2016/2017 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 4 pages.

SECTION A: [10 Marks Each]

1 (a) A construction site uses a star connected 400V/230V 50Hz 600kVA generator set for its operation. What type of earthing system must be used? At 400V, 3 phase and power factor of 0.8 what is the maximum current and power that can be delivered from the 600kVA generator? (7 marks)

(b) Draw the diagram of a single-phase electrical installation adopting the TNS earthing system, clearly labelled all the parts. (3 marks)

2 CP88 - Code of Practice for Temporary Electrical Installations mandated the use of Socket Outlet Assembly (SOA). (10 marks)

(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 any three places besides construction site that SOA is also applicable.
(iv) State the Inspection frequency required of Temporary Electrical Installations at the other places mentioned in (iii) above.

3 (a) Determine the size of a 6.8m long conduit with one bend needed to accommodate the following circuits. (Using the cable factor method.) (7 marks)

- 2 numbers of single-phase circuit using 2.5 mm^2 single core PVC-insulated stranded cables with **1.5**mm^2 single core PVC insulated cables for the protective conductors
- 1 number of three-phase 3-wire circuit using 2.5 mm^2 single core PVC-insulated stranded cables with **1.5**mm^2 single core PVC insulated cables for the protective conductors.

(b) You are the electrical supervisor at a construction site, a three phase 4-wire circuit using16mm^2 single core PVC insulated copper cable was to be installed in 32mm diameter galvanised iron conduit. However due to insufficient 32mm diameter galvanised iron conduit, the contractor proposes to install the wires in two 25mm diameter galvanised iron conduit, which will provide for plenty of space for installing the circuit. Give your reason(s) for accepting or rejecting the proposal. (3 marks)

4 Design a motor control circuit for the running of two motors, Motor 1 and Motor 2. Motor 1 and Motor 2 may be started independently. However, when Motor 1 is running, Motor 2 cannot be started and vice versa. A common stop button will stop either motor from running. Which measure of protection against indirect contact must be used for these two motors with steel casing? (10 marks)

5 State the conditions that must be satisfied so as to provide co-ordination between the conductors and protective devices against overload current. (6 marks)

Refer to the single line diagram in Figure Q5 below:

Determine the corresponding tripping time for the 20A BS 88 Fuse and the 40A Type B MCB when a short circuit current of 80A flows in Load B and briefly explain whether discrimination is achieved. (4 marks)

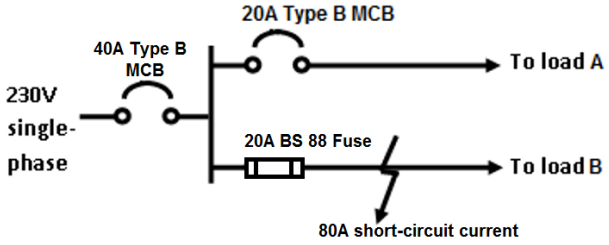

Figure Q5

6 (a) For continuity test of a ring circuit, the measurement in step 1 (Figure Q6(a)) where the resistance of the open ring for the phase conductor is 0.2Ω. What will be the reading on the meter as shown in step 2 when the ring is connected together? . (5 marks)

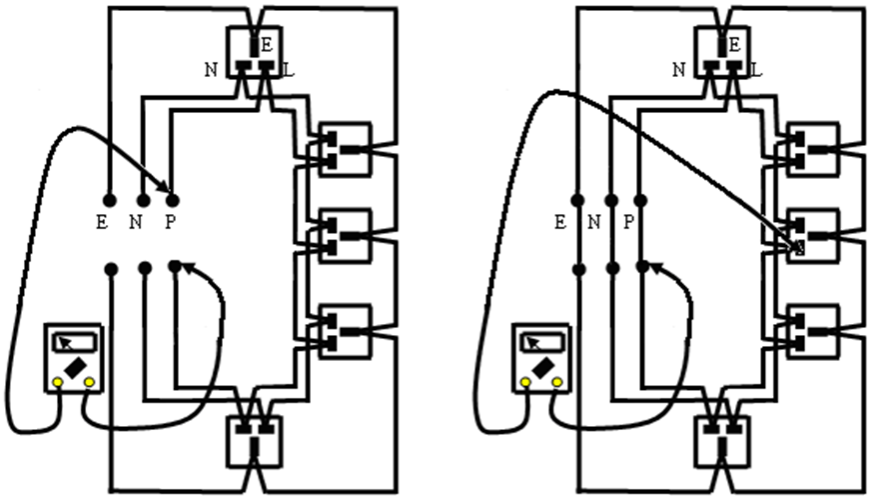

Figure Q6(a)

6 (b) Other than the continuity test of a ring circuit, name any 5 other tests which must be completed prior to the energisation of any electrical installation. (5 marks)

SECTION B : [20 Marks Each]

B1 A cluster housing unit is supplied by three-phase 400V/230V 50 Hz supply. It has the following electrical loads:

- 18 nos. 2 x 32W fluorescent lamps
- 4 nos. of 200W discharge lamp floodlights
- 36 nos. 13A switched socket outlet connected in **3 radial circuits**, each protected by a 32A MCB (Estimated demand of each circuit is 3500W)
- 4 nos. instantaneous water heaters, each rated 2.5 kW
- 6kW cooker connected to cooker control unit with 13A switched socket outlet
- A 600W chest freezer 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 6.0 kW with an efficiency of 85% 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 15% 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 distribution board (**DB**) has an estimated demand of 20kW at power factor of 0.85. The length of the cable is 30m from the main switchboard and it is to be wired in single-core PVC insulated copper cables sharing a trunking with one other similar circuits. The ambient temperature is 35^0 C. Determine:

(i) The design current of the **DB**, hence the nominal rating of the MCB
(Standard circuit breaker rating: 15A, 20A, 25A, 30A, 40A, 50A, 63A)

(ii) A suitable size of cable for the **DB**.

(iii) The actual voltage drop and check whether the cable size selected can meet the CP5 requirement. Re-select cable size if necessary.

(11 marks)

B2(b) A single-phase 230V, water heater (**fixed equipment**) 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 16A Type C MCB, the circuit length is 25 meters long. The value of Z_E is given as 0.75 Ω.

(i) Determine if the given size of circuit protective conductor (CPC) meets the requirement for shock protection, what should be done if given size of CPC does not meet this requirement? . (5 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 ******* "