Kafrelsheikh University — Final Exam of 1st semester-2018-2019
Faculty of Engineering — Department of Electrical Engineering
Subject: **Electrical Machine3 (I.M.)** course code: EPM4116 Full Mark: 100 Marks
Year: Fourth Electrical Power (R.2007) Number of pages: 2 Time allowed: 3 hours
Exam Date: 10/1/2019

This exam measure the following ILOS (a.4,13,14 b.11,12,14,15, c.3,16,17, and d.1,2)
Please, answer all of them; assume any missing data; manage your time.

Q1: (20 Marks)

a) How does the induction motor work? [7 Marks]

b) A 0.5 hp, 6-pole induction motor is excited by a 3- phase, 60 Hz source. If the full load speed is 1140 rpm. Calculate and explain the frequency of the rotor under the following conditions:

(*i*)At stand still (*ii*)motor running at 500 rpm in the same direction as the revolving field (*iii*) motor running at 500 rpm in the opposite direction as the revolving field (*iv*) motor running at 2000 rpm in the same direction as the revolving field. [13 Marks]

Q2: (15 Marks)

a) What are the functions of inner and outer winding of double cage induction motor? [5 Marks]

b) A 460 V, 25 hp, 60 Hz, 4-pole, Y-connected induction motor has the following impedances:

$R_1 = 0.641\ \Omega, X_1 = 1.106\ \Omega, R_2 = 0.332\ \Omega, X_2 = 0.464\ \Omega, X_m = 26.3\ \Omega$

Mechanical loss is 100 W and core loss is 1 kW for a slip is 2.2%, find: (i) n, T_d, Is, P_d, P_o, PF, and efficiency. Use exact equivalent circuit. [10 Marks]

Q3: (20 Marks)

a) Both the voltage and frequency induced in the rotor of an induction motor decrease as the rotor speed up. Explain. [5 Marks]

b) A 208-V, 10-hp, 60-Hz, four-pole, Y-connected wound-rotor induction motor develops its full load torque at 3.8 % slip. The motor has the following impedances in ohms per phase referred to the stator circuit: $R_1 = 0.33\ \Omega$, $X_1 = 0.42\ \Omega$, $R_2 = 0.0067\ \Omega$, $X_2 = 0.42\ \Omega$, $X_m = 16\ \Omega$. When it is necessary to stop an induction motor by using *plugging*. Use Thevenin equivalent circuit

(a) What is the slip s before plugging?
(b) What is the frequency of the rotor before plugging?
(c) What is the induced torque before plugging?
(d) What is the slip s immediately after switching the stator leads?
(e) What is the frequency of the rotor immediately after switching the stator leads?
(f) What is the induced torque immediately after switching the stator leads?
[15 Marks]

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Q4: (15 Marks)

a) What are the advantages of skewed slots in the rotor of squirrel cage motor?

b) A 3-phase delta connected cage type induction motor when connected directly to 400 V, 50 Hz supply takes a starting current of 100 A in each stator phase. Calculates:

i) The line current for direct on line starting.

ii) Line and phase starting currents for star-delta starting.

iii) Line and phase starting currents for a 70 % tapping on auto transformer starting.

Q5: (15 Marks)

a) Obtain the equation for starting torque of induction motor & obtain the condition for maximum starting torque.

b) A three phase, 400 V, 14.9 kW induction motor gave the following test readings:

No load test: 400V 9A 1250 W.
Block rotor test: 150V 38A 4 kW.

Find from circle diagram for full load (*i*) Line current (*ii*) Power factor (*iii*) Efficiency (*iv*) slip

Q6: (15 Marks)

During the stator design of a 3 phase, 30 kW, 400volts, 6 pole, 50Hz, squirrel Cage induction motor following data has been obtained. Gross length of the stator = 0.17 m, Internal diameter of stator = 0.33 m, Number of stator slots = 45, Number of conductors per slot = 12. Based on the above design data design a suitable rotor.

With my best wishes
Dr. Eng./Mohamed I. Abd EL_Wanis