UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ELECTRICAL AND ENERGY SUPPLY
COURSE CODE	:	BNB 31403
PROGRAMME CODE	:	BNB
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS PAPER CONSISTS OF **SEVEN (7)** PAGES.

Q1 (a) Define the terms below:

(i) Maximum demand

(2 marks)

(ii) Diversity factor

(2 marks)

(b) Describe **THREE (3)** types of electrical users.

(6 marks)

(c) A medium voltage industrial consumer having the following data for its monthly electricity bill:

Total electricity consumption in kWh - 200,000 units
The reactive power consumption in kVArh - 150,000 units
The monthly load factor - 63%
For each kilowatt of maximum demand per month= RM 22.50/ kW
For all kWh = 30 cents/ kWh

Table Q1(c) specifies the power factor penalty rate used to calculate the electrical bill on this premise.

(i) Calculate the monthly maximum demand for this consumer for take 30 days/month.

(2 marks)

(ii) Examine the total monthly bill charge for this premise?

(4 marks)

(iii) Estimate the total monthly bill charge if the reactive power consumption is increased to 185,000 units.

(4 marks)

Q2 (a) The domestic electrical supply system in Malaysia are divided into two part which are supplier control unit and user control unit. Discuss briefly **THREE (3)** types of protection devices that consisted in user control unit.

(6 marks)

(b) A small shop receive 400 V 3-phase supply from utility substation. The Main Switch Board (MSB) at the shop supplies the loads as stated in **Table Q2(b)**.

(i) Calculate the maximum demand of this small shop by considering the allowances for diversity provided in **Table Q2(b)(i)**.

(10 marks)

(ii) Propose the minimum current rating that should be used to protect the MSB. (MCCB rating: 1A, 2A, 5A, 10A, 30A, 60A, 80A, 100A, 125A, 150A)

(1 marks)

(c) If the shop owner wants to replace all of 3 kW instantaneous water heater with 5 kW instantaneous water heater with an efficiency of 85%, evaluate the new value of maximum demand and justify your answer does the protective device rating in answer **Q2(b)(ii)** is still valid.

(3 marks)

Q3 (a) (i) Explain the term earthing.

(3 marks)

(ii) Differentiate between grounding and bonding.

(4 marks)

(iii) Illustrate **THREE (3)** importance for grounding in electrical installation system.

(6 marks)

(b) A single phase, 240 V, 20 kW 50 Hz motor circuit operating at 0.85 power factor lagging is protected by a cartridge fuse having blowing current of 100 A. A fault occurs in the circuit causes a current of 200 A to flow through the earth continuity path. As a result of poor contact due to a lock nut and bush connecting a steel conduit to metal box, the resistance of this conduit connection alone is 1.35 Ω.

(i) Predict whether the fuse will rupture based on **Table Q3(b)(i).**

(4 marks)

(ii) Examine the amount of heat produced at the metal box.

(3 marks)

Q4 (a) Source of energy can be divided into primary sources (conventional) and secondary sources (renewable).

(i) List **THREE (3)** example of secondary sources.

(3 marks)

(ii) With the aid of diagram, describe in details one of its point mentioned in answer **Q4(a)(i)**.

(7 marks)

(b) Analyze the power converted from the wind into rotational energy in the turbine by using the following data:

Blade length : 500 cm
Wind speed : 10 m/sec
Air density : 1.23 kg/m^3

(i) For power coefficient of 45%.

(5 marks)

(ii) For power coefficient of 55%.

(3 marks)

(iii) Conclude the result in **Q4(b)(i)** and **Q4(b)(ii).**

(2 marks)

Q5 (a) Geothermal energy is the heat contain within the body of the earth. There are three principle ways of converting geothermal into electricity.

(i) List **THREE (3)** types of geothermal power plants.

(3 marks)

(ii) Propose **ONE (1)** of those three geothermal power plants that can be used for very hot temperature (> 230 °C).

(2 marks)

(iii) Illustrate with diagram and explain the principle operation of the chosen geothermal power plant in **Q5(a)(ii)** in order to generate electricity.

(7 marks)

(b) A factory consumes 425,200 kVAh in a year with the yearly average power factor, 0.86. If the half-an-hour demand was 120 kW.

(i) Calculate the average load demand.

(3 marks)

(ii) Estimate annual load factor.

(2 marks)

(iii) If the factory decided to increase the electricity usage to 450,000 kWh and the load factor to 65%, summarize the maximum demand.

(3 marks)

-END OF QUESTION-

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Table Q1(c): Power Factor Penalty

Power Factor Penalty Rate	
Below 0.85 and up to 0.75 lagging	1.5% of the bill for that month
Below 0.75 lagging	A supplementary charge of 3% of the bill for that month

Table Q2(b): Load Table

No	Load Details	Units
1	Fluorescent light fittings, where each fitting consists of 60 W fluorescent tube	20
2	LED downlight, each rated at 6 W	20
3	5 KW and 3 kw heater ovens	1 x 5 kw 5 x 3 kw
4	6 kw and 4 kw cookers	1 x 6 kw 2 x 4 kw
5	3 kw instantaneous water heaters	3
6	4 kw thermostatically controlled water heater	1
7	2 HP air conditioning unit	3
8	100 W energy efficient ceiling fan	6
9	Switch Socket Outlet (SSO) rated 300 W per Nos	14
10	Switch Socket Outlet (SSO) rated 500 W per Nos	3

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Table Q2(b)(i) Diversity allowance

Load Type	Allowance (%)
Lighting / Fan	66 % of total demand
Switch socket outlet	100 % of first largest circuit + 40 % of remaining
AC / heater	100 % of total demand

Table Q3(b)(i): Earthing requirement

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 fuse in 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.