

**CONFIDENTIAL**



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
(ONLINE)  
SEMESTER II  
SESSION 2020/2021**

COURSE NAME : UTILISATION OF ELECTRICAL ENERGY  
COURSE CODE : BEF 33203/BEV 30803  
PROGRAMME CODE : BEV  
EXAMINATION DATE : JULY 2021  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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- Q1** (a) (i) Define the term power quality in power systems based on IEEE Standard. (2 marks)
- (ii) Discuss **two (2)** possible consequences of poor power quality for factories. (4 marks)
- (b) **Table Q1(b)** tabulates the load for a medium size industry in Parit Raja. The loads are balanced over the three phases of 400 V supply system. Calculate:
- (i) The total apparent power. (13 marks)
- (ii) The overall power factor. (2 marks)
- (iii) The line current. (2 marks)
- (c) Harmonic in power system is defined as a sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency based on IEEE Standard 100, 1984.
- (i) Sketch the sinusoidal voltage and current function that represent the harmonics in power system. (4 marks)
- (ii) Calculate the harmonic frequency required to filter out the 11th harmonic from a bus voltage that supplies a 12-pulse converter with a 100 kVAr, 4160 V bus capacitor. (3 marks)
- (iii) Explain in **three (3)** points the harmonic sources in power system. (3 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)** purposes of having a good earthing system in building installation. (6 marks)
- (i) Sketch a logical condition of three phase lines that are using the “*Combine Neutral Earthing*” (TNC) type earthing arrangement with an appropriate explanation. (6 marks)

- (b) The purpose of primary protection devices is to protect installations against overvoltage such as direct strokes of lightning.
- (i) Sketch and explain with an appropriate label representation of overvoltage characteristics (plot voltage versus time). (6 marks)
  - (ii) With the help of appropriate illustration, describe **three (3)** types of primary protection that can be used as protection scheme for a building. (6 marks)
- (c) A single phase motor circuit is protected by a 63A circuit breaker. A fault occurs and causes a current of 98 A to flow through the earth continuity path. 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 0.5  $\Omega$ . Regulation D22 regarding the basic earthing requirements is given in **Table Q2(c)**.
- (i) Predict whether the protective device will be damaged. (3 marks)
  - (ii) Estimate the amount of heat produced at the metal box. (2 marks)
  - (iii) Suggest the degree of risk of a fire developing. (1 mark)

**Q3** (a) Illuminating Engineering Society (IES) is a recognized technical and educational authority on illumination, which publishes various documents, including standards on illumination level. In Malaysia however, there are guidelines from Malaysia Standard (MS 1525) and Public Works Department (JKR) for these standards. **Table Q3(a)** shows an example on the illumination level standards. Based on the table, deduce the reasons which contribute to lower illumination levels in Malaysia (MS and JKR) as compared to IES. (5 marks)

(b) Suppose:

- N = No. of lamps
- W = Wattage of each lamp
- $\eta$  = Efficiency of each lamp (lm/watt)
- UF = Utilization Factor
- DF = Depreciation Factor
- MF = Maintenance Factor

By using Lumen method prove that DF is the reciprocal of MF.

- (c) **Figure Q3(c)** shows a typical unit for an affordable home. As an M&E consultant, you are required to plan and design lighting and electrical system for its development. This house is to be illuminated and the illuminance required is 200 Lux. Assuming a standard maintenance factor and utilisation factor of 0.6 for the lighting scheme. If 36 W fluorescent lamps (75 lumens/watt) are used, suggest and determine the number of fluorescent lamps required for the whole house.
- (10 marks)
- (d) A windowless office is to be illuminated for 12 hours per day, for 5 days per week, for 50 weeks per year. The floor is 30 m long and 10 m wide. An overall illumination of 450 Lux is to be maintained over the whole floor. The total light loss factor for the installation is 70 %. The designers have the choice of using 100 W tungsten filament lamps, which have an efficacy of 12 lm/W and need replacing every 3000 hours, or 65 W tubular fluorescent warm white lamps, which have an initial output of 5400 lm and are expected to provide 12000 hours of service. The room layout requires an even number of lamps. Electricity costs RM 0.22/kWh. The tungsten lamps cost RM1.00 each while the fluorescent tubes cost RM10.00 each.
- (i) Determine the total costs per year for lighting system which is designed with tungsten lamps.
- (10 marks)
- (ii) Determine the total costs per year for lighting system which is designed with fluorescent lamps.
- (4 marks)

– END OF QUESTIONS –

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**Table Q1(b)**

i	A single induction motor taking 20 kW and operate at 0.75 PF lagging
ii	An electric pump taking 25 kVA and operate at 0.92 PF lagging
iii	Lumped load rated at 8 kW and operating at unity PF
iv	Lumped load rated at 15 kVA and operating at 0.68 PF lagging

**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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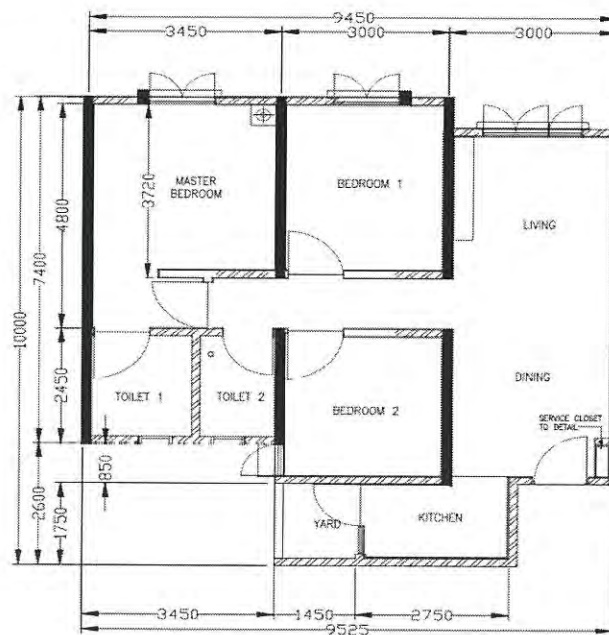
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**Table Q3(a)**

General Building Areas	IES Standards Illumination Level	MS 1525 Recommendation	Panduan Teknik JKR
<b>Circulation Area</b>			
Corridors, Passageway	100	50	100
Lift	150	100	100
Stairs	150	100	100
Escalator	150	150	100
External Covered Ways	30	50	30
<b>Entrances</b>			
Entrance halls, lobbies, waiting rooms	150	100	100
Enquiry desk	500	300	300
Gate houses	300	200	200
<b>Kitchens</b>			
Food stores	150	150 - 300	100
General	500	150 - 300	300



**UNIT FLOOR PLAN**  
(AREA : 850 sqft, 79.00 sq meter)

**Figure Q3(c)**