

2016/2017 SEMESTER ONE 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 4 pages.

SECTION A : [10 Marks Each]

- 1(a) A factory needs 3000kVA of electricity. State the voltage, frequency and number of wires that Singapore Power Services Limited will provide. What type of earthing system will be used? Determine the maximum current and power that can be drawn from Singapore Power at 3000kVA and power factor of 0.85 lagging. (8 marks)
- 1(b) Draw the diagram of a single-phase electrical installation adopting the TNS earthing system, clearly labelled all the parts. (2 marks)
- 2 Socket Outlet Assembly (SOA) are mandated for use in Temporary Electrical Installations.
- (i) State the purpose of SOA.
 - (ii) State the requirements relating to the enclosure of the assembly and type of protective devices used for the SOA.
 - (iii) State the colours used for 230 volts and 400 volts industrial plugs.
 - (iv) State the inspection frequency required of Temporary Electrical Installations at Construction Worksite.
- (10 marks)
- 3(a) Determine the size of a 7.8m long conduit with one bend needed to accommodate the following circuits. (Using the cable factor method.) (6 marks)
- 3 numbers of single-phase circuit using 2.5 mm² single core PVC-insulated stranded cables with 2.5mm² single core PVC insulated cables for the protective conductors
 - 1 number of three-phase 3-wire circuit using 4.0 mm² single core PVC-insulated stranded cables with 1.5mm² single core PVC insulated cables for the protective conductors.
- 3(b) An electrical installation of a four storey building has the insulation resistance test done for each storey, the results are: (4 marks)
- | | |
|------------------------|-------|
| 1 st storey | 20 MΩ |
| 2 nd storey | 20 MΩ |
| 3 rd storey | 10 MΩ |
| 4 th storey | 5 MΩ |
- Determine the overall insulation resistance value for the whole building. Does the overall insulation resistance value comply with CP5:1998?
- 4 Design a motor control circuit which has the following operations.
- There are two motors to be started in sequence:
- Motor 1 and a green light is started together by operating a start push button.
- Motor 2 will start up automatically together with a blue light 30 minutes after Motor 1 is started.
- The operation of a stop push button will stop the running of the two motors and also light up a red light. (10 marks)

- 5 Refer to the single line diagram in Figure Q5 below:
- Determine the corresponding tripping time for the 30A Type B MCB and the 50A Type B MCB when a current of 90A flows in Load B and briefly explain whether discrimination is achieved. (4 marks)
 - State the protective device that will operate when an earth leakage current of 0.04A flows at point A. (2 marks)
 - Determine the corresponding disconnection time for the 20A Type B MCB when the circuit for Load C is shorted to neutral with a short circuit current of 100A. Explain clearly whether it is appropriate to use the 50A Type B MCB with the 63A DP 30mA RCCB. (Standard rating for RCCB of 30mA sensitivity: 40A, 63A, 100A.) (4 marks)

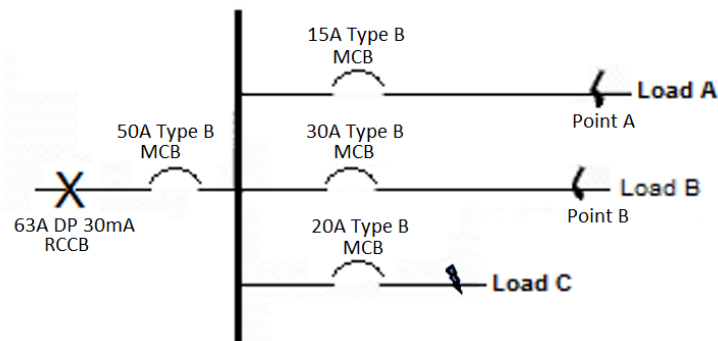


Figure Q5

- 6(a) In the circuit below, the value of Z is 50, the impedances are connected to a 400V/231V three phase supply. Determine V_1 , V_4 , I_1 and I_2 . (8 marks)

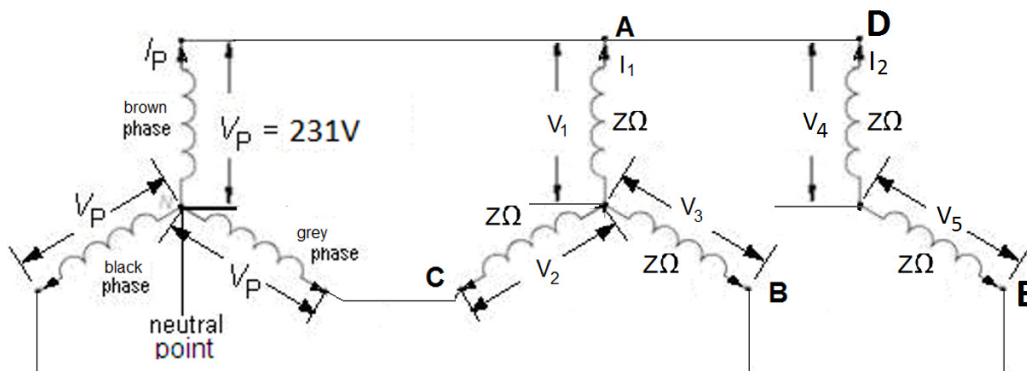


Figure Q6

- 6(b) Other than the insulation resistance test, name any 2 other tests which must be completed prior to the energisation of any electrical installation. (2 marks)

SECTION B : [20 Marks Each]

- B1 A condominium unit is supplied by three-phase 400V/230V 50 Hz supply. It has the following electrical loads:
- 10 nos. 2 x 36W fluorescent lamps
 - 18 nos. of 18W PLC (a type of compact fluorescent lamp) down lights
 - 48 nos. 13A switched socket outlet connected in **3 radial circuits**, each protected by a 20A MCB (Estimated demand of each circuit is 3000W)
 - 3 nos. instantaneous water heaters, each rated 2.5 kW
 - 5kW cooker connected to cooker control unit with 13A switched socket outlet
 - a 1000W side by side refrigerator connected to a 13A switched socket outlet
 - 1 nos. of MULTI SPLIT air-conditioning units where the electrical load can be considered to be a three-phase motor, rated 8.0 kW with an efficiency of 87% and a power factor of 0.85.

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 20% spare capacity is allowed for future expansion

(Standard circuit breaker rating: 30A, 40A, 50A, 63A, 80A, 100A). (19 marks)

- B2(a) A 3-phase, 400V 15kW induction motor is delta-connected. The efficiency and the power factor of the motor are 90% and 0.85 respectively. The length of the cable is 35m from the distribution board and it is to be wired in single-core PVC insulated copper cables sharing a trunking with two other similar circuits. The ambient temperature is 40° C. Determine:
- (i) The line current, hence the nominal rating of the MCB and Type (Standard circuit breaker rating: 15A, 20A, 25A, 30A, 40A, 50A, 63A)
 - (ii) The starting current if the windings are connected in star for starting
 - (iii) A suitable size of cable for the delta connected motor.
 - (iv) The actual voltage drop and check whether the cable size selected can meet the CP5 requirement. Re-select cable size if necessary.
- (12 marks)

- B2(b) A single-phase 230V, 13A switched socket outlets circuit is wired in single-core 2.5mm² PVC insulated copper conductor and 1.0mm² PVC insulated copper conductor for circuit protective conductor. The circuit is protected by a 20A Type B MCB, the circuit length is 30 meters long. The value of Z_E is given as 0.70 Ω .
- (i) Determine if the given size of circuit protective conductor (CPC) meets the requirement for shock protection, resize the CPC if necessary. (4 marks)
 - (ii) Calculate the actual earth fault loop impedance for the size of CPC selected and determine the earth fault current. Hence check whether the CPC selected can withstand the earth fault current. (Given $k = 115$.) (4 marks)

“ ***** End of Paper ***** ”