INTI
INTERNATIONAL COLLEGE PENANG (507232-U)
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session : January 2014

Programme : DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

Course : **EEE 2106 ELECTRICAL POWER SYSTEM**

Date of Examination :

Time : Reading Time : Nil

Duration : 2 Hours

Special Instructions :

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non-Programmable Scientific Calculator

Materials provided :

Nil

Examiner(s) : **KEN KONG SENG KUOK**

Moderator :

This paper consists of _5_ printed pages, including the cover page.

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME (DEE/I)

EEE 2106: ELECTRICAL POWER SYSTEM
FINAL EXAMINATION: JAN2014 SESSION

Instructions: This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Find out the supply voltage at the bus bar labeled V_S in the following figure Q1(a).

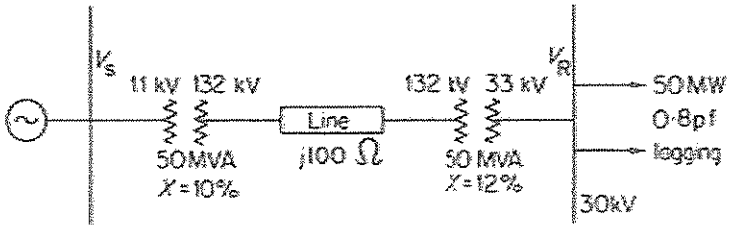

Figure Q1(a): Typical load system

(12 marks)

(b) The system shown in figure Q1(a) is expected to experience voltage drop along the transmission. Find out the requirement of a synchronous condenser that is suitable for maintaining the supply voltage at the bus bar to be 11 kV.

(13 marks)

Question 2

(a) What is the definition of loss less transmission line and surge impedance?

(6 marks)

(b) In the following figure Q2(b), there are two generators connected to a common 6.6 kV busbar and a feeder is taken out through a step-up transformer. Find the ohmic value of the current limiting feeder reactor in order that short circuit current is limited to four times the full load current if there is a 3-phase short circuit just near the reactor.

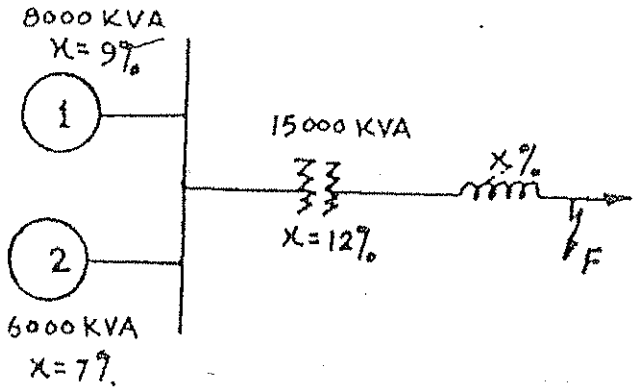

Figure Q2(b): 3-phase fault on a feeder. (14 marks)

Question 3

(a) A transmission line consists of two Lines 1 and 2 connected in series, the Line 1 being at the sending end, Line 2 at the receiving end. Auxiliary constants of lines 1 and 2 are A_1, B_1, C_1, D_1 and A_2, B_2, C_2, D_2 respectively. Find the A, B, C, D constants of the whole line which is equivalent to the two lines in series.

(10 marks)

(b) A 66 kV, 3-phase transmission line is connected to the station busbars at the sending end through a step-up transformer rated at 60 MVA with per unit impedance of (1 + j8)% as shown in the following figure Q3(b). The constants of the transmission line are

$A = D = 0.92\angle 5.3°$

$B = 65.3\angle 81°$

$C = 0.000582\angle 91.7°$

Find the A, B, C, D constants of the equivalent circuit of the line and transformer connected in series. (15 marks)

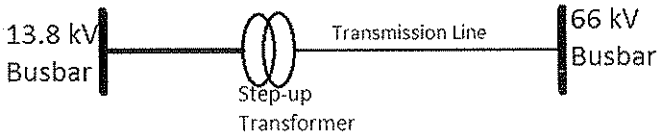

Figure Q3(b): Single line representation

Question 4

(a) A power station has the daily load curve given by the following:

Time (hrs)	12 pm – 7 am	7 – 9 am	9 – 11 am	11 am – 4 pm	4 – 10 pm	10 – 12 pm
Load (MW)	2	10	4.5	7	4	2.5

Plot the following curves:

i. Daily load curve
ii. Load duration curve
iii. Load energy curve

(15 marks)

(b) From the information in part (a), determine the total energy produced per annum and annual load factor if the capacity of the station is 18 MW.

(10 marks)

Question 5

(a) The variable operating cost of three generating units are given by

$F_1 = 350 + 7.20P_1 + 0.0040P_1^2$ RM/hr
$F_2 = 500 + 7.30P_2 + 0.0025P_2^2$ RM/hr
$F_3 = 600 + 6.74P_3 + 0.0030P_3^2$ RM/hr

where P_1, P_2 and P_3 are in MW. The governors are set such that generators share the load equally. Neglecting line losses and generator limits, find the total cost in RM/hr for the following cases

(i) Case 1: Total demand, $P_D = 450$ MW (2 marks)
(ii) Case 2: Total demand, $P_D = 745$ MW (2 marks)
(iii) Case 3: Total demand, $P_D = 1335$ MW (2 marks)

(b) The generating units in question (a) have generating limits (in MW) as follow:

$90 \leq P_1 \leq 150$
$120 \leq P_2 \leq 450$
$200 \leq P_3 \leq 750$

(i) Neglecting line losses, determine the optimal scheduling of generation for each loading as in question (a) using analytical method. (16 marks)
(ii) Find the savings in RM/hr for each case compared to the costs in question (a). (3 marks)

Question 6

A simple three-bus power system single line diagram is shown in the following Figure Q6. All impedances are expressed in per unit on a common 50 MVA base, with the resistances conveniently neglected. All generators are running at their rated voltage, or 1p.u., and rated frequency with their e.m.f.s in phase.

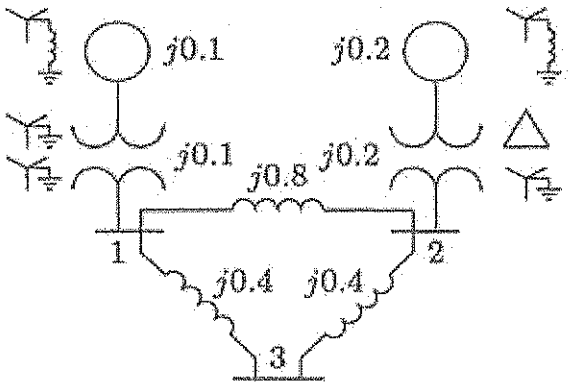

Figure Q6

If a balanced three-phase fault with a fault impedance $Z_f = 0.16$ p.u. occur on Bus 1, find the following in p.u.:

(a) Equivalent impedance of the power system in fault condition (8 marks)

(b) The fault current flowing through Bus 1, assuming all prefault bus voltages are equal to 1.0 p.u. (2 marks)

(c) The bus voltages on all three bus after fault (9 marks)

(d) The short-circuit current in all the lines connecting the buses (6 marks)

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