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INTERNATIONAL COLLEGE PENANG (507232-U)
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session : AUGUST 2014

Programme : DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

Course : EEE 2106 ELECTRICAL POWER SYSTEM

Date of Examination : December 11, 2014 (Thursday)

Time : 5.00pm – 7.00pm 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 : DR. OOI BENG LEE

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: AUG2014 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) A 3-phase transmission line is 300 km in length and has the following parameters:
 Phase resistance per km: 0.16Ω
 Phase reactance per km: $j0.25 \Omega$
 Phase admittance per km: $1.5 \times 10^{-6} \text{ S}$
 Calculate the sending end voltage and current when the line is delivering a load of 20 MW at 0.8 p.f. lagging. The receiving end line voltage is kept constant at 110 kV.
 (15 marks)
- (b) A circuit of a single-phase transmission line is composed of three solid 0.25 cm radius wires. The return circuit is composed of two 0.5 cm radius wires. The arrangement of conductors is shown in the Figure Q1(b) below.
 Find the inductance of the complete line in Henrys per meter.

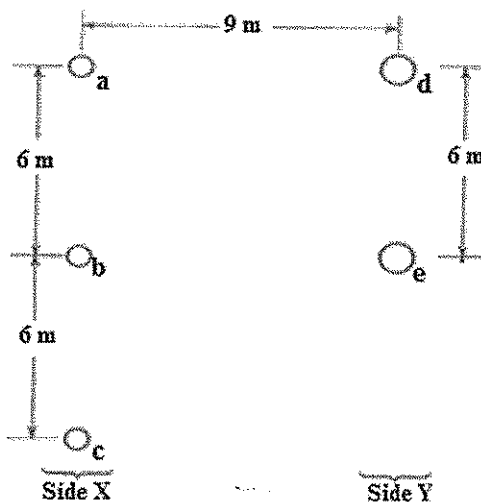


Figure Q1(b): Wire arrangement of a single-phase transmission line (10 marks)

Question 2

- (a) What is the advantage of placing wind turbine at high altitude? Give two advantages and two disadvantages of current wind energy generation method.
 (7 marks)

- (b) A 1,200 kW steam station has the following cost:
 Capital cost: RM 60×10^5
 Annual taxation: RM 1.2×10^5
 Salaries: RM 4×10^5
 The calorific value of coal burnt is 60×10^5 cal/kg and cost of fuel is RM 40 per ton. If the plant heat rate is 30×10^5 cal/kWh at 100% capacity factor and 40×10^5 cal/kWh at 50% capacity factor, calculate the generating cost per unit in each case. Take interest and depreciation charges equal to 12% of capital cost.

(18 marks)

Question 3

- (a) Find out the actual supply voltage at the bus bar labeled V_s in the following Figure Q3(a).

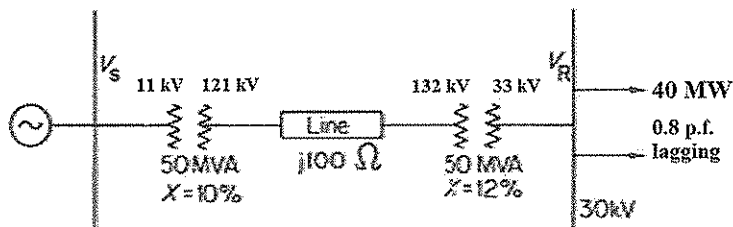


Figure Q3(a): Typical load system

(13 marks)

- (b) The system shown in Figure Q3(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.

(12 marks)

Question 4

- (a) List 5 advantages of per unit system.

(5 marks)

- (b) In the network shown in the Figure Q4(b) a three-phase fault occurs at point F. Calculate the fault MVA at F. The per unit values of reactance given are all referring to a power base of 100 MVA. Resistance may be neglected.

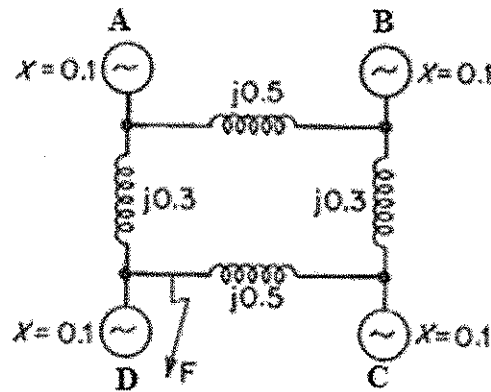


Figure Q4(b)

(20 marks)

Question 5

- (a) Describe the usage of commonly used types of synchronous generators (alternators). (10 marks)

- (b) A supply company offers the following alternative tariffs for a factory:
- i. High voltage (h.v.) supply RM (75 / kVA + 0.03 / kWh)
 - ii. Low voltage (l.v.) supply RM (60 / kVA + 0.04 / kWh)

The annual cost of transformers and switchgears for the h.v. supply are RM 50 per kVA and full load transformation losses are 2%. The annual fixed charges on the capital cost of h.v. plant are 15%. If the factory is run for 8 hours a day, find the number of days for which the factory should be used so that h.v. supply is cheaper than l.v. supply.

(15 marks)

Question 6

- (a) The variable operating cost of three generating units are given by
- $$F_1 = 655 + 6.8P_1 + 0.007P_1^2 \text{ RM/hr}$$
- $$F_2 = 695 + 6.5P_2 + 0.006P_2^2 \text{ RM/hr}$$
- $$F_3 = 755 + 6.0P_3 + 0.005P_3^2 \text{ RM/hr}$$
- If the total load demand varies from 125, 230 and 340 MW, determine the
- (i) incremental operation cost at each demand level, (4 marks)
 - (ii) power output of each unit at the mentioned demand level, (4 marks)
 - (iii) total operating cost, F_T , that minimize F_T for the above-mentioned load demands. (4 marks)

- (b) The two generating units are supplying to the grid as indicated in the following figure, Figure Q6(b). The per unit voltage, current and impedance value are given as follow.

$$I_1 = 1 \angle 0^\circ$$

$$I_2 = 0.8 \angle 0^\circ$$

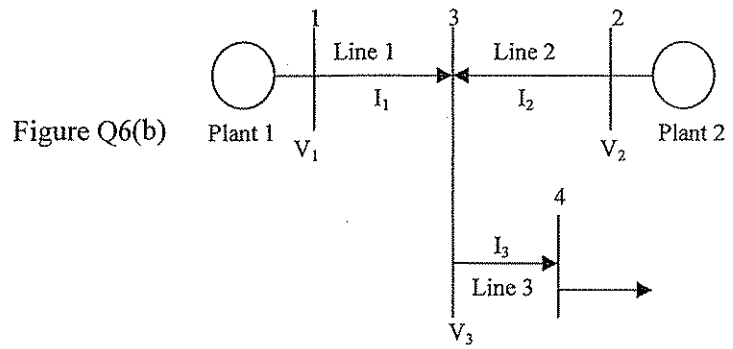
$$V_1 = 1.05 \angle 10^\circ$$

$$V_2 = 1.07 \angle 15^\circ$$

$$Z_1 = 0.05 + j0.2$$

$$Z_2 = 0.06 + j0.3$$

$$Z_3 = 0.06 + j0.4$$



- (i) Find out the system line coefficients, and (6 marks)
- (ii) Determine the penalty factor associated with each generating units. (7 marks)

—THE END—

$$I_1 = 1 \angle 0^\circ$$

$$I_2 = 0.8 \angle 0^\circ$$

$$V_1 = 1.05 \angle 10^\circ$$

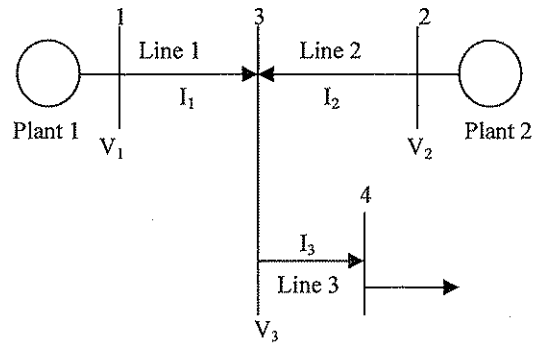
$$V_2 = 1.07 \angle 15^\circ$$

$$Z_1 = 0.05 + j0.2$$

$$Z_2 = 0.06 + j0.3$$

$$Z_3 = 0.06 + j0.4$$

Figure Q6(b)



- (i) Find out the system line coefficients, and (6 marks)
- (ii) Determine the penalty factor associated with each generating units. (7 marks)

—THE END—

EEE2106 (F)/Aug2014/Ken Kong/150814