FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session : **April 2022**

Programme : Diploma In Electrical and Electronics Engineering (DEEI)

Course : EEE 2113: Electrical Power & Machines

Date of Examination : 01 August 2022(Monday)

Time : 08.00am-11.00am Reading Time : Nil

Duration : 03 hours

Note: 30 minutes is added into the duration of the examination to factor in any connectivity matters and for you to scan and upload your scripts

Special Instructions :

This paper consists of **FIVE (5)** questions. Answer **ALL** questions in the answer booklet provided.

Material permitted :

Non-Programmable Scientific Calculator

Materials provided :

Nil

Examiner(s) : Lai Tian Fat

Chief Moderator : Alan Wong

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

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DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (DEEI)
EEE 2113: ELECTRICAL POWER & MACHINES
FINAL EXAM: APRIL 2022 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) The armature of a permanent magnet DC generator has a resistance of 1 Ω and generates a voltage of 50 V when the speed is 500 r/min. If the armature is connected to a source of 150 V, find:

(i) the starting current. (3 marks)
(ii) the counter e.m.f. when the motor runs at 1000 r/min. (1 marks)
(iii) the armature current at 1000 r/min. (4 marks)

(b) Sketch the wiring diagrams and schematic diagrams for both the DC shunt and DC series motor. Label all diagrams with appropriate symbols and the DC power supply. (12 marks)

(c) A 25 kW, 250 V DC shunt generator has armature and field resistance of 0.06 Ω and 100 Ω respectively. Find the total armature power developed. (5 marks)

Questions 2

(a) A single phase transformer rated at 3000 kVA, 69 kV/4.16 kV, 60 Hz has a total internal impedance Z_p of 127 Ω, referred to the primary side. Find:

(i) the primary and secondary current. (4 marks)
(ii) the voltage regulation from no-load to full-load for a 2000 kW resistive load, knowing that the primary supply voltage is fixed at 69 kV. (10 marks)

(b) A three phase, 208 V induction motor having a synchronous speed of 1200 r/min runs at 1140 r/min when connected to a 215 V line and driving a constant torque speed load. Find the speed if the voltage increases to 240 V. (7 marks)

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

(i) Starting torque. (2 marks)
(ii) Running torque. (2 marks)

Questions 3

(a) Figure Q3(a) shows the three phase synchronous motor equivalent circuit diagram and its phasor diagram. The motor has a terminal voltage of 400 V, with back e.m.f of 100 V operate at 50 Hz, with inductance of 100 mH. Find:

(i) the torque when the power angle, $\delta = 25°$. (6 marks)
(ii) the maximum torque . (3 marks)

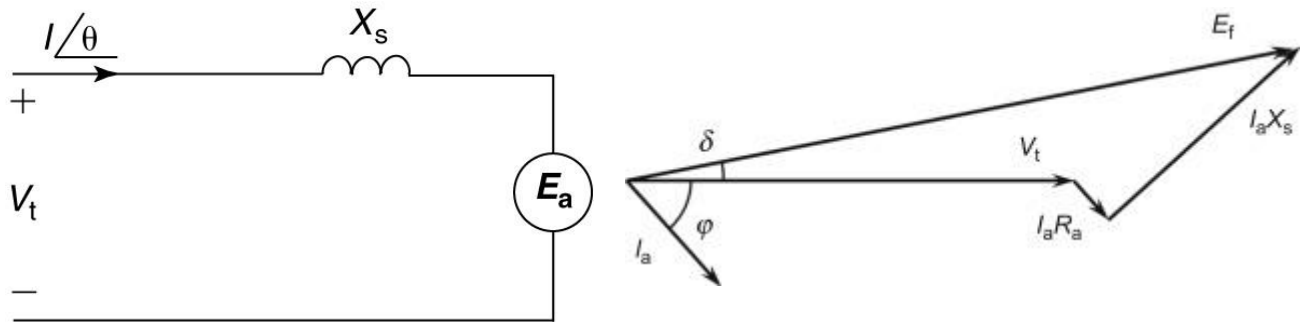

Figure Q3(a)

(b) A network has the following transmission parameters:

A = 1∠30° B = 150 ∠50° Ω
C = 0.02∠-6.8° S D = 3∠0°

Find the input impedance of the network when its output terminals are:

(i) open- circuited. (4 marks)

(ii) short-circuited. (4 marks)

(c) (i) Define the grading of the cable. (1 mark)

(ii) Figure Q3(c) shows the underground cable dielectric grading.

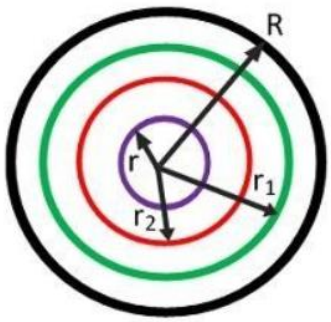

Figure Q3(c)

Prove that: $V_1 = g_{max1} r \ln \frac{r_1}{r}$

(7 marks)

Questions 4

(a) An 11.8 kV busbar shown in Figure Q4(a) is fed from three synchronous generators having the following ratings and reactance:

G1 = 20 MVA, X' = 0.08 p.u.

G2 = 60 MVA, X' = 0.1 p.u.

G3 = 20 MVA, X' = 0.09 p.u.

Find the fault current and MVA if a three phase symmetrical fault occurs at the busbar. The voltage base will be taken as 11.8 kV and the VA base as 60 MVA. Show the equivalent schematics for all your steps.

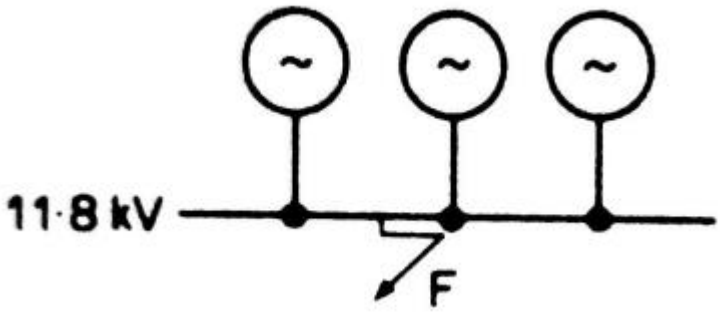

Figure Q4(a)

(12 marks)

(b) State THREE methods to control the voltage in the power system network. (3 marks)

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

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

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

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

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

(10 marks)

~THE END~