UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	POWER SYSTEMS
COURSE CODE	:	DAR 31603
PROGRAMME	:	3DAR
EXAMINATION DATE	:	DECEMBER 2014/JANUARY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) Draw a representation of the power system layout diagram of Malaysia using standard electrical symbols and voltage range.

(8 marks)

(b) The government of Malaysia has upgraded portions of the national grid system from 275 kV to 500 kV. Briefly describe the reasons for doing that.

(7 marks)

(c) **Figure Q1(c)** shows a one-line diagram of a three-phase power system. Select a common base of 100 MVA and 22 kV on the generator side. Draw an impedance diagram with all impedance including the load impedance marked in per-unit.

(10 marks)

Q2 (a) Draw a functional diagram showing the main parts of a gas turbine driven power plant. Briefly explain the working of the plant.

(8 marks)

(b) Unlike steam turbine and hydro power plant that can start from rest when steam or water reaches the respective turbine. Gas turbine needs to be started by external means. Explain briefly any two methods that can be employed to start the gas turbine.

(8 marks)

(c) Consider a mountain stream with an effective head of 20 meters (m) and a flow rate of 700 liters (ℓ) per minute. Assume plant efficiency (η) of 86%, gravitational acceleration of 9.81 m/s^2. Determine:

(i) How much power could this hydro plant generate
(ii) About how many people will this energy support (assume approximately 2,500 kWh/yr/person)

(9 Marks)

Q3 (a) In Peninsular Malaysia a national grid system was set up to link all the TNB as well as the IPPs power stations together. Briefly describe the merits of having the grid system.

(8 marks)

(b) **Figure Q3(b)** shows a representation of a π network for a medium transmission line. If the line equation can be represented by the matrix equation shown below,

$V_S = AV_R + BI_R$
$I_S = CV_R + DI_R$

Show that the values of A,B,C and D are as follows:

$$A=\left(1+\frac{ZY}{2}\right),\ B=Z,\ C=Y\left(1+\frac{ZY}{4}\right) \text{ and } D=\left(1+\frac{ZY}{2}\right)$$

(8 marks)

(c) A 50 Hz short transmission line, having R = 0.5 Ω per phase and L = 90 mH per phase, supplies a three-phase, star-connected 60 MW load of 0.9 lagging power factor at 132 kV line-to-line voltage. Calculate:
:

(i) The sending end phase voltage
(ii) The voltage regulation at the receiving end
(iii) The power loss per phase in the transmission line

(9 marks)

Q4 (a) With the aid of sketches explain the merits of ring distribution as compared to the radial circuit.

(8 marks)

(b) Draw a construction diagram of a 3-phase, 415V main switch board circuit comprising of the following using standard symbols and practice:

- Three-phase input with pilot lights indication of its presence
- An Air Circuit Breaker (ACB)
- Three-phase switch board bus-bar energized pilot lights indication
- Earth fault and overcurrent relay and CB tripping circuit
- Volt selector switch and voltmeter
- Ammeter selector switch and ammeter
- Outgoing bus-bar or cables

(8 marks)

(c) With reference to **Figure Q4(c)**, which is a typical consumer's LV distribution system. Read the circuit carefully and answer the following:

(i) Two incoming feeders are used in this system. Give two reasons why two feeders are used instead of one feeder

(ii) A standby diesel generator is employed in this system. Why is it needed and can it meet all the load requirements should the two incoming fail to deliver

(iii) The usage of the bus coupler is to connect two bus-bar sections together. However it is normally disconnected. Under what circumstances will the bus-coupler be used? How do you go about using it suppose INCOMING #1 shuts down and INCOMING #2 is required to supply to loads normally supplied by INCOMING #1

(9 marks)

Q5 (a) Draw in each case a vector diagram of a healthy line in terms of voltage to be superimposed with vector diagram of voltage and current due to the following fault:

(i) A line to ground fault occurs at R-phase
(ii) A line-to-line fault occurs between Y and B phases

In both instances briefly outline the reason in which the voltage and current of the faulted line is obtained. Indicate what sort of assumptions made, if any.

(12 marks)

(b) With reference to **Figure Q5(b)**, calculate the short circuit current at the point 'A' in per unit and in actual value when a three-lines to ground fault occurs at the point 'F' of the distribution line. Choose 100 MVA to be the base MVA and 22 kV as base voltage at the generator side.

(13 marks)

Q6 (a) Draw and label a simple magnetic over-current relay and briefly describe how it operates.

(8 marks)

(b) Describe briefly, with the aid of diagram(s), how over-current and earth fault protection is achieved at the star-connected, neutral solidly grounded secondary of a step down transformer in a three-phase power system.

(8 marks)

(c) Describe briefly, with the aid of diagram(s), how you would make use of the over-current relay to achieve a differential protection of a Delta-Star connected substation transformer. Illustrate clearly with the aid of diagram(s) for the case of section earth fault and through earth fault.

(9 marks)

- END OF QUESTION -

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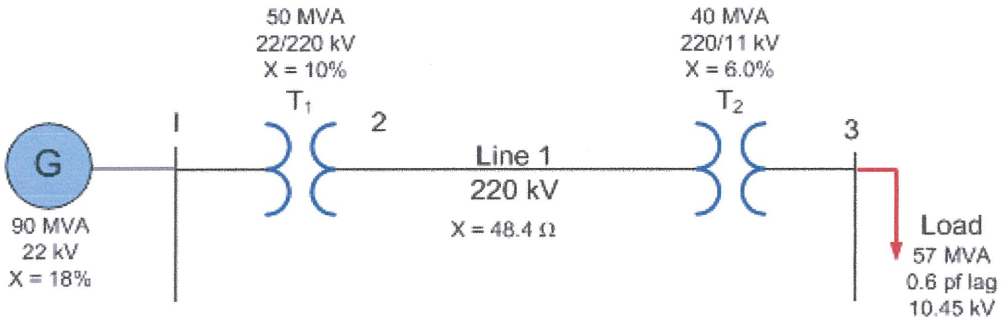

FIGURE Q1(c)

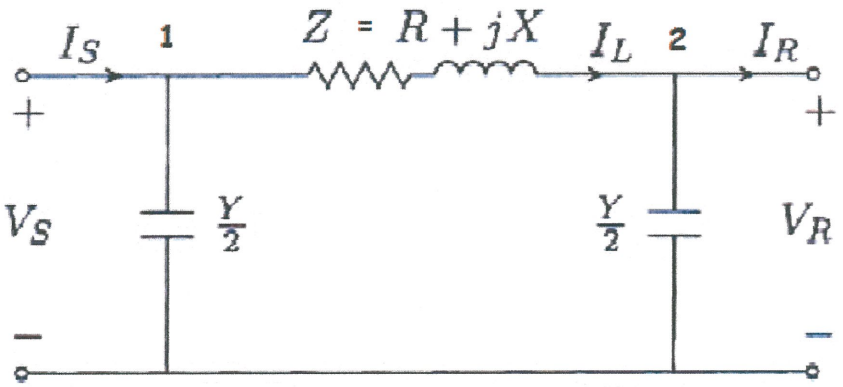

FIGURE Q3(b)

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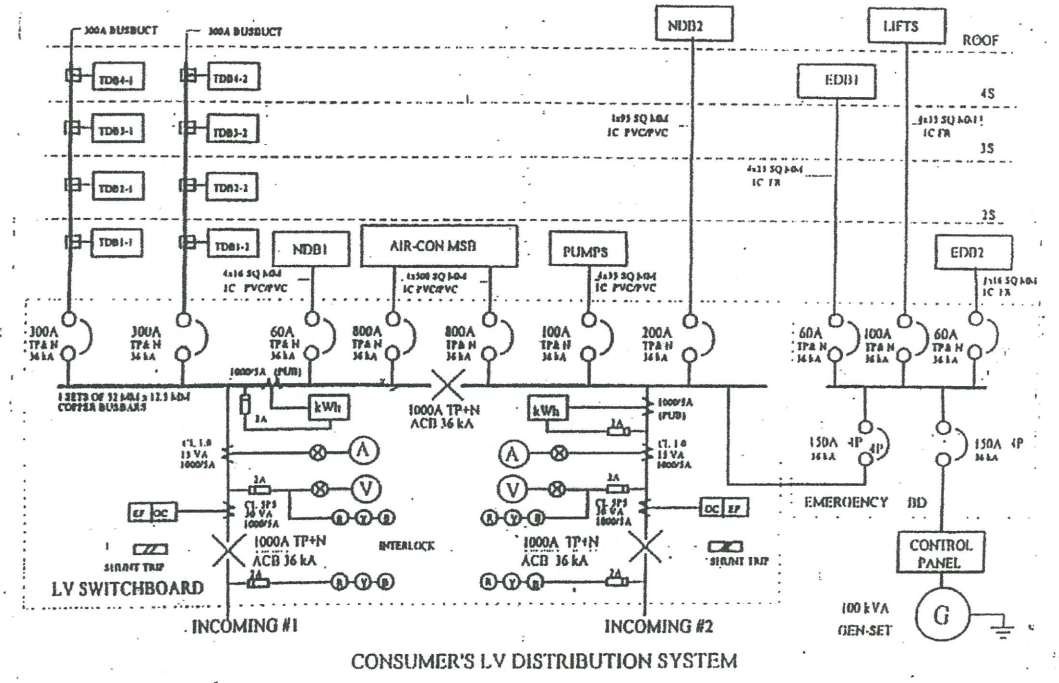

FIGURE Q4(c)

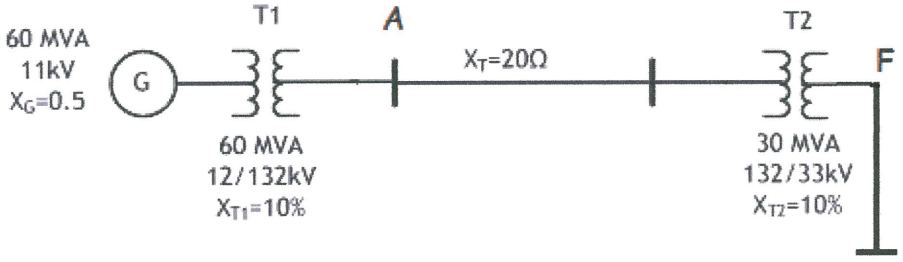

FIGURE Q5(b)