INTI International College Penang

FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**April 2021**
Programme	:	Diploma in Electrical & Electronic Engineering (DEEI)
Course	:	**EEE2113: Electrical Power Systems & Machines**
Date of Examination	:	26 July 2021 (Monday)
Time	:	8.00am – 11.00am Reading Time : Nil
Duration	:	3 Hours

Special Instructions :

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

Material permitted :
Non-Programmable Scientific Calculator

Materials provided :
Nil

Examiner(s)	:	**Richard Lai TF**
Chief Moderator	:	Alan Wong Kam Mun

*This paper consists of **4** printed pages, including the cover page*

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)
EEE2113: ELECTRICAL POWER SYSTEMS AND MACHINES
FINAL ALTERNATIVE ASSESSMENT: APRIL 2021 SESSION

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

Question 1

(a) A shunt DC motor rotating at 1500 r/min is fed by a 120 V source. The line current is 51 A and the shunt-field resistance is 120 Ω. If the armature resistance is 0.1 Ω, find:

(i) The current in the armature. (2 marks)
(ii) The counter-e.m.f. (3 marks)
(iii) The mechanical power developed by the rotor. (4 marks)

(b) A 75 kVA, 4800/240 V, 60 Hz, single phase transformer has the following parameters expressed in Ohms:

$R_{LS} = 0.006$ $R_{HS} = 2.488$ $R_{fe,HS} = 44.20$
$X_{LS} = 0.012$ $X_{HS} = 4.838$ $X_{M,HS} = 7798$

The transformer is operating in the step-down mode, delivering one-half rated load at rated voltage and 0.96 power factor lagging. Find:

(i) The equivalent impedance of the transformer referred to high side. (9 marks)
(ii) The input impedance of the combined transformer and load. (4 marks)
(iii) The actual input voltage at the high side. (3 marks)

Question 2

(a) The frequency and induced voltage in the rotor of a certain 6 pole wound rotor induction motor, whose shaft is blocked, are 60 Hz and 100 V respectively. Find the corresponding values when the rotor is running at 1100 r/min.

(4 marks)

(b) A certain 3 phase, 460 V, two-pole, 60 Hz, wye-connected synchronous alternator, with a synchronous reactance of 1.26 Ω/phase is connected to an infinite bus. The power angle, when supplying 112 kW to the bus is, 25°. Neglecting the loss, find:

(i) Turbine torque supplied to the alternator in Nm. (2 marks)
(ii) Excitation voltage. (3 marks)
(iii) Active and reactive components of apparent power. (7 marks)
(iv) Power factor. (1 mark)

(c) Define the following torques for the synchronous motor:

(i) Starting torque. (2 marks)
(ii) Running torque. (2 marks)
(iii) Pull in torque. (2 marks)
(iv) Pull out torque. (2 marks)

Question 3

(a) A 150 km, three phase, 110 V, 50 Hz transmission line transmits a load of 40,000 kW at 0.8 p.f. lag at receiving end. Given the following:

Resistance/km/phase = 0.15 Ω, Reactance/km/phase = 0.6 Ω
Susceptance/km/phase = 1×10^{-5}S

Find the A, B, C and D constant of the line by using π method modelling.

(8 marks)

(b) Figure Q3(b) shows the schematic diagram of a radial transmission system. The ratings and reactances of the various components are shown along with the nominal transformer line voltages. A load of 50 MW at 0.8 power factor lagging is taken from 33 kV substation which is to be maintained at 30 kV. Find the sending end voltage V_s using per unit method. Take 100 MVA as base apparent power.

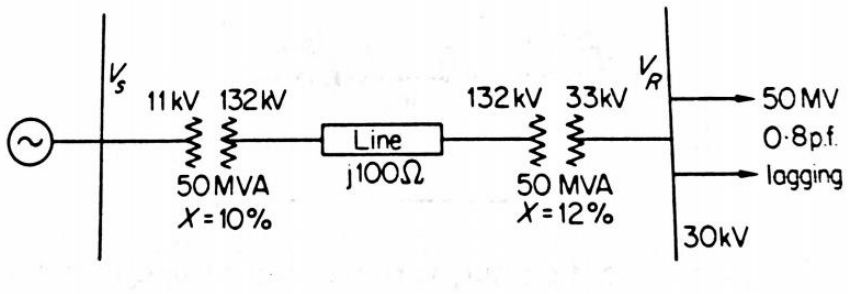

Figure Q3(b)

(11 marks)

(c) An 11.8 kV busbar is fed from three synchronous generators having the following ratings and reactances:

Generator 1: 20 MVA, X' = 0.08 p.u.
Generator 2: 60 MVA, X' = 0.1 p.u.
Generator 3: 20 MVA, X' = 0.09 p.u.

Find the fault current and fault MVA if a three phase symmetrical fault occurs on the bus bar. Take 11.8 kV as base voltage and 60 MVA as base MVA.

(6 marks)

Question 4

(a) A consumer has the following load schedule for a day:

Time	**Power consumption**
12 am - 6 am	200 W
6 am - 12 pm	3000 W
12 pm - 1 pm	100 W
1 pm - 4 pm	4000 W
4 pm - 9 pm	2000 W
9 pm - 12 am	1000 W

Find:

(i) Average power (3 marks)
(ii) Daily load factor (2 marks)
(iii) Demand factor (2 marks)

(b) Explain simple tariff and two part tariff. (5 marks)

(c) The power needs of a large plant are served by three generating units, which have the following incremental cost functions:

$IC_1 = \beta_1 + 2\gamma_1 P_{G1} = 8.8 + 0.01P_{G1}$ \$/MW-h

$IC_2 = \beta_2 + 2\gamma_2 P_{G2} = 10.2 + 0.015P_{G2}$ \$/MW-h

$IC_3 = \beta_3 + 2\gamma_3 P_{G3} = 12.1 + 0.02P_{G3}$ \$/MW-h

Find the opimal economic dispatch for a total power of $P_D = 800$ MW.

(10 marks)

(d) State THREE methods to control the voltage along the transmission (3 marks)

~THE END~