# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2023/2024

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| COURSE NAME | : | ELECTRICAL POWER SYSTEM |
| COURSE CODE | : | DAE 32403 |
| PROGRAMME CODE | : | DAE |
| EXAMINATION DATE | : | JULY 2024 |
| DURATION | : | 2 HOURS 30 MINUTES |
| INSTRUCTIONS | : | 1. ANSWER ALL QUESTIONS<br>2. THIS FINAL EXAMINATION IS CONDUCTED VIA<br>☐ Open book<br>☒ Closed book<br>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 **EIGHT (8)** PAGES

**Q1** (a) List five (5) sources of renewable electrical energy available to be harnessed other than solar energy.

(5 marks)

(b) Solar energy has become an increasingly popular renewable energy source among Malaysian consumers, with solar PV systems installed to generate electricity and feed excess energy back into the TNB power grid. This not only reduces households' reliance on the grid but also promotes sustainable energy practices. With reference to Malaysia's context, address the following:

(i) Sketch block diagram of the general working principles for the electric power system.

(3 marks)

(ii) Solar PV systems installed by consumers consist of solar panels, inverters, and net energy meters. Demonstrate the working principles of the system based on the components.

(6 marks)

(iii) Explain two (2) advantages and two (2) disadvantages of using solar PV system.

(8 marks)

(c) Mr. Samad has installed solar panel on his rooftop. The panel is 2.56 square meters in size, with 21% efficiency & the area of his residential house gets 7 hours of sun per day. Apply the information given to get the output of the solar panel per day.

(3 marks)

**Q2.** Two loads $Z_1 = 90 + j25\Omega$ and $Z_2 = 40 + j60\Omega$ are connected across a 300-Vrms source, with the frequency of 60Hz;

(a) Compute the following values

(i) Total real and reactive power

(4 marks)

(ii) Power factor at the source

(1 marks)

(iii) Total current.

(2 marks)

(b) (i) Calculate the capacitance of the capacitor connected across the loads to improve the overall power factor from the **Q2(a)(ii)** to 0.9 lagging.

(6 marks)

(ii) Compare the current reduction after installing the capacitor to the system.

(2 marks)

(c) Based on the **Figure Q2.1** below;

(i) Indicate the per-unit values of the following single-line diagram.

(7 marks)

(ii) Draw the impedance diagram. Given $S_{base}$ = 100MVA.

(3 marks)

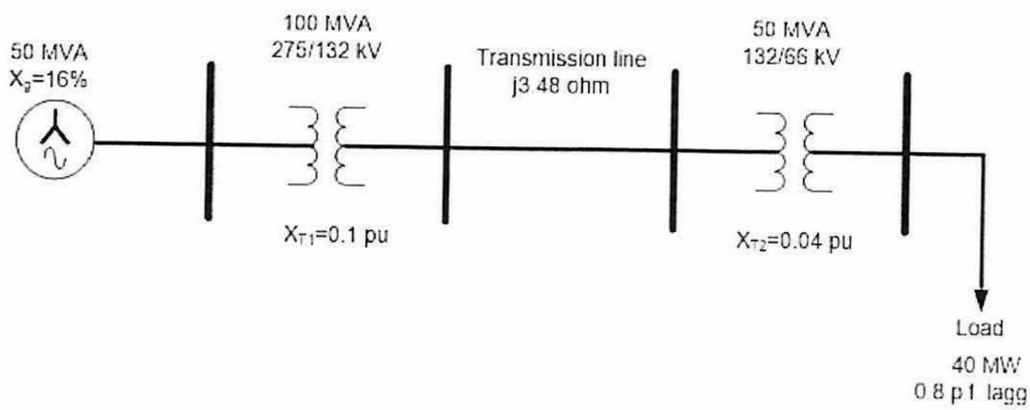


**Figure Q2.1**

**Q3** (a) Power lines made up the important aspect of the electrical power system. Elaborate the factors considered in designing electrical power lines.

(5 marks)

(b) Briefly explain five (5) main components of transmission lines.

(10 marks)

(c) Each conductor of the bundle-conductor line shown in **Figure Q3.1** is ACSR, 1,272,000 cmil Pheasant.
Given the Geometric Mean Radius ($D_s$) = 0.0466 *ft* = 0.0142 *m*

(i) Solve the inductive reactance in Ω/km and in Ω/mile per phase for d = 45 cm.

(6 marks)

(ii) Calculate the per unit series reactance of the line if its length is 160 km and the base is 100 MVA, 345 kV.

(4 marks)

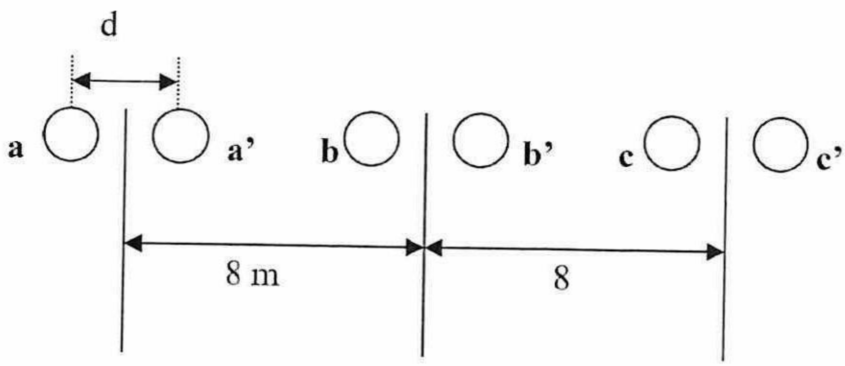


**Figure Q3.1**

**Q4** A typical electrical substation comprises several key components that play vital roles in ensuring the **efficient** and safe distribution of electrical power:

(a) List any two (2) equipments that are commonly found in electrical substations.

(2 marks)

(b) Explain the working concept of equipments in **Q4 (a)** that contribute to the efficient and safe distribution of electrical power.

(4 marks)

(c) The **Figure Q4.1** shows one of the power system protection equipment.

(i) Name this equipment.

(1 mark)

(ii) State one (1) advantage and one (1) disadvantage of this equipment.

(2 marks)

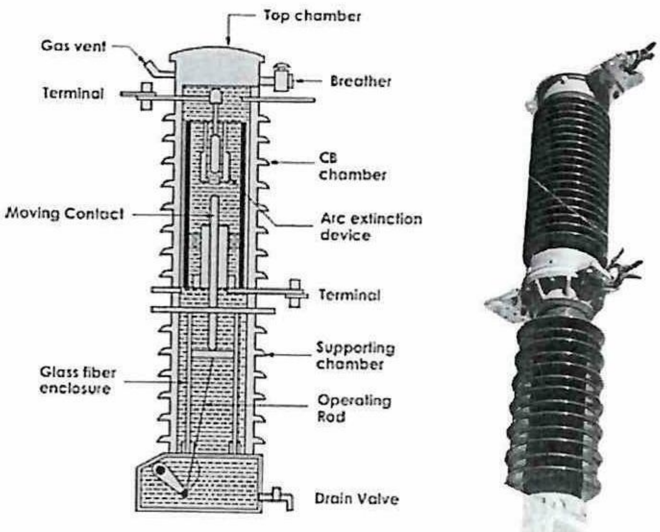


**Figure Q4.1**

(d) Protection zone is defined as the part of the power system which is protected by a certain protective scheme. It is established around each power system equipment. For the following part of power system as in **Figure Q4.2**,

(i) Draw the protective zones.

(4 marks)

(ii) Determine which circuit breaker should open for fault at $P_1$ and $P_2$.

(2 marks)

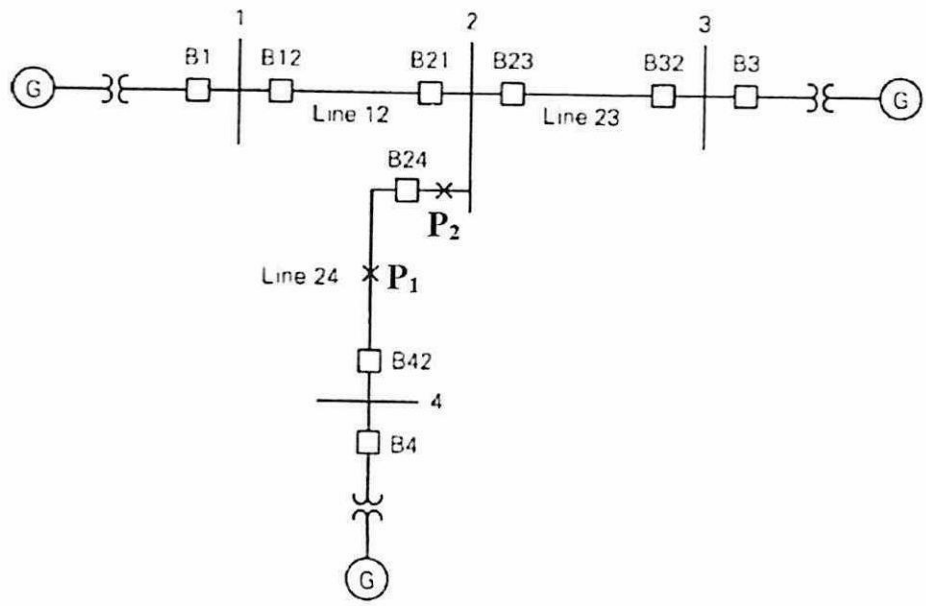


**Figure Q4.2**

(e) In the network system shown in the **Figure Q4.3**, a fault occurs at point **F** on the feeder. Using a base of 100 MVA,

(i) Calculate the 3-phase symmetrical fault current in amperes.

(8 marks)

(ii) Indicate the corresponding fault level (in MVA).

(2 marks)

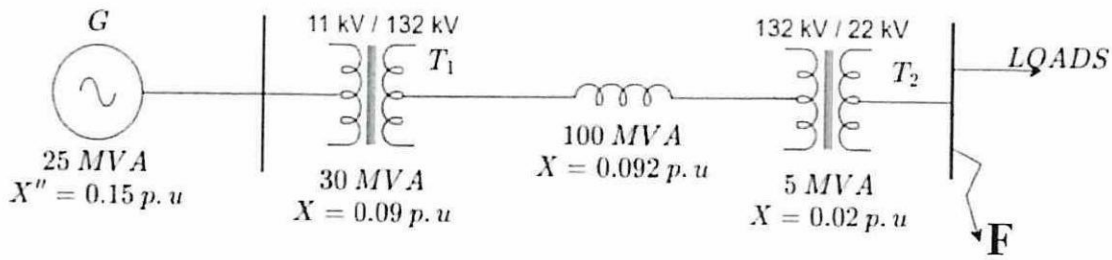


**Figure Q4.3**

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\- **END OF QUESTIONS** –

**APPENDIX : LIST OF FORMULAS**

1. S = VI*

2. $$Z_{pu_{new}} = Z_{pu_{old}} \left( \frac{V_{Base_{old}}}{V_{Base_{new}}} \right)^2 \left( \frac{S_{Base_{new}}}{S_{Base_{old}}} \right)$$

3. $Z_{base} = V_{base}/I_{base} = V^2_{base}/S_{base}$

4. $D_s^b = \sqrt{Ds.d}$

5. $D_s^b = \sqrt[3]{Ds.d.d}$

6. $D_s^b = 1.09.\sqrt[4]{Ds.d.d.d}$

7. $L = 2x\ 10^{-7} \ln \frac{GMD}{GMR} H/m$

   $= 2x10^{-7} \ln \frac{Dm/eq}{Ds} H/m$

8. $C = \frac{2\pi k}{\ln(D/r)} = \frac{2\pi k}{\ln(Deq/Ds)}$ F/m to neutral