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SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2011 SESSION

SUBJECT CODE	:	FEB 24083
SUBJECT TITLE	:	ELECTRICAL MACHINES
LEVEL	:	BACHELOR
TIME / DURATION	:	3.30pm – 5.30pm (2 HOURS)
DATE	:	5 MAY 2011

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. Answers should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of FOUR questions. Answer ALL questions.
6. Answer all questions in English.

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

(a) Describe the characteristics of the shunt, series and cumulative compound dc motors. List down 3 applications of each type of these motors. Write your answers in the appropriate columns in Table 1 below.

Table 1

Type of dc motor	Characteristics	Applications
Shunt		
Series		
Cumulative compound		

(12 marks)

(b) A single phase series motor is connected to 240 V, 50 Hz supply has an armature resistance of 0.2 Ω and a series field resistance of 0.3 Ω. Its shaft is connected to a particular load and runs at 24 rev/s when drawing 15 A from the supply.

(i) Determine the generated e.m.f. at this load.

(4 marks)

(ii) Calculate the speed of the motor when the load is changed such that the current is increased to 30 A. Assume that this causes a doubling of the flux.

(8 marks)

(c) A separately excited dc generator with compensating windings is rated at 172 kW, 430 V, 400 A and 1800 revolutions per minute (RPM). Its magnetizing curve is shown in Figure 1 below. The dc generator has the following characteristics as summarised in Table 2 below:

Table 2

Armature resistance, R_A	Field resistance, R_F	Adjustable Field resistance, R_{adj}	Field voltage supply, V_F	Number of turns per pole of field coil, N_F
0.05 Ω	20 Ω	0 – 300 Ω	430 V	1000

(i) If the adjustable field resistance R_{adj} in this generator's field circuit is adjusted to 63 Ω and generator's prime mover is driving it at 1600 RPM, what is this generator's no-load terminal voltage, V_T?

(6 marks)

(ii) What would its voltage be if a 1 Ω load were connected to its terminals?

(4 marks)

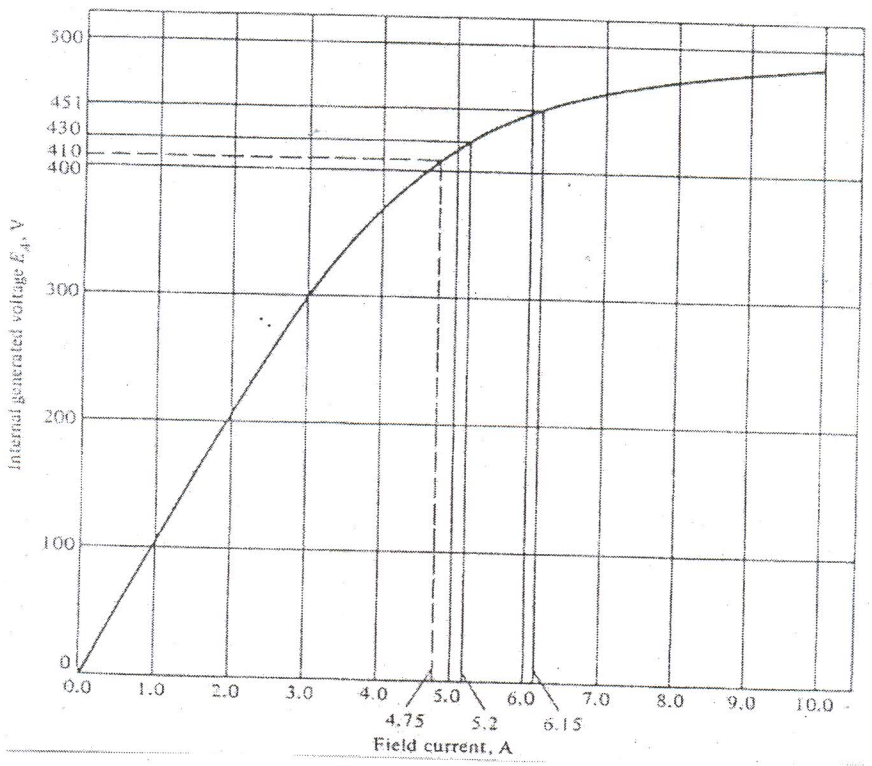

Figure 1: The magnetization curve for the separate excited dc generator

Question 2

The equivalent circuit impedances of a 20 kVA, 8000/240 V, 60 Hz transformer are to be determined. The open-circuit (no-load) test and the short-circuit test were performed on the primary side of the transformer and the following data were taken as summarised in Table 3 below.

Table 3

Types of test	
Open-circuit test (on primary side)	Short-circuit test (on primary side)
Voltage, V_{OC} = 8000 V	Voltage, V_{SC} = 489 V
Current, I_{OC} = 0.214 A	Current, I_{SC} = 2.5 A
Power, P_{OC} = 400 W	Power, P_{SC} = 240 W

(a) Find the impedances, R_C, X_M and the equivalent resistance R_{eq} and equivalent reactance X_{eq} of the approximate equivalent circuit referred to the primary side.

(12 marks)

(b) Sketch the approximate equivalent circuit referred to primary side, indicate the values of the impedances.

(6 marks)

Question 3

A 3-phase, 460 V, 100 hp, 60 Hz, 4-pole induction motor delivers rated output power at a slip of 0.05. Determine

(a) Synchronous speed, N_{syn} and motor speed, N_r.

(b) Speed of rotating air gap field.

(c) Frequency of the rotor circuit.

(d) Slip rpm.

(e) Speed of the rotor field relative to the

  (i) Rotor structure

  (ii) Stator structure

  (iii) Stator rotating field

(f) Rotor induced voltage at the operating speed, if the stator-to-rotor turns ratio is 1:0.5.

(16 marks)

Question 4

(a) List down three advantages of three phase squirrel cage induction motor and wound rotor when comparing one to another.

(6 marks)

(b) Describe three types of single phase motors.

(6 marks)

(c) List down single phase induction motor by comparing and ranking them from best to worst in terms of their starting and running characteristics.

(10 marks)

(d) Briefly, describe the technique can be applied for speed control of single phase induction motor for squirrel-cage rotor motors.

(5 marks)

(e) For a particular application, a three-phase stepper motor must be capable of stepping in 10^{o} increments. How many poles must it have?

(5 marks)

END OF QUESTION PAPER