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UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JANUARY 2014 SESSION

SUBJECT CODE	:	**FED 20103**
SUBJECT TITLE	:	**ELECTRICAL MACHINES**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**2.5 HOURS**
DATE	:	

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 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

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

Question 1

(a) Draw the Self-Excited DC Shunt Generator equivalent circuit and describe the main components .

(5 marks)

(b) The output of the DC shunt generator is 500 A at a terminal voltage of 250 V. If armature resistance is 0.04 Ω and the shunt field resistance is 50 Ω, what is the generated e.m.f ?

(5 marks)

(c) A 4 pole, wave-wound DC shunt generator running at 750 rpm, has armature and field resistances of 0.4 Ω and 200 Ω respectively. The armature has 720 conductors and the flux per pole is 29 mWb. If the load resistance is 10 Ω, determine the terminal voltage of the machine.

(7 marks)

(d) Calculate the efficiency of a 200 V, 100kW DC shunt generator if the resistance of the armature and shunt field are 0.005 Ω and 20 Ω respectively. The iron, friction and windage losses (C) together amount to 3000 W.

(8 marks)

Question 2

(a) Describe various losses occurring in the DC motor and sketch the power stages flow diagram showing input/output power and losses.

(5 marks)

(b) A eight (8) pole, 240 V lap wound DC series motor has 660 armature conductors. The armature and series field resistance are 0.2 Ω and 0.02 Ω. If the flux is 0.3 Wb and the total torque developed is 320 Nm, find:-

(i) Current taken by the motor.

(ii) Speed of the motor.

(10 marks)

(c) A four (4) pole, 250 V, wave connected DC shunt motor delivers 10 kW rated power when running at 1000 rpm. It has a total of 560 armature conductors. The motor draws an armature and shunt currents of 60 A and 1 A respectively.

If the armature resistance is 0.2 Ω, determine :-

(i) Output torque.

(ii) Useful flux.

(iii) Generated torque.

(iv) Mechanical losses.

(v) Motor's efficiency

(10 marks)

Question 3

(a) Describe what is a transformer and state the two types of transformer core. Explain why the core of the transformer is laminated.

(5 marks)

(b) A 20 kVA, 8000/240 V, 60 Hz, distribution transformer has been tested to determine its equivalent circuit. The results of the tests are shown below:

Open circuit test (L.V side) : V_{oc} = 8000 V I_{oc} = 0.214 A P_{oc} = 400 W
Short circuit test (H.V. side) : V_{sc} = 489 V I_{sc} = 2.5 A P_{sc} = 240 W

If the transformer operates at full load:

(i) Find the transformer approximate equivalent circuit, when referred to secondary side.
(ii) Determine the full-load current on the secondary side of the transformer.
(iii) Calculate the primary voltage terminal referred to the secondary side at rated condition and 0.8 lagging power factor.
(iv) Find the total transformer losses at 0.8 lagging power factor.
(v) The efficiency at full load and 0.8 lagging power factor.

(20 marks)

Question 4

(a) Draw the per phase approximate equivalent circuit of a 3–phase induction motor at slip 's' showing all relevant voltage, current and impedance parameters.

(5 marks)

(b) A three-phase, 220-V, 10-hp, 60-Hz, six-pole, wye-connected induction motor has the following per-phase parameters, which are referred to the stator:

$R_1 = 0.3\ \Omega$ $jX_1 = 0.5\ \Omega$
$R_2 = 0.15\ \Omega$ $jX_2 = 0.2\ \Omega$ $jX_m = 15\ \Omega$

The total friction, windage and core losses can be assumed to be constant at 400W, independent of load. While operated at rated voltage and frequency, and at a slip of 2%, determine the following:

(i) Input current and power factor (8 marks)
(ii) Input and output power (4 marks)
(iii) Developed torque in the air gap (4 marks)
(iv) Efficiency of the motor (4 marks)

Question 5

(a) Why a single phase induction motor is not self starting and describe one method to make a single phase induction motor self starting.

(5 marks)

(b) A 0.25 hp, 230 V, 60 Hz, four-pole single-phase induction motor has the following parameters and losses:

$R_1 = 10\ \Omega$ $X_1 = 12.5\ \Omega$
$R_2 = 11.5\ \Omega$ $X_2 = 12.5\ \Omega$ $X_m = 250\ \Omega$

Core-loss at 230V = 35 W;
Friction and windage loss = 10 W.
For a slip of 0.05, determine the following parameters when the motor is running at rated voltage and frequency.

(i) Forward impedance
(ii) Backward impedance
(iii) Stator current
(iv) Power factor
(v) Developed power
(vi) Output power at the shaft
(vii) Speed
(viii) Output (shaft) torque
(ix) Efficiency

(20 marks)

END OF QUESTION PAPER