INTI International College Penang
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FINAL
Examination Paper

(COVER PAGE)

Session	:	JANUARY 2015
Programmes	:	**DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)**
Course	:	**ELECTRICAL MACHINES (EEE2103)**
Date of Examination	:	9 MARCH 2015
Time	:	8.00am – 10.00am 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.

Students are not allowed to remove this question paper from the examination venue.

Materials permitted : Non-programmable calculator

Materials provided: Nil

Examiner(s)	:	**Alan Wong Kam Mun**
Moderator	:	**Dr. Mandeep Singh**

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

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME (DEE)

EEE2103 : ELECTRICAL MACHINES
FINAL EXAMINATION : JAN 2015 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 D.C shunt motor is rated for 230 V, 1350 rpm, 10 hp, $I_L = 37.5$ A, and $I_f = 0.75$ A. It is known that Ra = 0.35 Ω and rotational losses = 519 W at rated speed.

(i) Determine the developed torque, counter emf Ea, and efficiency at the rated condition.
(8 marks)

(ii) For operation at 230 V, with $I_L = 20$ A and field current $I_f = 0.75$ A, calculate the value of developed torque and speed.
(11 marks)

(b) A four pole D.C motor is wave wound with 540 conductors. The armature current is 60 A and the armature circuit resistance is 0.5 Ω. If the flux per pole is 25 mWb, estimate the speed when the motor is connected across a 500 V supply.
(6 marks)

Question 2

(a) An ideal transformer is hypothetical transformer. Draw the circuit diagram for an ideal transformer with a load and explain the transformer's action with reference to the circuit. Indicate all the voltages and current in the circuit. Explain the term emf / turns ratios, rating of a transformer and full-load secondary current.
(9 marks)

(b) A short circuit was performed on a 10 kVA, 2400/240 V transformer with the following data recorded:
$V_{sc} = 138$ V , $P_{sc} = 202$ W , $I_{sc} = 4.17$ A
Calculate in the primary turns:

(i) the equivalent resistance , reactance and impedance.
(6 marks)

(ii) the voltage regulation when supplying full load at a power factor of 0.866 lagging.
(10 marks)

Question 3

(a) Assume that the transformer in Figure Q3 is to be an ideal transformer. The secondary part of the transformer is connected to a load impedance of $5\angle 30^\circ\ \Omega$.
Calculate the primary and secondary:
(i) Currents and their pf.
(ii) Real power.

(7 marks)

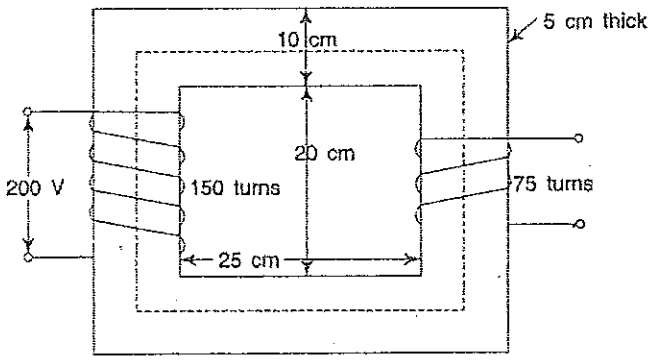

Figure Q3

(b) A 500 kVA transformer has 95 % efficiency at full load and also at 60 % of full load, both at unity power factor.
(i) Separate out the transformer losses.

(9 marks)

(ii) Determine the transformer efficiency at 75 % full load and at unity power factor.

(3 marks)

(c) The electromotive force per turn of a 1-phase 2200/220 V, 50 Hz transformer is 12 V. Calculate the :
(i) Number of primary and secondary turns, and
(ii) Net cross-sectional area of the core for a maximum flux density of 1.5 T

(6 marks)

Question 4

(a) A DC shunt motor connected across a 440 V supply takes an armature current of 20 A and runs at 500 rpm. The armature resistance is 0.6 Ω. If the magnetic flux is reduced by 30 % and the torque developed by the armature increases by 40 %, calculate the value of the armature current and speed of the shunt motor.

(9 marks)

(b) Define interpoles and where are interpoles located in a dc motor?

(4 marks)

(c) A DC series motor operates at 700 rpm with a line current of 80 A from a 230 V mains. Its armature circuit resistance is 0.25 Ω with field resistance of 0.15 Ω. Calculate the speed at which the motor runs at a line current of 20 A, assuming the flux at this current is 30 % of the flux at 80 A.

(12 marks)

Question 5

(a) A 3-phase , 4000 V ,60 Hz, 5000 hp, 4-pole induction motor is operating at 67 % rated load at 4130 V. The breakdown of losses for this load are : stator copper loss 12.4 kW, rotor conductor loss 9.92 kW, core loss 12.44 kW, stray power 10.2 kW, fiction and windage 18.2 kW.

(i) Sketch the power flow diagram with its values.

(5 marks)

(ii) Calculate shaft speed

(7 marks)

(iii) Calculate shaft torque

(3 marks)

(iv) Calculate developed torque

(4 marks)

(v) Calculate input power to stator

(3 marks)

(iv) Calculate overall efficiency

(3 marks)

Question 6

(a) Explain the condition when a synchronous motor operates under normal excitation.

(4 marks)

(b) A 20 kW, 3- phase, Y-connected , 50 Hz, 400 V, 4 - pole synchronous motor is operating at rated condition. It operates with a power angle of 50° and an efficiency of 95 %. The motor has a synchronous reactance of 3 Ω per phase. Determine the:

(i) Active input power, P_{in}

(4 marks)

(ii) Excitation voltage, E_f

(5 marks)

(iii) Armature current, I_a

(8 marks)

(c) What is the effect of increasing the field excitation on the performance of a Synchronous Motor ?

(4 marks)

--THE END--