UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME : UTILISATION OF ELECTRICAL ENERGY

COURSE CODE : BEV 30803

PROGRAMME CODE : BEV

EXAMINATION DATE : JULY / AUGUST 2023

DURATION : 3 HOURS

INSTRUCTION :
1. ANSWER ALL QUESTIONS

2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**

3. STUDENTS ARE PROHIBITED TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

TERBUKA

Q1 (a) Power quality concerns refer to any deviation or distortion in the voltage, current, or frequency of an electrical power supply that can negatively affect the performance or reliability of electrical equipment and systems. List and sketch **three (3)** different power quality concerns with appropriate figures and labels.

(6 marks)

(b) Power quality can be categorised based on the duration. Discuss **one (1)** example of power quality issues and its respective solution for each transient and short-duration category.

(4 marks)

(c) When connected to a 120 V, 60 Hz power line, a load absorbs 4 kW at a lagging power factor of 0.8. Identify the value of capacitance necessary to raise the power factor to 0.95.

(5 marks)

(d) A 120 V 60 Hz source supplies two loads connected in parallel. The arrangement is shown in **Figure Q1(d)**.

(i) Determine the power factor of the system.

(10 marks)

(ii) Determine the value of the capacitance required to connect in parallel in order to raise the power factor to unity.

(5 marks)

Q2 (a) An earthing system connects specific component of an electrical power system with the ground for safety purposes.

(i) Explain the **three (3)** different grounding versus bonding with an appropriate installation diagram and label.

(8 marks)

(ii) Sketch a logical condition of three phase lines that are using the "*TT system (earthed neutral)* type earthing arrangement with an appropriate explanation.

(6 marks)

(b) Earth Leakage Circuit Breaker (ELCB) is a type of circuit breaker that is used for protection against leakage current.

(i)   Sketch and explain with an appropriate label representation of ELCB in 3-phase connection.

(4 marks)

(ii)   Explain **three (3)** types of ELCB rating and sensitivity that can be used as protection scheme for earth fault.

(6 marks)

(c)   A single phase motor circuit is protected by a circuit breaker with the maximum current in the fault is 94.5 A in damage condition. A fault occurs and causes a current flow through the earth continuity path with the amount of heat power produced at the metal box is 5 kW. Due to the poor contact of lock nut and bush connecting a steel conduit to a metal box, the resistance of this conduit connection alone is 0.4 Ω. Regulation D22 regarding the basic earthing requirements is given in **Table Q2(c)**.

(i)   Analyse the current value of protective device in damage condition.

(3 marks)

(ii)   Analyse the fault current flows based on the amount of heat produced at the metal box.

(2 marks)

(iii)   Evaluate the degree of risk of a fire developing.

(1 mark)

Q3   (a)   Define and state the unit in the International System of Units (SI) of luminous flux and illuminance.

(4 marks)

(b)   Two lamps with 2000 lumens and 4000 lumens are placed at A and B, respectively. The arrangement is shown in **Figure Q3(a)**. C is midway between the lamps. Calculate the illumination on the floor at positions C.

(6 marks)

(c)   An industrial plant has an incandescent lighting load comprising 120 Nos. of 60 W and 160 Nos. of 100 W. The management team plans to replace each incandescent load with 1 x 40 W fluorescent load to save energy. Lighting is required for 4000 hours/year and the cost of electricity is RM 0.22/kWh. Replacement cost is RM 13.5/unit consider ballast consumption as 15 W.
Given data:

100 W incandescent lamp	=	2200 lumens
60 W incandescent lamp	=	1320 lumens
40 W Fluorescent lamp	=	2400 lumens

3

Determine:
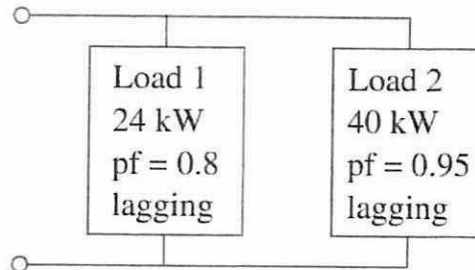(i)   Annual energy saving

(8 marks)

(ii)   Annual cost saving

(2 marks)

(ii)   Replacement cost

(2 marks)

(iii)   Simple payback period

(2 marks)

(d)   A squared exhibition hall with a width of 12 m is to be illuminated to a level of 350 Lux. The utilisation and the maintenance factors are to be taken as 0.60 and 0.80, respectively. Estimate the power required to illuminate the hall if:

(i)   Using energy-saving T5 fluorescent lamp, having an efficacy of 65 lm / W.

(3 marks)

(ii)   Using LED lighting, having an efficacy of 90 lm / W.

(3 marks)

-END OF QUESTIONS –

FINAL EXAMINATION

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Load 1	Load 2
24 kW	40 kW
pf = 0.8	pf = 0.95
lagging	lagging

FigureQ1(d)

Table Q2(c)

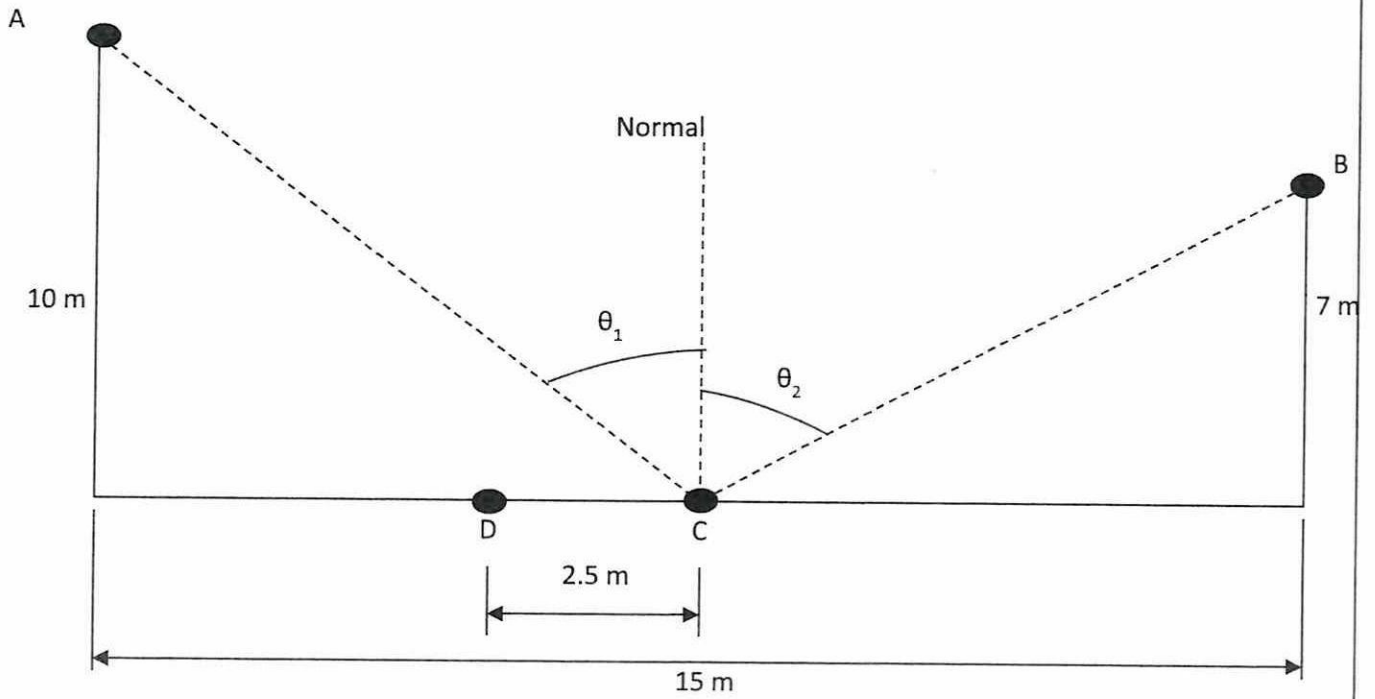| **Regulation D22 (Basic Earthing Requirements)** |
|---|
| States that earth leakage protection may be provided by means of fuses or excess current circuit breakers if the earth fault current available to operate the protective device and so make the faulty circuit dead exceeds:

 1. 3 times the current rating of any semi enclosed fuse or any cartridge fuse having a fusing factor exceeding 1.5, used to protect the circuit, or
 2. 2.4 times the rating of any cartridge fuse having a fusing factor not exceeding 1.5, used to protect the circuit, or
 3. 1.5 times the tripping current of any excess current circuit breaker used to protect the circuit. |

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FigureQ3(a)