK (2 marks)	FAIR (3 marks)	GOOD (4 marks)	VERY GOOD (5 marks)
Ethics And Profesionalism	Work Responsibility	Does not perform assigned tasks within by the scope of work even with close supervision	Perform assigned tasks within by the scope of work with close supervision	Perform assigned tasks within by the scope of work and meets expectation	Perform assigned tasks within by the scope of work and exceeds expectation	Perform assigned tasks beyond the scope of work and beyond expectation

Electrical Engineering Department
DET 10022 - Electrical Wiring
Practical Work 2

TOPIC	Industrial Wiring Installation (PVC- Conduit Pipe)
LAB LEARNING OUTCOME	<p>At the end of this practical work, students should be able to:</p> <ol style="list-style-type: none"> 1. Handle complete Industrial Wiring Installation for a one way switch control one lamp connected and radial type socket outlet. 2. Able to cut, bend 90° and 135° offset. 3. Install and assemble the PVC conduit on wiring bay. 4. Perform electrical wiring and conduct a test according to MS IEC 60364 5. Perform practical work as a team within the stipulated time frame.
ACCESSORIES	<ol style="list-style-type: none"> 1. PVC pipe as required 2. Coupler 3. Female bush 4. Lock nut 5. Plastic bush 6. Saddle & bar 7. 3-way terminal box 8. Inspection Tee 9. One way switch 10. Socket outlet 11. Termination box 12. Switch box base 13. Required cables
ELECTRICAL TOOLS	<ol style="list-style-type: none"> 1. Measuring Tape 2. Screwdriver Philip / flat 3. Combination pliers 4. Cable cutter 5. Test pen 6. Vinly pipe cutter 7. Spring Bender 8. Cable Puller
WORKING PROCEDURE:	
<ol style="list-style-type: none"> 1. Cut the PVC conduit by using Vinly pipe cutter according to given measurement. 2. Bend the PVC conduit by using spring bender. 3. Assemble PVC conduit with given PVC conduit accessories as in the diagram. The PVC conduit joints shall be tight in between conduit joints to become water prove. 4. Draw cables in the PVC conduit as instructed by your Instructor. Make sure, assembling conduit completely before draw the cable. 5. The Wiring Installation shall meets all necessary MS IEC 60364 regulations and the measurements are in mm. 	



Circuit Diagram 1

S1 - One way switch control (L1) Lamp 1 connected with Distribution Board.

S/O1 & S/O2 socket outlet to be connected as radial circuit.

The Wiring Installation shall meet all necessary MS IEC 60364 regulations and the measurements are in mm.

QUESTIONS AND REPORT

1. Draw wiring diagram as in the circuit diagram.

Wiring Diagram

Conclusion



KEMENTERIAN PENGAJIAN TINGGI



ELECTRICAL ENGINEERING DEPARTMENT

DET 10022 – WIRING INSTALLATION

PROGRAMME :
PRACTICAL WORK NO : 3
TITLE : Industrial Wiring Installation (PVC- Conduit Pipe)
DATE :
LECTURER'S NAME :

1. PRACTICAL WORK ASSESSMENT (PLO5, CLO2, P4)					
COMPETENCY SKILL	ATTAINMENT				TOTAL PERCENTAGE 100%
<i>Student able to identify, construct and handle the Practical Work and project base on criteria below :</i>	Refer list of students				
	S1	S2	S3	S4	
1. Functional Circuit (Lamp Circuit)					
2. Functional Circuit (Power Circuit)					
3. Earthing					
4. Circuit Polarity					
5. Bend 90°					
6. 135° off set					
7. Measurement ± 30mm					
8. Cable Termination / Spare Cable					
9. Wiring Diagram					
10. Discussion					
Percentage Practical Skill (100%)					
2. GENERIC SKILL ASSESSMENT (PLO8, CLO3, A3)					ATTAINMENT
	S1	S2	S3	S4	
Work Responsibility					
Work Relation					
Work Ethics					
Integrity					
Score (20)					
Score (100%)					

NO.	REG. NO.	NAME GROUP MEMBERS	COMPETENCY SKILL (100%)
S1			
S2			
S3			
S4			

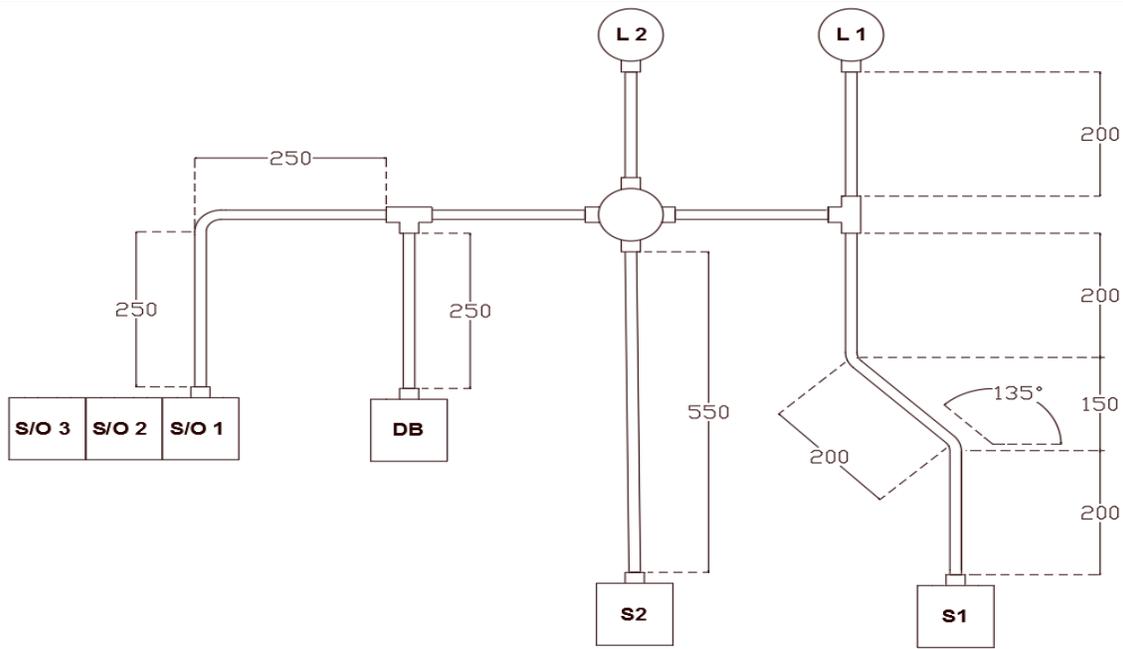
PRACTICAL SKILLS RUBRIC (PLO5, CLO2, P4)					
10	8	6	4	2	0
Student can complete all tasks assigned without errors	Student can complete all tasks assigned with a few errors	Student can complete all tasks assigned with more errors	Student can complete partial tasks assigned without errors	Student can complete partial tasks assigned with a few errors	Student shows no response / task not attempted

LABORATORY REPORT RUBRIC (PLO5, CLO2, P4)					
Report Component	Excellent	Very Good	Good	Fair	Unsatisfactory
	10	8	6	4	2
Analysis /Discussion Ability to present, interpret and analyze result.	All point of discussion on the results obtained covered and elaborated	Most point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and but not properly elaborated	Very few point of discussion on the results obtained covered and elaborated
Conclusion Provide answer to objective stated earlier.	Conclusion includes wheather the findings supported the hypothesis,possible sources of error, and what was learned from the experiments.	The closing paragraph summarizes and draw a sufficient conclusion	The closing paragraph attempts to summarize but draws a weak conclusion	The closing paragraph do not attempts to summarize the experiment OR shows little effort and reflection	The closing paragraph does not relate with experiment

GENERIC SKILLS RUBRIC (PLO8, CLO3, A3)						
Attribute	Subattribute	VERY WEEK (1 mark)	WEEK (2 marks)	FAIR (3 marks)	GOOD (4 marks)	VERY GOOD (5 marks)
Ethics And Profesionalism	Work Responsibility	Does not perform assigned tasks within by the scope of work even with close supervision	Perform assigned tasks within by the scope of work with close supervision	Perform assigned tasks within by the scope of work and meets expectation	Perform assigned tasks within by the scope of work and exceeds expectation	Perform assigned tasks beyond the scope of work and beyond expectation

Electrical Engineering Department
DET 10022 - Electrical Wiring
Practical Work 3

TOPIC	Industrial Wiring Installation (PVC- Conduit Pipe)
LAB LEARNING OUTCOME	<p>At the end of this practical work, students should be able to:</p> <ol style="list-style-type: none"> 1. Handle complete Industrial Wiring Installation for a one way switch control one lamp connected and radial type socket outlet. 2. Able to cut, bend 90° and 135° offset. 3. Install and assemble the PVC conduit on wiring bay. 4. Perform electrical wiring and conduct a test according to MS IEC 60364 5. Perform practical work as a team within the stipulated time frame.
ACCESSORIES	<ol style="list-style-type: none"> 1. PVC pipe as required 2. Coupler 3. Female bush 4. Lock nut 5. Plastic bush 6. Saddle & bar 7. 3-way terminal box 8. Inspection Tee 9. One way switch 10. Socket outlet 11. Termination box 12. Switch box base 13. Required cables
ELECTRICAL TOOLS	<ol style="list-style-type: none"> 1. Measuring Tape 2. Screwdriver Philip / flat 3. Combination pliers 4. Cable cutter 5. Test pen 6. Vinly pipe cutter 7. Spring Bender 8. Cable Puller
WORKING PROCEDURE:	
<ol style="list-style-type: none"> 1. Cut the PVC conduit by using Vinly pipe cutter according to given measurement. 2. Bend the PVC conduit by using spring bender. 3. Assemble PVC conduit with given PVC conduit accessories as in the diagram. The PVC Conduit joints shall be tight in between conduit joints to become water prove. 4. Draw cables in the PVC conduit as instructed by your Instructor. Make sure, assembling conduit completely before draw the cable. 5. The Wiring Installation shall meets all necessary MS IEC 60364 regulations and the measurements are in mm. 	



Circuit Diagram 1

S1 & S2 – Two-way switch

S1 & S2 - Control (L1) Lamp 1 & (L2) Lamp 2 connected with Distribution Board.

S/O 1 , S/O 2 & S/O3 socket outlet to be connected as ring circuit.

The Wiring Installation shall meets all necessary MS IEC 60364 regulations and the measurements are in mm.

QUESTIONS AND REPORT

1. Draw wiring diagram as in the circuit diagram.

Wiring Diagram

Conclusion



KEMENTERIAN PENGAJIAN TINGGI



ELECTRICAL ENGINEERING DEPARTMENT

DET 10022 – WIRING INSTALLATION

PROGRAMME :
 PRACTICAL WORK NO : 4
 TITLE : Industrial Wiring Installation (GI CONDUIT)
 DATE :
 LECTURER'S NAME :

1. PRACTICAL WORK ASSESSMENT (PLO5, CLO2, P4)

COMPETENCY SKILL	ATTAINMENT				TOTAL PERCENTAGE 100%
<i>Student able to identify, construct and handle the Practical Work and project base on criteria below :</i>	Refer list of students				
	S1	S2	S3	S4	
1. Functional Circuit (2-way Circuit)					
2. Earthing					
3. Circuit Polarity					
4. Cable Termination / Accessories Installation					
5. Measurement $\pm 30mm$					
6. Extra Cable / Spare Cable (connection for terminal box)					
7. Threading					
8. Bend 90°					
9. Wiring Diagram					
10. Discussion					
Percentage Practical Skill (100%)					

NO.	REG. NO.	NAME GROUP MEMBERS	COMPETENCY SKILL ASSESSMENT (100%)
S1			
S2			
S3			
S4			

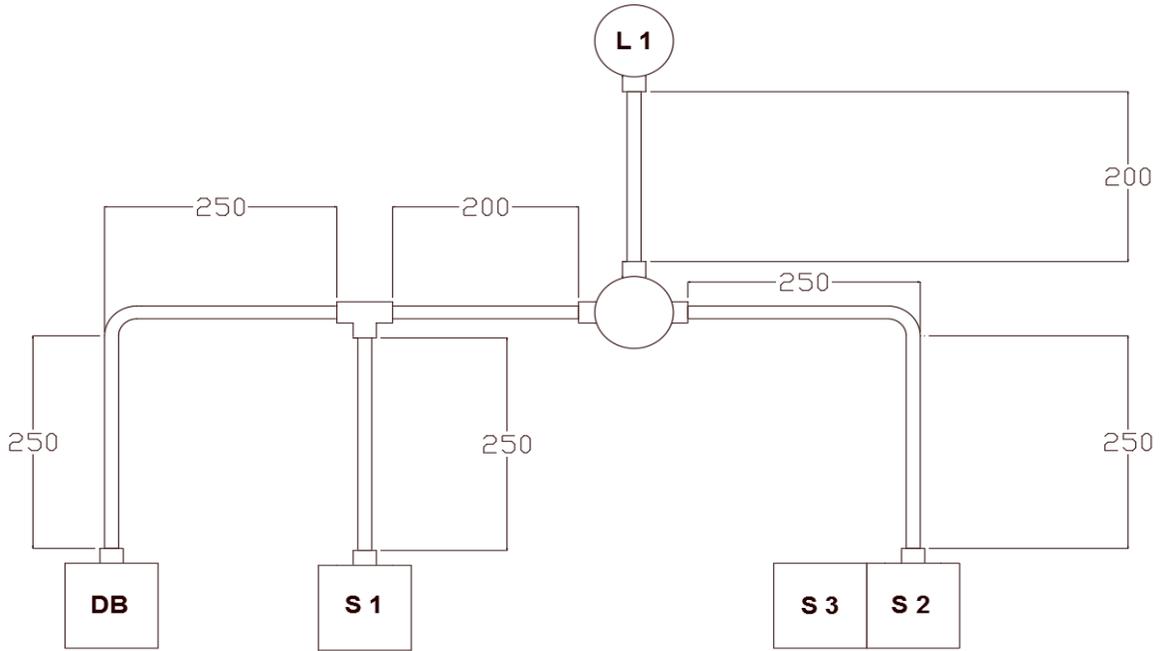
PRACTICAL SKILLS RUBRIC (PLO5, CLO2, P4)					
10	8	6	4	2	0
Student can complete all tasks assigned without errors	Student can complete all tasks assigned with a few errors	Student can complete all tasks assigned with more errors	Student can complete partial tasks assigned without errors	Student can complete partial tasks assigned with a few errors	Student shows no response / task not attempted

LABORATORY REPORT RUBRIC (PLO5, CLO2, P4)					
Report Component	Excellent	Very Good	Good	Fair	Unsatisfactory
	10	8	6	4	2
Analysis /Discussion Ability to present, interpret and analyze result.	All point of discussion on the results obtained covered and elaborated	Most point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and but not properly elaborated	Very few point of discussion on the results obtained covered and elaborated
Conclusion Provide answer to objective stated earlier.	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiments.	The closing paragraph summarizes and draw a sufficient conclusion	The closing paragraph attempts to summarize but draws a weak conclusion	The closing paragraph do not attempts to summarize the experiment OR shows little effort and reflection	The closing paragraph does not relate with experiment

GENERIC SKILLS RUBRIC (PLO8, CLO3, A3)						
Attribute	Subattribute	VERY WEEK (1 mark)	WEEK (2 marks)	FAIR (3 marks)	GOOD (4 marks)	VERY GOOD (5 marks)
Ethics And Profesionalism	Work Responsibility	Does not perform assigned tasks within by the scope of work even with close supervision	Perform assigned tasks within by the scope of work with close supervision	Perform assigned tasks within by the scope of work and meets expectation	Perform assigned tasks within by the scope of work and exceeds expectation	Perform assigned tasks beyond the scope of work and beyond expectation

Electrical Engineering Department
DET 10022 - Electrical Wiring
Practical Work 4

TOPIC	Industrial Wiring Installation (GI CONDUIT)
LAB LEARNING OUTCOME	At the end of this practical work, students should be able to: 1. Handle complete Industrial Wiring Installation for a two way switch control one lamp connected to a final circuit. 2. Able to cut, bend 90° and thread the conduit. 3. Install and assemble the conduit on wiring bay. 4. Perform electrical wiring and conduct a test according to MSIEC 60364 5. Perform practical work as a team within the stipulated time frame.
ACCESSORIES	1. GI Conduit pipe as required 2. Coupler 3. Female bush 4. Lock nut 5. Lamp Holder 6. Saddle & Bar 7. 3-way terminal box 8. Inspection Tee 9. 2-way switch c/w base 10. Termination box
ELECTRICAL TOOLS	Bender Stock & Dies GI Cutter Hacksaw Reamer Cable Puller Cable Cutter Test Pen
WORKING PROCEDURE (CLO 3) :	
1. Cut and bend the conduit according to given measurement. 2. Use Stock & Dies to make threading at the end of each conduit 3. Use Reamer or round file to clean burrs at the end of each conduit. 4. Assemble conduit with given conduit accessories as in the diagram. The conduit joints shall be tight, in order to get low resistance. 5. Draw cables in the conduit as instructed by your Instructor. Make sure, complete assembling conduit before draw the cable.	



Circuit Diagram

S1 & S2 – Two-way switch

S3 – Intermediate Switch

S1,S2 & S3 - Control (L1) Lamp 1 connected with Distribution Board.

The Wiring Installation shall meets all necessary MS IEC 60364 regulations and the measurements are in mm.

QUESTIONS AND REPORT (CLO2)

1. Draw wiring diagram as in the circuit diagram.

Wiring Diagram

Conclusion



KEMENTERIAN PENGAJIAN TINGGI

ELECTRICAL ENGINEERING DEPARTMENT DET 10022 – WIRING INSTALLATION

PROGRAMME :
 PRACTICAL WORK NO : 5
 TITLE : Earthing System in Wiring Installation
 DATE :
 LECTURER'S NAME :

1. PRACTICAL WORK ASSESSMENT (PLO5, CLO2, P4)								
COMPETENCY SKILL	ATTAINMENT				TOTAL PERCENTAGE 100%			
<i>Student able to identify, construct and handle the Practical Work and project base on criteria below :</i>	Refer list of students							
	S1	S2	S3	S4				
1. Equipment Earthing								
2. Types of Earthing Accessories								
3. Functions of Earthing Accessories								
4. Terminal E connection								
5. Terminal P connection								
6. Terminal C connection								
7. Measurement								
8. Termination to Earth								
9. Result								
10. Discussion								
Percentage Practical Skill (100%)								
2. GENERIC SKILL ASSESSMENT (PLO8, CLO3, A3)					ATTAINMENT			
					S1	S2	S3	S4
Work Responsibility								
Work Relation								
Work Ethics								
Integrity								
Score (20)								
Score (100%)								

NO.	REG. NO.	NAME GROUP MEMBERS	COMPETENCY SKILL ASSESSMENT (100%)
S1			
S2			
S3			
S4			

PRACTICAL SKILLS RUBRIC (PLO5, CLO2, P4)					
10	8	6	4	2	0
Student can complete all tasks assigned without errors	Student can complete all tasks assigned with a few errors	Student can complete all tasks assigned with more errors	Student can complete partial tasks assigned without errors	Student can complete partial tasks assigned with a few errors	Student shows no response / task not attempted

LABORATORY REPORT RUBRIC (PLO5, CLO2, P4)					
Report Component	Excellent	Very Good	Good	Fair	Unsatisfactory
	10	8	6	4	2
Analysis /Discussion Ability to present, interpret and analyze result.	All point of discussion on the results obtained covered and elaborated	Most point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and but not properly elaborated	Very few point of discussion on the results obtained covered and elaborated
Conclusion Provide answer to objective stated earlier.	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiments.	The closing paragraph summarizes and draw a sufficient conclusion	The closing paragraph attempts to summarize but draws a weak conclusion	The closing paragraph do not attempts to summarize the experiment OR shows little effort and reflection	The closing paragraph does not relate with experiment

GENERIC SKILLS RUBRIC (PLO8, CLO3, A3)						
Attribute	Subattribute	VERY WEAK (1 mark)	WEAK (2 marks)	FAIR (3 marks)	GOOD (4 marks)	VERY GOOD (5 marks)
Ethics And Profesionalism	Work Responsibility	Does not perform assigned tasks within by the scope of work even with close supervision	Perform assigned tasks within by the scope of work with close supervision	Perform assigned tasks within by the scope of work and meets expectation	Perform assigned tasks within by the scope of work and exceeds expectation	Perform assigned tasks beyond the scope of work and beyond expectation

Electrical Engineering Department
DET 10022 - Electrical Wiring
Practical Work 5

TOPIC	Earthing Systems in Wiring Installation
LAB LEARNING OUTCOME	At the end of this practical work, students should be able to: 1. Perform inspection and test a of earth electrodes according to MSIEC 60364 requirement. 2. Perform practical work as a team within the stipulated time frame.
ACCESSORIES	1. Earth Electrode 2. Earth Conductor 3. Earth Chamber
ELECTRICAL TOOLS	1. Megger Earth Resistance Tester 2. Measuring tape 3. Ball Pein Hammer

Earthing

Earthing is a connection system between the metallic parts of an electrical wiring system and the general mass of the earth. This will provide an easy path with a low impedance or resistance to earth to enable the protection system to operate effectively. It will thus ensure safety to human beings/consumers from the dangers of electric shocks if earth leakage currents are present. In general, an electrical installation is earthed because of: -

- i. Safety reasons.
- ii. Protection system requirements.
- iii. Need to limit over voltages.
- iv. Need to provide a path for electrical discharge.
- v. Legal requirements.

7.2 Classification of Earthing

Generally, earthing can be divided into 2 parts, namely: -

i. System Earthing

- a. To isolate the system under fault conditions;
- b. To limit the potential difference between conductors which are not insulated in an area;
- c. To limit the occurrence of over voltages under various conditions.

ii. Equipment Earthing

Equipment earthing is undertaken to protect human beings/consumers.

If a live source comes into contact with the equipment body, electrical energy will flow to the earth, without flowing through the human being/ consumer's body.

This is because of the fact that the human body has a greater resistance compared with the resistance to earth.

7.3 Types and Functions of Earthing Accessories

Earthing accessories are as follows: -

i. Earthing Electrode

Copper jacketed steel core rods are used as electrodes for domestic wiring.

ii. Equipotential Bonding

This is the conductor which is connected between the consumer earthing point and the exposed metallic part. The minimum cable size for this purpose is 10 mm².

iii. Protection Conductor

This is the conductor which connects the consumer earthing point with other parts of the installation which needs earthing. Its size is as follows:-

- a) Same size as the phase cable up to a size of 16mm²
- b) 16 mm² if the phase cable size is between 16 mm² and 35 mm²
- c) Half the size of the phase cable if the size of the phase cable exceeds 35 mm².

Earthing Arrangements Using a TT System

- i. The first alphabet indicates the earthing arrangements from the supply side.
- ii. The second alphabet indicates the earthing arrangement in the consumer's installation.

T – first: Indicates that the supply system has its own earthing arrangements

T – second: Indicates that all metallic frames of the electrical appliances, etc. are connected directly to earth.

The earthing arrangement using a TT system is as shown in Figure 5.1.

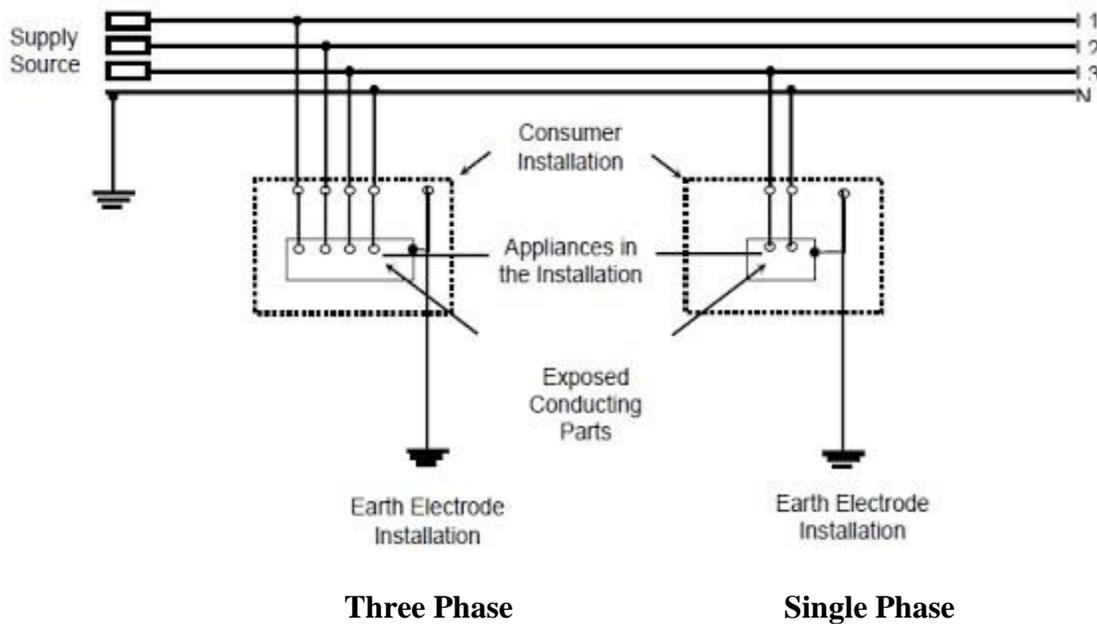


Figure 5.1 : TT System Earthing

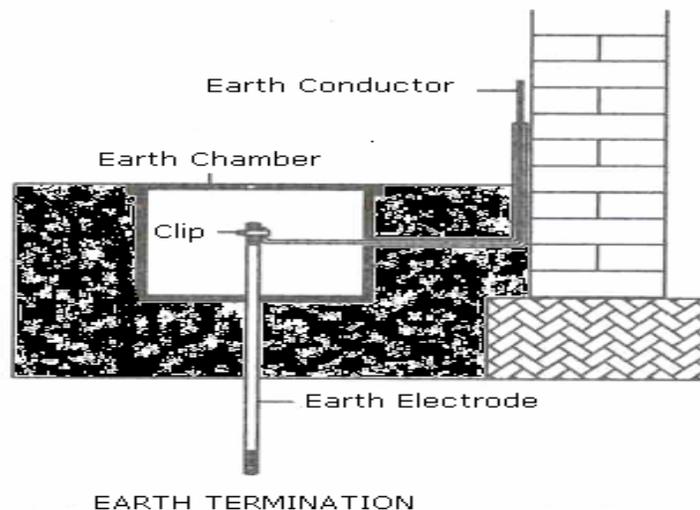


Figure 5.2 : Termination to Earth

Earth Electrode Resistance Test

- i. To test the earth electrode resistance.
- ii. To ascertain the suitability of the location of the electrode.
- iii. To ensure that the electrode is not buried within the resistance area of another electrode.
- iv. Test equipment – Earth Resistance Tester.
- v. Test method: -
 1. Terminal ‘E’ is connected to the electrode to be tested (green conductor)
 2. Terminal ‘P’ is connected to the potential spike (yellow conductor) at a distance of 10 meters from the earth electrode.
 3. Terminal ‘C’ is connected to the current spike (red conductor) at a distance of 20 meters from the earth electrode.

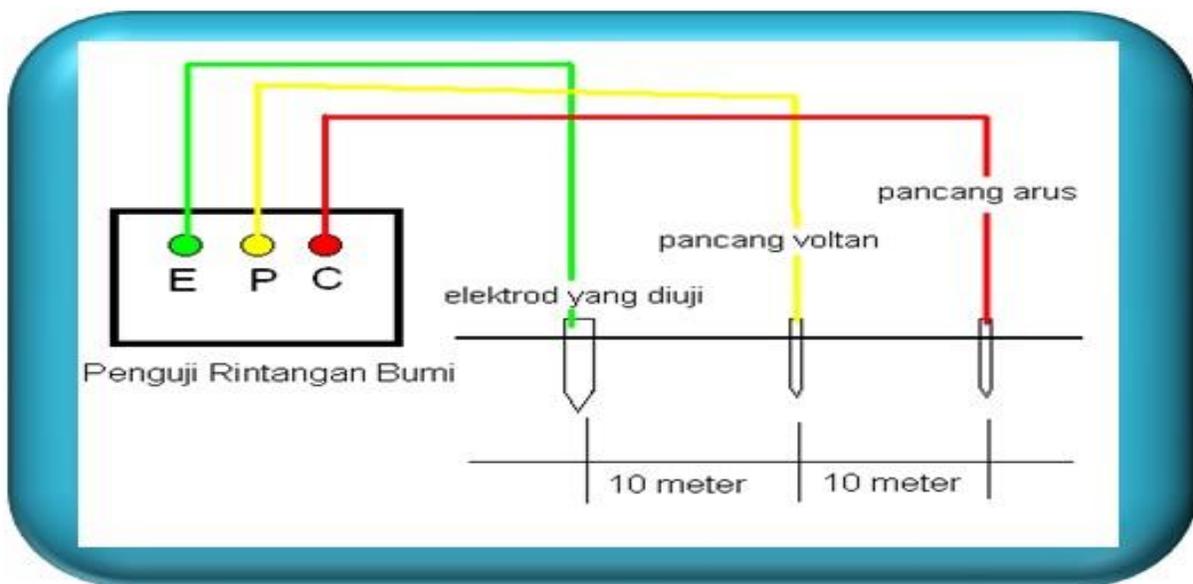
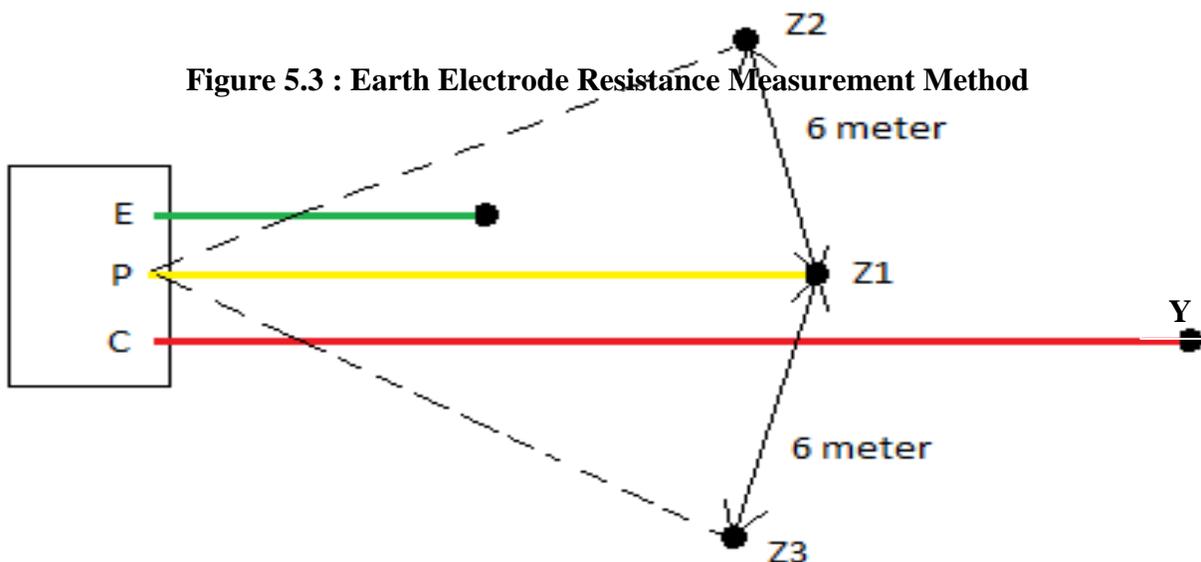


Figure 5.3 : Earth Electrode Resistance Measurement Method



Procedure:

1. Connect earth electrode resistance tester as in above diagram.
2. Ground the auxiliary electrode Y and Z as given distance.
3. Press the push button on the tester and dial the resistance simultaneously. Adjust resistance dial knob until the galvanometer shows zero reading.
4. Read the value as shown at the resistance dial.
5. Repeat procedure 1 to 4 for the second time as follows; Adjust the distance of Z to two (2) meter from earth electrode X (now the distance are from X1, Y and Z).
6. Repeat procedure 1 to 4 for the third time as follows; Adjust the distance of Z to two (2) meter from earth electrode X (now the distance are from X2, Y and Z).
7. The reading from second and the third must be close to the first one. The reading must be less than 10 ohms.

This test must be repeated at least three times, to ensure that the reading is not affected by interacting earthing regions.

- i. Record the first reading (Z1)

Example : $Z1 = 10 \Omega$

- ii. Move the voltage spike to a distance of 6 meters from the original position. Record the second reading (Z2)

Example : $Z2 = 10 \Omega$

- iii. Move the voltage spike to a distance of 6 meters from the original position. Record the third reading (Z3)

Example : $Z3 = 10 \Omega$

From value of Z1, Z2 and Z3 obtain an average value of determine the value of earth electrode resistance.

$$\frac{Z1+Z2+Z3}{3}$$

3

$$= \frac{10+10+10}{3}$$

3

$$= 10 \Omega$$

Result :

Location of Testing Earth Electrode	Distance from X (meter)		Reading (ohm)
		to Z1 = 10 m	
	to Z2 = 6 m	to Y = 20 m	
	to Z3 = 6 m	to Y = 20 m	

Conclusion



KEMENTERIAN PENGAJIAN TINGGI



ELECTRICAL ENGINEERING DEPARTMENT

DET 10022 – WIRING INSTALLATION

PROGRAMME :
PRACTICAL WORK NO : 6
TITLE : Inspection and Testing of a Completed Wiring Installation
DATE :
LECTURER'S NAME :

1. PRACTICAL WORK ASSESSMENT (PLO5, CLO2, P4)

COMPETENCY SKILL	ATTAINMENT				TOTAL PERCENTAGE 100%
Student able to identify, construct and handle the Practical Work and project base on criteria below :	Refer list of students				
	S1	S2	S3	S4	
1. Equipment Inspection and Testing					
2. Function of Equipment Inspection and Testing					
3. Continuity of Ring circuit Test					
4. Continuity of earth protective cable/conductor (EPC) Test					
5. Polarity Test					
6. Insulation Resistance Test					
7. Meter Connection					
8. Meter Reading					
9. Result					
10. Discussion					
Percentage Practical Skill (100%)					

NO.	REG. NO.	NAME GROUP MEMBERS	COMPETENCY SKILL ASSESSMENT (100%)
S1			
S2			
S3			
S4			

PRACTICAL SKILLS RUBRIC (PLO5, CLO2, P4)					
10	8	6	4	2	0
Student can complete all tasks assigned without errors	Student can complete all tasks assigned with a few errors	Student can complete all tasks assigned with more errors	Student can complete partial tasks assigned without errors	Student can complete partial tasks assigned with a few errors	Student shows no response / task not attempted

LABORATORY REPORT RUBRIC (PLO5, CLO2, P4)					
Report Component	Excellent	Very Good	Good	Fair	Unsatisfactory
	10	8	6	4	2
Analysis /Discussion Ability to present, interpret and analyze result.	All point of discussion on the results obtained covered and elaborated	Most point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and elaborated	Some point of discussion on the results obtained covered and but not properly elaborated	Very few point of discussion on the results obtained covered and elaborated
Conclusion Provide answer to objective stated earlier.	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiments.	The closing paragraph summarizes and draw a sufficient conclusion	The closing paragraph attempts to summarize but draws a weak conclusion	The closing paragraph do not attempts to summarize the experiment OR shows little effort and reflection	The closing paragraph does not relate with experiment

GENERIC SKILLS RUBRIC (PLO8, CLO3, A3)						
Attribute	Subattribute	VERY WEEK (1 mark)	WEEK (2 marks)	FAIR (3 marks)	GOOD (4 marks)	VERY GOOD (5 marks)
Ethics And Profesionalism	Work Responsibility	Does not perform assigned tasks within by the scope of work even with close supervision	Perform assigned tasks within by the scope of work with close supervision	Perform assigned tasks within by the scope of work and meets expectation	Perform assigned tasks within by the scope of work and exceeds expectation	Perform assigned tasks beyond the scope of work and beyond expectation
	Work Relation	Has a disharmonious relationship with co-workers and within, institution, work groups and community when at work	Has a less harmonious relationship with co-workers and within, institution, work groups and community when at work	Has a satisfactory relationship with co-workers and within, institution, work groups and community when at work	Has a good relationship with co-workers and within, institution, work groups and community when at work	Has a wellacknowledged relationship with co-workers and within, institution, work groups and community when at work
	Work Ethics	Practise inappropriate working culture such as bad behaviour, no punctuality as well as not being efficient, productive and ethical at work in all situations	Practise less appropriate working culture such as inconsistent behaviour, less punctuality as well as being less efficient, productive and ethical at work in many situations	Practise good working culture such as good moral, timeliness as well as being efficient, productive and ethical at work in general	Practise good working culture such as good moral, timeliness as well as being efficient, productive and ethical at work in most situations	Always practise excellent working culture such as good moral, timeliness as well as being efficient, productive and ethical at work in all situations
	Integrity	Perform a task with lack of trust, honesty, sincerity and transparency	Perform a task with limited trust, honesty, sincerity and transparency	Perform a task with acceptable trust, honesty, sincerity and transparency	Perform a task with trust, honesty, sincerity and transparent in most situations	Always perform a task with trust, honesty, sincerity and transparent in any situation

Electrical Engineering Department
DET 10022 - Electrical Wiring
Practical Work 6

TOPIC	Inspection and Testing of a Completed Wiring Installation
LAB LEARNING OUTCOME	At the end of this practical work, students should be able to: 1. Perform inspection and testing a completed domestic and industrial wiring installation according to MSIEC 60364 requirement. 2. Perform practical work as a team within the stipulated time frame.
ACCESSORIES	1. Socket Outlet 2. Switch 3. Lamp Holder 4. Distribution Board
ELECTRICAL TOOLS	1. Multimeter / Ohm Meter 2. Insulation Resistance Tester

Legal Requirements

- i. Sub regulation 12(1) and 12(2) of the Electricity Regulations 1994 state that any electrical wiring in an installation shall be under the immediate supervision of a Wireman with Single Phase Restriction or Three Phase Restriction. Upon completion, the Wireman shall certify a Supervision and Completion Certificate.
- ii. Sub regulation 13(1) and 13 (2) of the Electricity Regulations 1994 state that the installation shall be tested by a Wireman with Single Phase Restriction or a Wireman with Three Phase Restriction authorised to test any installation, and who shall certify a Test Certificate for the installation.
- iii. Sub regulation 14(1) of the Electricity Regulations 1994 states that the Supervision and Completion Certificate and the Test Certificate as in regulations 12 and 13 shall be in Forms and respectively as prescribed in the First Schedule.

Testing

On completion of a wiring installation, a number of tests on the installation have to be conducted to ascertain that the wiring circuits and connected appliances are safe for use. Prior to carrying out the tests, an inspection has to be done. The results of the inspection/supervision and test have to be presented in **Form**.

To have the test certification as in Form, the following tests shall be conducted:

1. Continuity Test
2. Insulation Resistance Test
3. Polarity Test
4. Earth Electrode Resistance Test
5. Residual Current Device Test

Testing

On completion of a wiring installation, a number of tests on the installation have to be conducted to ascertain that the wiring circuits and connected appliances are safe for use. Prior to carrying out the tests, an inspection has to be done. The results of the inspection/supervision and test have to be presented in **Form**.

To have the test certification as in Form, the following tests shall be conducted:

1. Continuity Test
2. Insulation Resistance Test
3. Polarity Test
4. Earth Electrode Resistance Test
5. Residual Current Device Test.

1.Continuity Test

There are 3 main types of continuity tests for the final circuits:-

- i. Protection Conductor Continuity Test.
- ii. Final Ring Circuit Conductor Continuity Test.
- iii. Live and Neutral Conductor Continuity Test.

i. Protection Conductor Continuity Test

- To ascertain that all protection conductors are connected in the correct and effective manner.
- Test equipment – Multimeter (Ohm range) or Ohm meter.

• Test Method:

1. Ensure that the main switch, RCD and MCB are open circuited (switched off) and all loads are disconnected
2. Connected the test leads as in the Figure 6.1
- 3.The meter reading shall be less than 1 ohm.

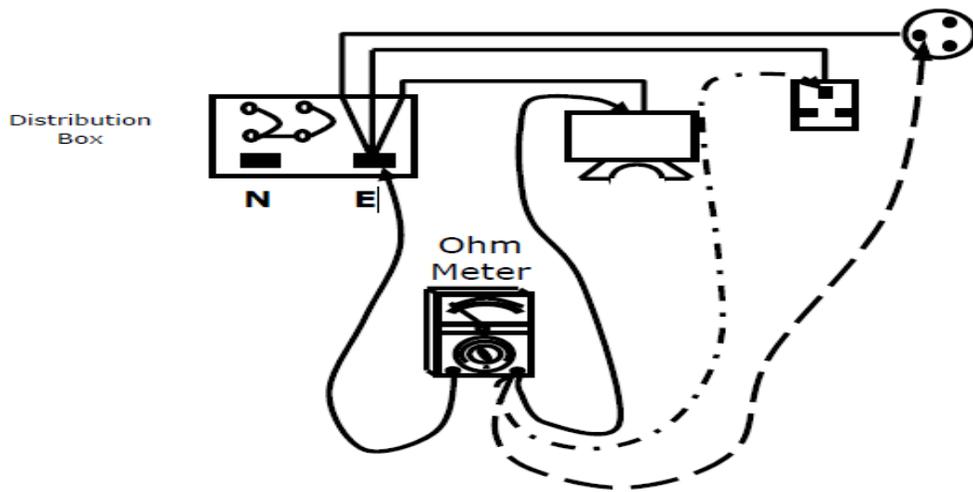


Figure 6.1 : Protection Conductor Continuity Test (Surface Wiring)

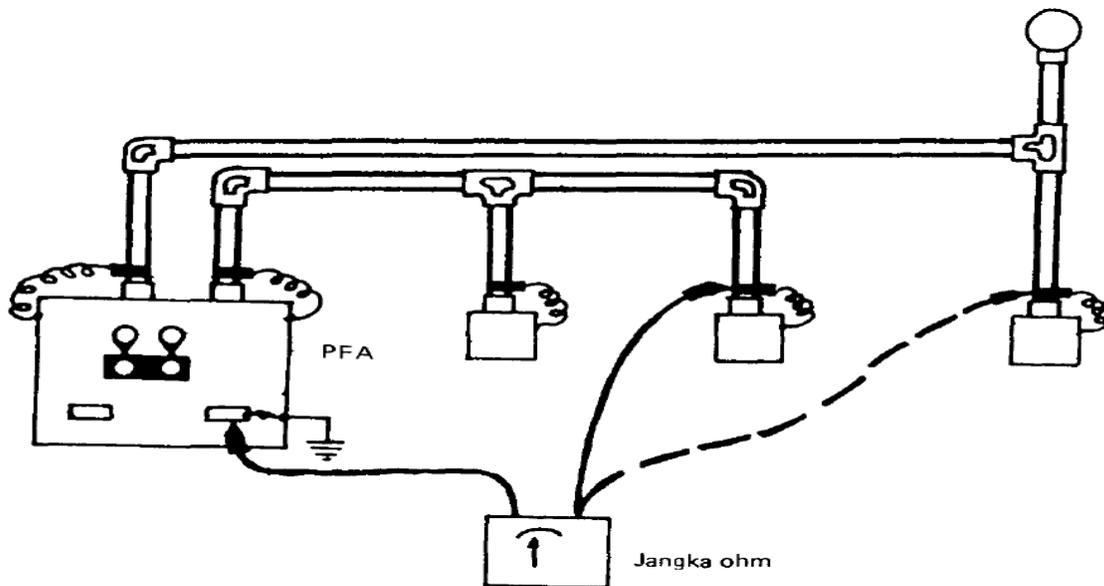


Figure 6.2 - Protection Conductor Continuity Test (Conduit Wiring)

Result:

Reading by Ohm meter/Multimeter:

- a. Earth Protective cable in surface wiring : _____
- b. Earth Protective cable in conduit wiring : _____

Conclusion:

Final Ring Circuit Conductor Continuity Test

- To ensure that all conductors around the ring circuit have continuity
- Test Equipment – Multimeter (Ohm range) or Ohm Meter
- **Test Method:**

1. Disconnect both the supply source live conductors from the MCB, the neutral conductor from the neutral terminals and the earth conductor from the earth terminal in the distribution board.
2. Connect the test leads as in the Figure 6.3 (E - E)
3. Repeat the procedure for (L - L) and (N - N)
4. The meter reading value shall be less than 1ohm.

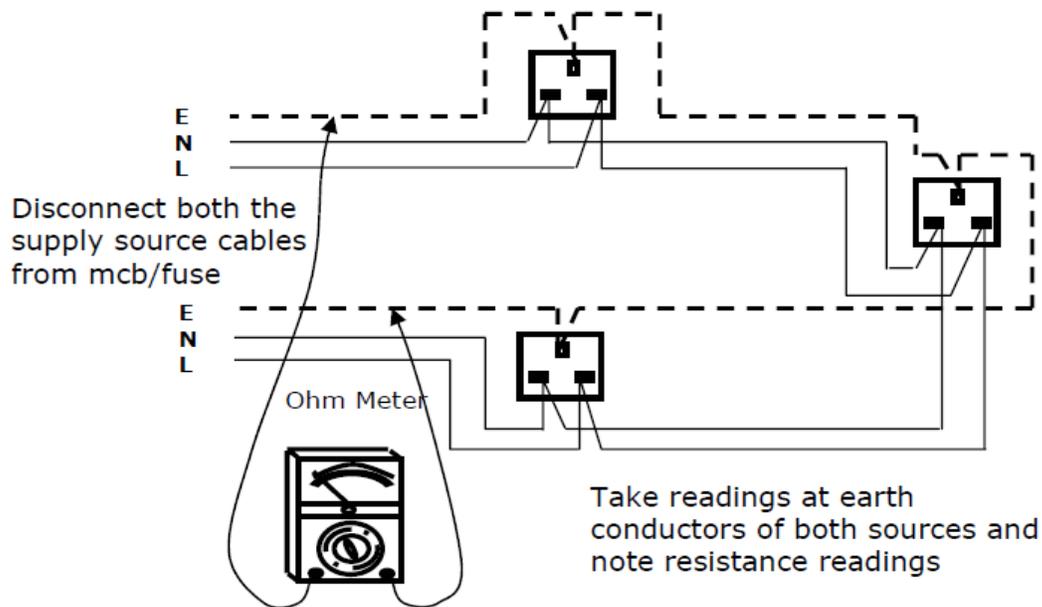


Figure 6.3 : Final Ring Circuit Conductor Continuity Test

Result:

Reading by Ohm meter/Multimeter:

- a. Final Ring Circuit Conductor in surface wiring : _____
- b. Final Ring Circuit Conductor in conduit wiring : _____

Conclusion:

Live and Neutral Conductor Continuity Test

- To ensure that each conductor in the circuit has continuity
- Test Equipment – Multimeter (Ohm range) or Ohm Meter

• Test Method:

1. Switch off the Main switch, RCD and MCB
2. Disconnect all loads
3. Switch on all switches in the circuit
4. Disconnect the fuses/final circuit breakers and close the circuit
5. Carry out the test as shown in Figure 6.4
6. The meter reading value shall be less than 1ohm.

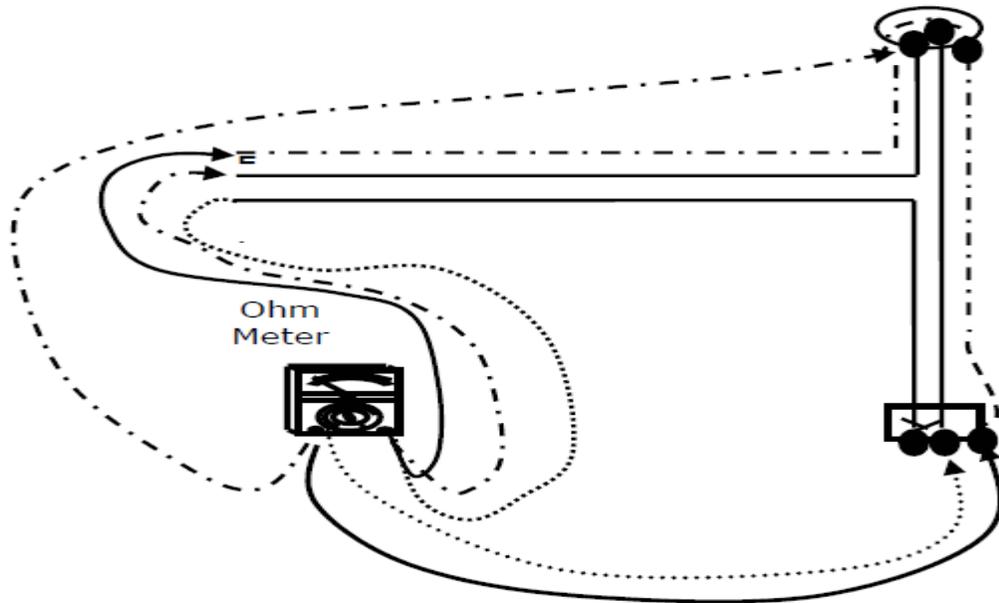


Figure 6.4 : Live and Neutral Conductor Continuity Test

Result:

Reading by Ohm meter/Multimeter:

- a. Live and Neutral Conductor in surface wiring : _____
- b. Live and Neutral Conductor in conduit wiring : _____

Conclusion:

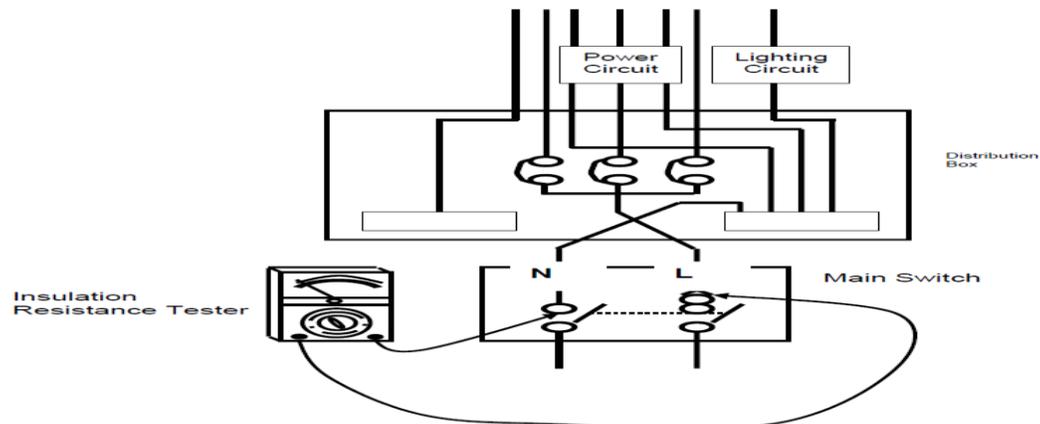
Insulation Resistance Test

- Ensure that there is no leakage current between phase conductors, phase and neutral conductors and phase conductor and earth.
- Test the strength of the cable insulation.
- Test Equipment – Insulation Resistance Tester. operating voltage is 250VDC or 500VDC.

Test Method:

1. Switch off main switch
2. Disconnect all loads
3. Switch on all circuit control switches
4. Carry out test as in the Table below
5. Meter reading value shall be less than 1 Mega Ohm.

Test At Single Phase Consumer Unit	Test At Three Phase Consumer Unit		Test At Final Lighting Circuit	Test At 13A Socket Outlet Circuit – Radial Circuit and Ring Circuit
L & N	R & Y	B & N	L & N	L & N
L & E	Y & B	Y & E	L & E	L & E
N & E	R & B	B & E	N & E	N & E
	R & N	N & E		
	Y & N			



Result:

1. L – N : _____
2. L – E : _____
3. N – E : _____

Conclusion:

Polarity Test

- Ensure that each fuse or single pole control and protection device is connected only in the phase conductor.
- Intermediate contact of Edison screw lamp holder is connected to the phase conductor.
- Ensure that phase, neutral and earth conductors at socket outlets are connected at the correct terminals.
- Test Equipment – Multimeter (Ohm range) or Ohm meter.

Test Method:

1. Switch off Main switch;
2. Disconnect all loads
3. Switch on all circuit control switches
4. Carry out test as in Figure 6.5
5. Test switches and single phase control devices at the phase conductors.
6. Test socket outlet connection sources.
7. Test Edison screw lamp holder connections.
8. Meter reading value shall be less than 1 ohm

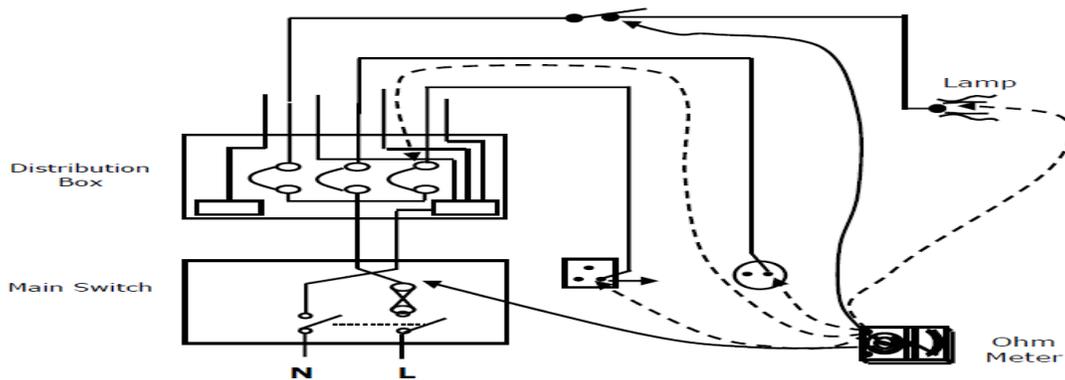


Figure 6.5 : Polarity Test

Result:

Reading by Ohm meter/Multimeter:

a. Polarity Test in surface wiring : _____

b. Polarity Test in conduit wiring : _____

Conclusion:

REFERENCES :

Main:

Main reference supporting the course:

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