

2015/2016 SEMESTER TWO EXAMINATION

Diploma in Electrical and Electronic Engineering (DEEE)

2nd Year Full-Time (DEEE)

Diploma in Energy Systems and Management (DESM)

2nd Year Full-Time (DESM)

ELECTRICAL INSTALLATION DESIGN

Time Allowed : 2 hours

Instructions to Candidates:

1. The examination rules set out on the last page of the answer booklet are to be complied with.
2. This paper consists of TWO sections:

Section A : 6 Short Questions, 10 marks each.
Section B : 2 Long Questions, 20 marks each.
3. **ALL** questions are **COMPULSORY**.
4. All questions are to be answered in the answer booklet. Start each question in Section A and Section B on a new page.
5. Extracts of Table and Graph from CP 5 will be issued for examination use only and shall be returned to Examination Office at the end of the examination.
You are NOT allowed to write anything on these tables/graphs.
6. This examination paper consists of 5 pages.

SECTION A : [10 Marks Each]

- 1(a) A shopping centre needs **1800kW** (not kVA) at **power factor of 0.8** lagging. State the voltage, phases, number of wires and frequency that Singapore Power Services Limited will likely provide. What type of earthing system must be used? What is the maximum current that can be drawn from the given supply voltage? (6 marks)
- 1(b) Draw the diagram of a three-phase electrical installation adopting the TNS earthing system, clearly labelled all the parts. (4 marks)
- 2 Temporary Electrical Installations for Construction and building sites requires the use of Socket Outlet Assembly (SOA). State four other areas where SOA is also applicable for temporary electrical installations. State the requirements relating to the enclosure of the assembly and type of protective devices used for the SOA, also state the colours used for 230 volts and 400 volts industrial plugs and sockets. (10 marks)
- 3 Find a suitable conduit size for the installation of the following circuits: (Using the cable factor method.)
- 4 No. of single phase circuits consist of 1.5 mm² single-core PVC insulated cable for the phase conductor and the protective conductor.
- 1 No. of three 4-wire phase circuits consist of 2.5 mm² single-core PVC insulated cable for the phase conductor and protective conductor.
- The conduit shall be run as in Figure Q3. (10 marks)

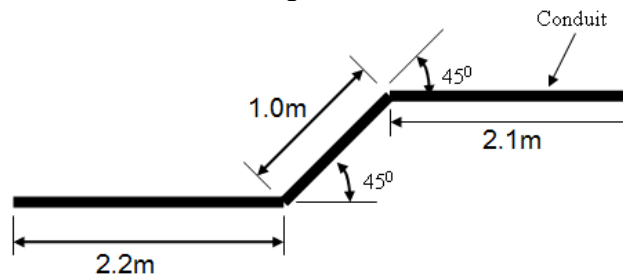


Figure Q3

- 4 An electrical distribution board has a single-line diagram as shown in Figure Q4(a). Determine the tripping times obtain from the Time/Current curve of the protective devices and state whether discrimination is achieved.
- (i) When an overload current of 50A flowing in Load1 (4 marks)
- (ii) When a fault current of 150A occurs at Point A (4 marks)
- (iii) Which mechanism operates to clear the fault current in (ii) (2 marks)

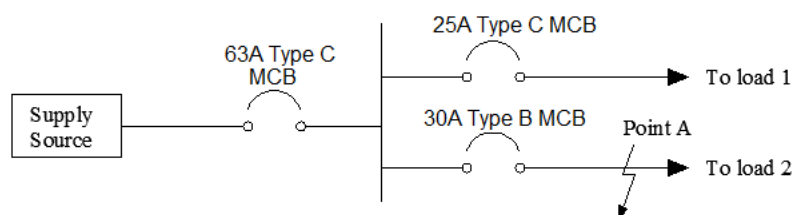


Figure Q4

- 5(a) In a crime prone area, the flat owner leaves his flat at 10.00am and only returns at 11.00pm, he decided to use a timer control circuit to gives the illusion of persons in the flat by switching on the light at 7.00pm and off at 11.00pm. Help the owner to design such a control circuit where pressing the start button will cause the light to turn on after 9 hours and the light will turn off by itself after a further four hours. The stop button will reset the circuit. (7 marks)
- 5(b) Draw the lighting control circuit of switching one lamp from two locations, label all components of the circuit. (3 marks)
- 6(a) An electrical installation with many circuits was divided into three sections the Insulation Resistance Test. The values obtained are $6\text{ M}\Omega$, $6\text{ M}\Omega$ and $3\text{ M}\Omega$. What is the equivalent insulation resistance value for the installation, and is it acceptable? (4 marks)
- 6(b) In an electrical installation protected by a 30mA RCCB, a neutral wire is shorted to the metal casing of an earthed steel trunking, briefly explain what will happens? (2 marks)
- 6(c) In the earth electrode test done as per circuit shown in Figure Q6(c), the ammeter shows 500mA, the voltmeter shows 400mV, calculate the earth electrode resistance. Name any two types of earth electrodes that are acceptable for use in Singapore. (4 marks)

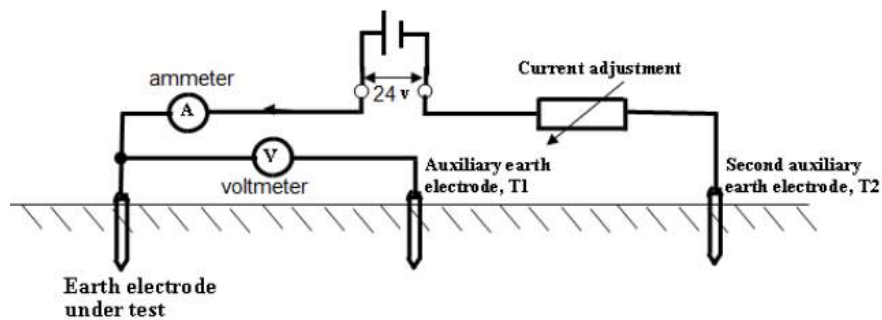


Figure Q6(c)

SECTION B : [20 Marks Each]

B1 A two-storey detached residential unit is to receive a three-phase 400V/230V 50 Hz supply. It has the following electrical loads:

- 18 nos. 2 x 36W fluorescent lamps
- 60 nos. 13A switched socket outlet connected in **3 ring circuits**, each protected by a 32A MCB (Estimated demand of each circuit is 3000W)
- 5 nos. instantaneous water heaters, each rated 3 kW
- 10kW cooker connected to cooker control unit with switched socket outlet
- 1500W audio video system connected to a 13A switched socket outlet
- Multi-split air-conditioning unit where the electrical load can be considered to be a three-phase motor, rated 12 kW with an efficiency of 90% and a power factor of 0.88.

Using the diversity factor given in Table 4B, draw a load list table as per sample below. (1 mark)

Description	Connected Load	D.F.	Current Demand

Hence calculate:

- (i) the **three phase** maximum demand
- (ii) the suitable size of the main circuit breaker, assuming 10% spare capacity is allowed for future expansion

(Standard circuit breaker rating: 20A, 25A, 30A, 40A, 50A, 63A, 80A, 100A).

(19 marks)

B2(a) State the conditions to be satisfied where a cable is to be protected by the selected protective device for

- (i) Overload (2 marks)
- (ii) Short circuit (2 marks)

A motor is rated 15 kW, 400V, 3-phase, power factor 0.8 lagging, efficiency 89%. The length of the cable is 80m from the distribution board and it is to be wired in single-core PVC insulated copper cables sharing a trunking with one other similar circuit. The ambient temperature is 40° C. Determine:

- (iii) the design current, hence the nominal rating of the MCB and Type
(Standard circuit breaker rating: 15A, 20A, 25A, 30A, 32A, 40A, 50A, 63A)
- (iv) the suitable size of the cable
- (v) the actual voltage drop and check whether the cable size selected can meet the CP5 requirement. Re-select cable size if necessary.

(8 marks)

B2(b) A single-phase 230V, cooker control unit is wired in single-core 4.0mm² PVC insulated copper conductor and 1.5mm² PVC insulated copper conductor for circuit protective conductor. The circuit is protected by a 32A Type B MCB, the circuit length is 18 meters long. The value of Z_E is given as 0.72 Ω . Determine if the size of the circuit protective conductor meet both the shock protection and thermal constraint requirements. (8 marks)

“ ***** End of Paper ***** ”