Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	ELECTRICAL POWER SYSTEM
COURSE CODE	:	DAE 32403
PROGRAMME CODE	:	DAE
EXAMINATION DATE	:	JULY 2022
DURATION	:	2 HOURS AND 30 MINUTES
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

Q1 (a) An electrical power system consists of national grid that transmit bulk of electrical energy to commercial and domestic consumers throughout the region.

(i) State main objective of electrical power transmission.

(1 mark)

(ii) Illustrate the electric power system by using appropriate block diagram.

(3 marks)

(iii) List the voltage range for both AC and DC of the extra low voltage (ELV), low voltage (LV) and high voltage (HV) in accordance with the standard IEC 61140:206.

(3 marks)

(b) An electric power distribution system can be classified into **four (4)** types of connection system according to its feeder connection schemes or topologies.

(i) List those all **four (4)** types of the connection systems.

(4 marks)

(ii) Explain **two (2)** advantages and **two (2)** disadvantages in any of **one (1)** type connection system answered in **Q1(b)(i)**.

(4 marks)

(c) Electricity is measured in a unit of true power called Watts (W). For the machine rating, 1 horsepower (hp) is equivalent to 745.7 W. In Malaysia, a tariff rates to the domestic consumers by energy provider Tenaga National Berhad (TNB) is tabulated as below:

TARIFF CATEGORY (Tariff A - Domestic Tariff)	**UNIT**	**RATE**
For the first 200kWh per month	sen/kWh	21.8
For the next 100 kWh (201 - 300 kWh) per month	sen/kWh	33.4
For the next 300 kWh (301 - 600 kWh) per month	sen/kWh	51.6
For the next 300 kWh (601 - 900 kWh) per month	sen/kWh	54.6
For the next kWh (901 kWh onwards) per month	sen/kWh	57.1
The minimum monthly charge is RM3.00		

If a house with one room uses a 1 unit of air conditioner rated at 1.5 hp and 2 units of 100 W light bulbs, run for 8 hours duration every day in January 2022, calculate:

(i) A total usage of electrical energy in kWh.

(6 marks)

(ii) The electricity bill charge amount for that month.

(4 marks)

Q2 (a) Electricity generation is the process of generating electric power from sources of primary energy. List **three (3)** major categories of that energy sources.

(3 marks)

(b) A solar power is the renewable energy method that converts the sunlight into the electricity.

(i) Explain **two (2)** methods of solar power conversion.

(4 marks)

(ii) Explain the working concept of photovoltaic cell together with appropriate related diagram.

(6 marks)

(iii) Construct a schematic diagram of solar power generation plant that uses photovoltaic technology.

(10 marks)

(iv) Is solar energy good for future? Give **one (1)** reason to support your answer.

(2 marks)

Q3 (a) Summarise **two (2)** advantages of one line diagram.

(2 marks)

(b) Evaluate a 100 Ω impedance and 230 $V_{r.m.s}$ voltage as per unit quantities. The base impedance and base voltage are given as 60 Ω and 300 $V_{r.m.s}$ respectively.

(3 marks)

(c) The one-line diagram of a three-phase power system is shown in **Figure Q3(c)**. The three-phase power and line ratings for the system are given in **Table Q3(c)**. By using 50 MVA, 132 kV, 50 Ω in the transmission line L1 as base;

(i) Analyse a new per-unit impedance for each component of the electrical system.

(14 marks)

(ii) Draw reactance diagram based on the values calculated in **Q3(c)(i)**.

(6 marks)

Q4 (a) Summarize a general working concept of the voltage and the current transformers.
(6 marks)

(b) Consider a three-phase, 50 MVA power transformer connected to a current transformer using the differential protection style. Their rating data is stated in **Table Q4(b)**. Analyse:

(i) The circuit by providing a full schematic diagram of the equipment connections.
(5 marks)

(ii) The relay current level at full load capacity.
(5 marks)

(iii) The minimum relay current setting to allow 1.3p.u overload condition.
(1 marks)

(c) List **two (2)** types of unbalanced three phase faults in power system.
(2 marks)

(d) A 'symmetrical components' is a popular method can be used to calculate the unbalanced current and voltage faults rating in the three-phase system.

(i) Obtain the set of symmetrical components of a set of unbalanced currents below.

$$I_a = 1.6\angle 25°,\ I_b = 1.0\angle 180°,\ I_c = 0.9\angle 132°$$

(3 marks)

(ii) Obtain the original set of unbalanced phasors three-phase voltage with set of symmetrical components below.

$$V_a^0 = 0.6\angle 90°,\ V_a^1 = 1.0\angle 30°,\ V_a^2 = 0.8\angle -30°$$

(3 marks)

-END OF QUESTIONS –

FINAL EXAMINATION

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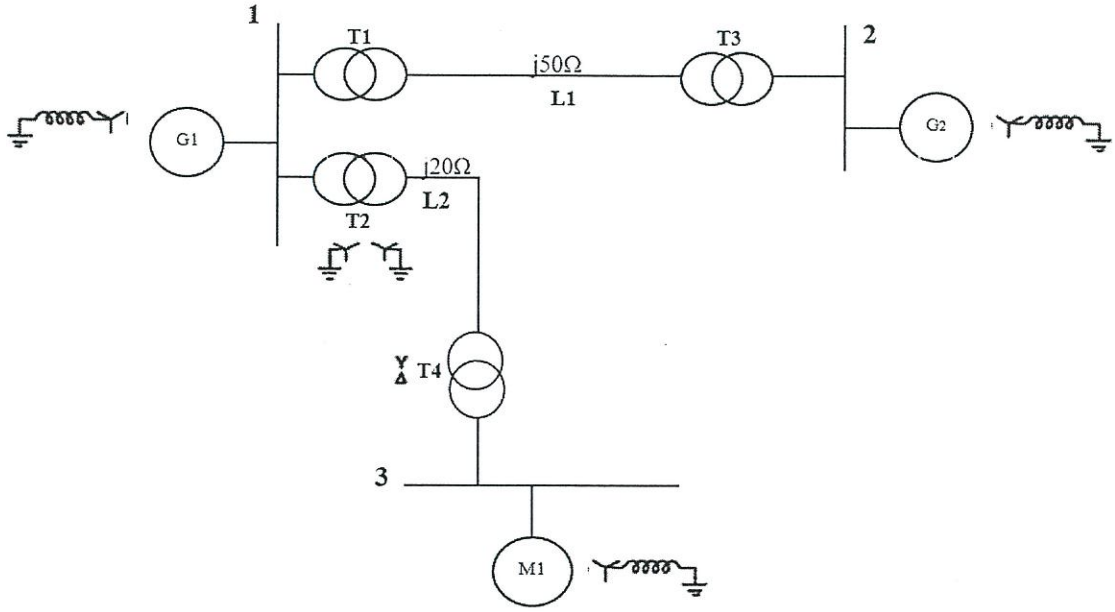

Figure Q3(c)

FINAL EXAMINATION

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Table Q3(c)

Components	MVA Ratings	kV Ratings	X
Generator 1	20 MVA	30 kV	20%
Generator 2	10 MVA	30 kV	20%
Motor 1	30 MVA	2.5 kV	20%
Three-phase Y-Y Transformer (T1, T2 & T3)	20 MVA	33Y/132Y kV	10%
Three-phase Y-Δ Transformer (T4)	15 MVA	132Y/11Δ kV	10%

Table Q4(b)

Equipment	Primary Circuit	Secondary Circuit
Three-phase Transformer (T1)	132 kV / Δ	11 kV / Y
Current Transformer (CT)	500 A / 5 A / Y	5000 A / 5 A / Δ