Kafrelsheikh University — Final Exam of 1st semester-2016-2017
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: 31/12/2016

Answer as much as you can

Q1: (20 Marks)

a) Construct the Thevenin circuit parameters, Thevenin torque and write your Matlab code to determine the torque-speed characteristics.

b) A 50-kW 440-V 50-Hz two-pole induction motor has a slip of 6 percent when operating at full-load conditions. At full-load conditions, the friction and windage losses are 520 W, and the core losses are 500 W. Find the following values for full-load conditions: (a) The shaft speed nm (b) The output power in watts (c) The load torque load in N-m (d) The induced torque in N-m (e) The rotor frequency in hertz

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Q2: (15 Marks)

a) State the effects of increasing rotor resistance on starting current, starting torque, maximum torque and full-load slip of an induction motor.

b) A 460-V 50-hp six-pole Δ-connected 60-Hz three-phase induction motor has a full-load slip of 4 percent, an efficiency of 91 percent, and a power factor of 0.87 lagging. At start-up, the motor develops 1.75 times the full-load torque but draws 7 times the rated current at the rated voltage. This motor is to be started with an autotransformer reduced voltage starter. (a) What should the output voltage of the starter circuit be to reduce the starting torque until it equals the rated torque of the motor? (b) What will the motor starting current and the current drawn from the supply be at this voltage?

Q3: (20 Marks)

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

b) A three-phase, 6-pole, 10 HP, 400 Hz induction motor has a slip of 3% at rated output power. Friction and windage losses are 300 W at rated speed. The rated condition total core losses are 350 W. $R_1=R'_2 = 0.05\ \Omega$. $X_1 = X_2 = 0.15\ \Omega$. If the motor is operating at rated output power, speed, and frequency, find (a) rotor speed, (b) frequency of rotor currents, (c) total power across the air gap, (d) efficiency, and (e) applied line voltage. Use the approximate equivalent circuit for analysis.

Q4: (15 Marks)

a) What is DC Dynamic Braking?

b) The use of a 10 hp, 60 Hz,1760 r/min, 440 V, three-phase induction motor as an asynchronous generator. The full-load current of the motor is 10 A and the full-load power factor is 0.8. Required capacitance per phase if capacitors are connected in delta, what is the prime mover typically speed.

Q5: (15 Marks)

A 440-V, 3-φ, 4-pole, 50-Hz slip-ring motor gave the following test results:

No-load reading : 440 V, 9 A, p.f. = 0.2

Blocked rotor test : 110 V, 22 A, p.f. = 0.3

The ratio of stator to rotor turns per phase is 3.5/1. The stator and rotor Cu losses are divided equally in the blocked rotor test. The full-load current is 20 A. Draw the circle diagram and obtain the following:

(a) Power factor, output power, efficiency and slip at full-load

(b) Standstill torque or starting torque.

(c) Resistance to be inserted in the rotor circuit for giving a starting torque 200 % of the full-load torque. Also, find the current and power factor under these conditions.

Q6: (15 Marks)

A 415 V, 3-phase, 50 Hz, 6-pole delta connected induction motor has a specific magnetic loading of 0.5 Wb/m2 and specific electric loading of 24000 A/m. the stator core diameter and length are 0.275 m and 0.15 m respectively. Find the output of the machine if the full load efficiency and power factor are 0.88 and 0.89 respectively. Determine the number of stator slot, conductor per slot and the length of air gap.

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