Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	POWER SYSTEMS
COURSE CODE	:	BEF 25503
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Summarize **three (3)** main features available in the primary distribution substation.

(3 marks)

(b) Justify the purpose for the size and shape of the metal conductor to be among important elements to be considered in designing the busbars.

(5 marks)

(c) Typically at the entrance point of utilization, the distribution electrical power lines are carried either a three-phase or single-phase AC live voltage, together with a ground or neutral line used for protection purposes.

(i) Construct the schematic diagram of three-phase four wires system referred from the source.

(5 marks)

(ii) Construct the typical system and equipment grounding connections inside a premise being supplied with single-phase two wires AC lines.

(7 marks)

Q2 (a) Summarize a general working concept of the voltage and the current transformers.

(4 marks)

(b) Propose the appropriate circuit breaker placements and the zone of protections for a power system network shown in **Figure Q2(b)**.

(7 marks)

(c) Consider a three-phase, 50 MVA power transformer is connected with a current transformer based on the differential protection style. Their rating data is stated in **Table Q2(c)**.

(i) Analyze the circuit by providing a full schematic diagram of the equipment connections.

(3 marks)

(ii) Analyze the relay current level at full load capacity.

(5 marks)

(iii) Analyze the minimum relay current setting to allow 1.3p.u overload condition.

(1 mark)

Q3 (a) Calculate the ABCD constant for transmission line model that is 50 km long and operates at 50 Hz. Series resistance and inductance of the transmission line is 0.2 Ω/km and 0.3183 mH/km.

(5 marks)

(b) A 220 kV, 200 MVA and 50 Hz, three-phase transmission line is 150 km long completely transposed transmission line has the following positive-sequence impedance and admittance:

$r = 0.11\ \Omega/\text{km}$
$x = 0.90\ \Omega/\text{km}$
$y = 5.0 \times 10^{-6}\ \text{S/km}$

Given the voltage at the receiving end of the transmission line is 200 kV;

(i) Calculate the values of series impedance and shunt admittance of the transmission line.

(2 marks)

(ii) Calculate the sending end line to line voltage if the transmission line is supplying rated apparent power at unity power factor.

(8 marks)

(iii) Calculate the efficiency of the transmission line.

(5 marks)

Q4 (a) Determine the daily average load demand of Factory X having its daily load profiling as in **Table Q4(a).**

(5 marks)

(b) Calculate the mass of uranium fissioned per hour when an atomic reactor delivers 300 MW power if due to fission of each atom $_{92}U^{235}$, the energy released is 200 MeV. Given 1 MeV = 1.6×10^{-19} J.

(5 marks)

(c) (i) Differentiate between the horizontal-axis and vertical-axis type wind turbine systems.

(4 marks)

(ii) Explain briefly the operation of binary cycle (geothermal) energy generation system with the aid of appropriate diagram.

(6 marks)

Q5 (a) By referring to the circuit shown in **Figure Q5(a)**, two parallel loads of Z_1=120 Ω and Z_2=15 + j20 Ω are connected across 250 V_{rms}, 50 Hz source.

(i) Calculate the total real and reactive power, the power factor at the source and the total current.

(6 marks)

(ii) Propose a suitable capacitance value for the capacitor that will be connected across the loads in order to improve the overall power factor to 0.9 lagging.

(4 marks)

(b) A Y connected synchronous generator rated 100 MVA, 13.2 kV has a rated impedance of R = 5% and X_s = 80%. It is connected to a j10 Ω transmission line through a 100 MVA, 13.8/120 kV, Δ - Y three phase transformer. The rated impedance for the three phase transformer is R = 2% and X = 8%.

(i) Construct the one line diagram of this system.

(1 mark)

(ii) Outline the new impedance diagram for this system by using 200 MVA and 120 kV at the transmission line as base.

(9 marks)

- END OF QUESTIONS -

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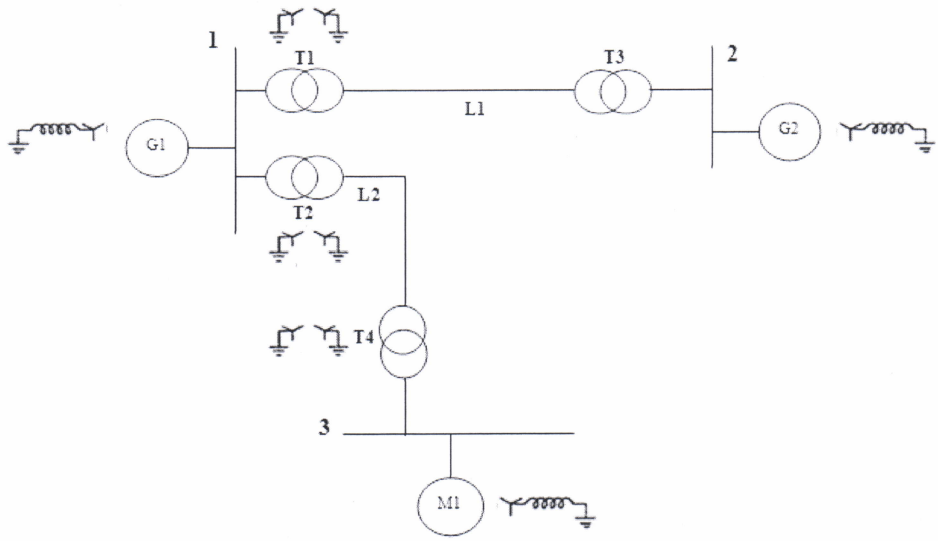

FIGURE Q2(b)

TABLE Q2(c)

Equipments	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

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TABLE Q4(a)

TIME	POWER, P (kW PER HOUR)
9 am – 11 am	200
11 am – 3 pm	100
3 pm – 6 pm	300
6 pm – 10 pm	500
10 pm – 1 am	50
1 am – 6 am	250
6 am – 9 am	100

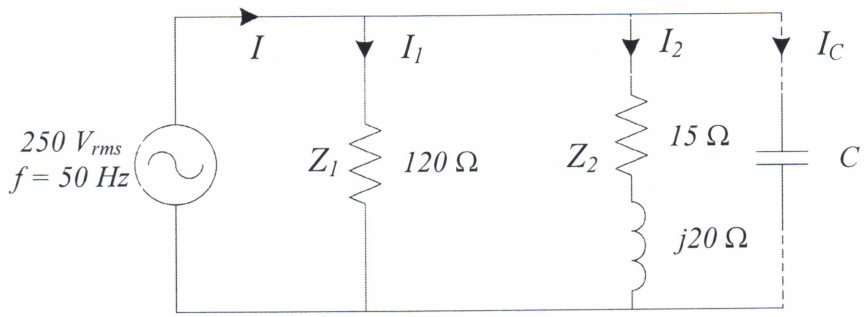

FIGURE Q5(a)