

FINAL ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session : April 2021

Programme : Diploma In Mechanical Engineering (DMEN)

Course : EEE 2115: Electrical Power & Machines

Date of Examination : July 29, 2021 (Thursday)

Time : 4.00pm – 6.30pm Reading Time : Nil

Duration : 2 Hours : 30 Minutes

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 :

Answer **ALL** the questions

Materials permitted : Non-Programmable Calculator

Materials provided : Nil

Examiner(s) : Dennis Koh Mui Siang and Alan Wong

Moderator : Johnny Wong

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

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
 EEE 2115: ELECTRICAL POWER & MACHINES
 FINAL ALTERNATIVE ASSESSMENT: APRIL 2021 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

Question 1

- (a) An induction motor draws 25 A from 460 V three-phase line at a power factor of 0.85 lagging. The following data are collected. The stator copper loss and rotor copper loss are 1,000 W and 500 W respectively; Rotational windage and friction losses is 250 W; Core loss is negligible and stray load loss is 200 W.

Calculate

- | | | |
|-------|--------------------------------|-----------|
| (i) | the air gap power | (3 marks) |
| (ii) | the developed mechanical power | (3 marks) |
| (iii) | output horse power | (3 marks) |
| (iv) | efficiency | (1 marks) |
- (b) A 30 hp, 3-phase, 12-pole, 60 Hz, 460 V, induction motor operating at reduced load draws a line current of 35 A, and has an efficiency and power factor of 90% and 79% respectively. The stator conductor loss, rotor conductor loss, and core loss are 837 W, 485 W, and 375 W respectively. Solve for the following:
- | | | |
|-------|--|-----------|
| (i) | sketch power-flow diagram and label the known values | (2 marks) |
| (ii) | input power | (2 marks) |
| (iii) | shaft horse power | (2 marks) |
| (iv) | total losses | (3 marks) |
| (v) | rotor speed | (3 marks) |
| (vi) | shaft torque | (3 marks) |

(Total:25 marks)

Question 2

- (a) The following are questions related to induction motor.
- (i) Explain the meaning of breakdown torque and locked-rotor torque. (4 marks)
 - (ii) Explain under what circumstances (in the aspect of torque quantities) will the rotor be locked. (4 marks)
- (b) The power input to the rotor of a 415 V, 50 Hz, 6-pole, 3-phase induction motor is 75 kW. Under an observation, the rotor voltage is making 120 complete alternations per minute. The stator losses are negligible. Determine the:
- (i) Slip (4 marks)
 - (ii) Rotor speed (5 marks)
 - (iii) Rotor copper loss (4 marks)
 - (iv) Mechanical power developed (4 marks)
- (Total:25 marks)**

Question 3

- (a) A 660 V, 50 Hz, three-phase, four-pole, star-connected, cylindrical rotor synchronous generator has an armature resistance of 0.42Ω per phase and synchronous reactance of 7.2Ω per phase. The mechanical loss and core loss of the synchronous machine are 1.2 kW and 0.3 kW respectively.
- (i) Sketch the corresponding schematic diagram and power flow diagram. (4 marks)
 - (ii) Find the input mechanical power and torque required to supply a line current of 24 A at a lagging power factor of 0.9. (11 marks)
- (b) A star connected synchronous motor of 3-phase, 6,600 V, 50 Hz, is drawing 50 A current. The synchronous reactance per phase is 20Ω . Find the power supplied to the motor and induced emf for a power factor of 0.8 lagging. Given the power angle of the motor is 15° . (10 marks)
- (Total:25 marks)**

Question 4

- (a) A 750 kW, 11 kV, 3-phase, star-connected synchronous motor has a synchronous reactance of 35Ω per phase and negligible resistance. Determine the excitation voltage per phase when the motor is operating on full-load at 0.8 power factor leading with an efficiency of 93%. (10 marks)
- (b) A 100 hp, 3-phase, star-connected, 60 Hz, 420 V, 4-pole cylindrical rotor synchronous motor is operating at rated conditions and at 80% power-factor leading. The efficiency, excluding field and stator losses, is 96%, and the synchronous reactance is 2.72Ω per phase. Determine the:
- (i) Developed torque (4 marks)
 - (ii) Armature current (5 marks)
 - (iii) Excitation voltage (4 marks)
 - (iv) Power angle (2 marks)
- (Total:25 marks)**

-THE END-

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