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CONFIDENTIAL

SET B

UNIVERSITI KUALA LUMPUR

MALAYSIA FRANCE INSTITUTE

FINAL EXAMINATION

JULY 2010 SESSION

SUBJECT CODE	:	FEB 20102
SUBJECT TITLE	:	ELECTRICAL MACHINES
LEVEL	:	BACHELOR
DURATION	:	8.00pm – 10.00pm (2 HOURS)
DATE / TIME	:	19 NOVEMBER 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. Answer four (4) questions only
6. Answer all questions in English.

THERE ARE 5 PRINTED PAGES OF QUESTIONS EXCLUDING THIS PAGE

INSTRUCTION: Answer FOUR questions only.
Please use the answer booklet provided.

Question 1

(a) Explain the meaning of the following term in dc generator :

i. Generated voltage.

(2.5 marks)

ii. Generated power.

(2.5 marks)

(b) The armature winding of a 200 V, 4-pole, series generator is lap connected. There are 300 slot and each slot has 4 conductors. The current is 40 A and the flux produces ia 20 mWb. The armature resistance is 0.4 Ω and the iron loss and friction losses total 800 W. Find the generated torque of this generator.

(8 marks)

(c) A dynamo running at 1000 rpm supplies 22 kW at a terminal voltage of 220 V. The resistance of armature, shunt field are 0.05 Ω and 110 Ω. The overall efficiency at the above load is 88 %. Find :-

i. Copper losses.

(4 marks)

ii. Mechanical losses.

(4 marks)

iii. Input torque.

(4 marks)

Question 2

(a) Shows speed developed by DC series motor equal to :

(5 marks)

$$N = \left(\frac{V_{in}}{\sqrt{K}}\right)\left(\frac{1}{\sqrt{T_g}}\right) - \frac{R_a}{K}$$

(b) A separately excited DC motor is shown in Figure 1. The field current and supply voltage are assumed constant. (10 marks)

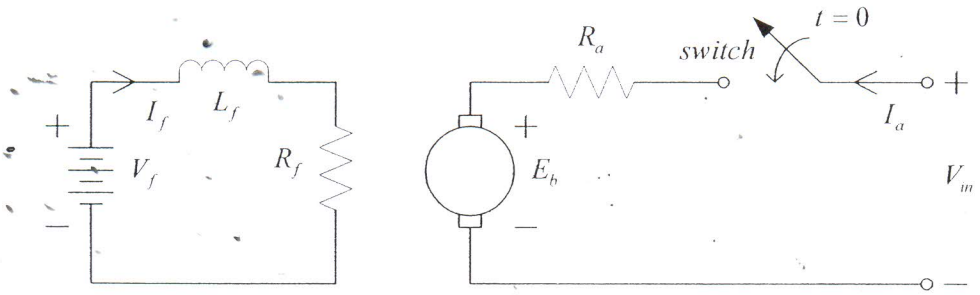

Figure 1

Assuming that, the motor is initially stationary. If the switch loses at t = 0, describe clearly and briefly, using equations to support your explanation on how the motor achieves its steady state speed under no-load conditions. Neglect all losses and armature reaction. Be sure to specify the behavior of armature current and back emf in your description.

(c) A 220 V, 10 kW, 2500 rpm shunt motor draws 41A when operating at rated conditions. The resistance of the armature and shunt field resistance are 0.35 Ω and 110 Ω respectively. Calculate the values of armature current and motor speed if flux is reduced by 25%, a 1Ω resistance is placed in series with armature and the load torque is reduced by 50%. (10 marks)

Question 3

(a) Explain, why a single phase induction motor unable to start itself without special auxiliary winding.

(7.5 marks)

(b) Construct a table showing step size versus number of poles for three-phase phase stepper motor.

(7.5 marks)

(c) A 110 V, 1.5 Hp, 60 Hz, six pole, capacitor start induction motor has the following main winding impedances :

$R_1 = 1.52\ \Omega$ $R_2 = 3.13\ \Omega$

$X_1 = 2.10\ \Omega$ $X_2 = 1.56\ \Omega$

$X_m = 58.2\ \Omega$

At a slip of 0.05, the motor rotational losses are 51 W. Find the following quantities for this motor :

i. Stator current

(5 marks)

ii. Input power

(2.5 marks)

iii. Mechanical power, Pm

(2.5 marks)

Question 4

(a) Show developed mechanical power, P_m is given by

(6 marks)

$$P_m = 3I^2{}_2 R_2 \left(\frac{1-S}{S} \right)$$

(b) An induction motor is running at the rated conditions. If the shaft load is now increased, explain do the following quantities change .

i. Synchronous speed.

(2 marks)

ii. Rotor frequency.

(2 marks)

iii. Rotor copper loss.

(2 marks)

(c) A 3 phase, 50 kW, 415 V, 50 Hz, 4 pole, star connected wound rotor induction motor has per phase equivalent circuit parameter referred to the stator as follows :

$R_1 = 0.35\ \Omega$ $R'_2 = 0.2\ \Omega$, $X_m = 20\ \Omega$

$X_1 = X'_2 = 0.55\ \Omega$

The rotational losses is 1200 W. At a slip of 0.05 .

i. Draw the per-phase exact equivalent circuit and the active power flow chart for this motor.

(4 marks)

ii. Name all the active power and power losses on the flow chart and calculates their values.

(9 marks)

Question 5

(a) Explain, how eddy current effect can be reduced in single phase transformer.

(2 marks)

(b) Describe the purpose and how to perform open circuit test and short circuit test of single phase transformer. (10 marks)

(c) A 200kVA, 11000 / 240 V transformer has been tested to determine its equivalent circuit. The result of the tests are shown in table 1 below.

Table 1

Open circuit test	Short circuit test
V_{OC} = 11000 V	V_{SC} = 1100 V
I_{OC} = 1.0 A	I_{SC} = 833.0 A
P_{OC} = 2.2 k W	P_{SC} = 5.0 k W

All data given were taken from the primary side of the transformer.

i. Find the equivalent circuit of this transformer referred to the low-voltage side of the transformer.

(6 marks)

ii. Determine the transformer's efficiency at 0.8 PF lagging.

(7 marks)

END OF QUESTION PAPER