Mansoura University.
Faculty of Engineering.
Electrical Engineering Dept.

First Semester.
Date: 29-12-2013.
Time: Three Hrs/Two-parts.

Final-Term Exam of (Electrical Machines II-- EE 2312)
For 3rd Grad Electrical Engineering Dept. students.

Answer the following questions and assume any missing data.
الامتحان من جزأين، من فضلك أجب كل جزء من الامتحان في اتجاه مختلف من ورقة الإجابة.

Question № (1):

1-1) **Explain** the term "*synchronization*" and ***enumerate*** the synchronization conditions. ***(5 marks)***

1-2) **Compare** the performance of a synchronous generator connected to an infinite bus with that of an isolated generator operating on its own load. ***(7 marks)***

Question № (2):

The following data were obtained for the OCC of a 10 MVA, 13 kV, 3-phase, 50 Hz, star-connected synchronous generator:

If [A]	50	75	100	125	150	162.5	200	250	300
Voc (line) [kV]	6.2	8.7	10.5	11.6	12.8	13.7	14.2	15.2	15.9

An excitation of 100 A causes the full-load current to flow during the short-circuit test. The excitation required giving the rated current at zero power-factor and rated voltage is 290 A.

i) **Determine** the excitation required when the machine supplies full-load at 0.8 pf lagging by using MMF and Potier methods then calculate the voltage regulation.
ii) **Compare** and **comment** upon the results. ***(11 marks)***

Question № (3):

3-1) **What** are the differences between a "Transformer" and an "Induction motor"? ***(5 marks)***

3-2) **What** is the function of starter? Enumerate the various methods of starting 3-phase induction motors and briefly explain two of them? ***(6 marks)***

3-3) **How** single-phase induction motors are classified; **explain** each type's characteristics, advantages, disadvantages, and applications? ***(6 marks)***

Question № (4):

A 3-phase, Y-connected, 30 hp, 500 V, 4-pole, 50 Hz cage type induction motor, the figures given below give the measurements of line currents, line voltages, and readings of two wattmeters connected to measure the input power:

No-load	500 V	8.3 A	+2.85 kW	-1.35 kW
Blocked rotor	100 V	32 A	-0.75 kW	+2.35 kW

At standstill, the rotor copper loss = half of the total copper loss.

Draw the circle diagram (current scale 1 cm = 16 A, 1 hp = 735.5 W), then **estimate**:

i) Full-load input current, power factor, slip, torque and efficiency.
ii) Starting torque, maximum power factor, maximum torque, maximum slip, maximum input power, and maximum output power.
iii) Half-load input current, power factor, slip, torque and efficiency. ***(15 marks)***

Good Luck *Dr, Mohamed Eid* انظر الجزء الآخر

Mansoura University

Faculty of Engineering — **Third Year Exam.**
Electrical Eng. Dept. — **Time: 1.5 Hours**

"ELECTRIC MACHINE EXAMINATION)-2013 PART (1"

ANSWER ALL THE FOLLOWING QUESTIONS:

1) A doubly excited magnetic system has the self and mutual inductances as follows:

$L_{ss} = 0.6 + 0.20 \cos 2\beta \quad H$

$L_{rr} = 0.75 + 0.30 \cos 2\beta \quad H$

and $L_{sr} = 0.8 \cos \beta \quad H$

a) Draw accurately the nature of the inductances variations with different rotor angular positions (ß = 0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330 ,360) degree.

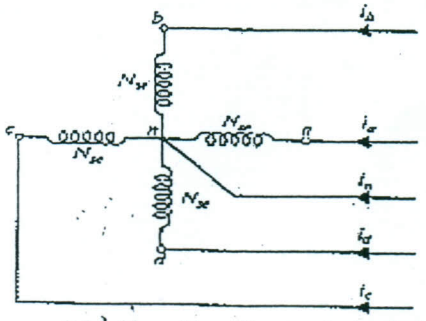
b) If a sinusoidal current of 20 A (r.m.s.) flows in stator winding , find the magnitude and direction of torque for stationary rotor at $\beta = 60^o$, when :

(i) The rotor winding is short-circuited ;

(ii) The rotor winding is open-circuited. [15pts]

2) A cylindrical machine with a 4-phase stator is excited from a 4-phase, 5-wire 50-Hz system of 127 volts line-to-neutral. The machine parameters are:

$N_{se} = 300$, $L_{ss} = 0.07\ H$, $L_{ab} = 0$, *air gap length* $g = 1.5\ mm$



The four windings are sinusoid ally distributed and displaced $\pi / 2$ radians from one another. The winding resistances are negligible. The circuit diagram is shown in the above figure. Assuming negligible reluctance of the ferromagnetic part of the magnetic circuit, Determine:

a) an expression for the flux density produced in the air gap;
b) an expression for the torque produced in the air gap when terminals *c* and *d* are disconnected, and the rotor is assumed carrying two –phase windings short-circuited.
c) as given in part (b), find an expression for the voltage induced in c, and d phases.
d) state how to control the speed of this motor. [20 pts]

3) (a) A 2-phase, 4-pole, 50-Hz , V_{ph} =127 volt, induction motor has the following

parameters referred to the stator side :

$r_s = 0.2\ \Omega$, $r_r = 0.2\ \Omega$, $x_{ls} = 0.4\ \Omega$, $x_{lr} = 0.8\ \Omega$, $x_m = 600\ \Omega$;

Using the exact equivalent circuit, with slip = 0.5 determine;

(i) The rotor voltage and frequency;

(ii) Motor starting torque and current;

(iii) Maximum torque, corresponding current and slip, when the no-load equivalent circuit is shifted to the equivalent circuit supply voltage terminals.

(b) During an unbalanced operation with slip = 0.5, assume the positive and negative current components are, $I_{a1} = 2$ ampere , $I_{a2} = 0.42$ ampere respectively. Calculate the stator currents(I_a , I_b), total power across air gap, mechanical power, and useful torque, Draw the positive and negative equivalent circuits with their parameters and calculated values. [20 pts]

" أنظر ورقة امتحان الجزء الآخر "

Good Luck and Best Wishes
Prof. Dr. A.R.A. Amin