Course: Electric Drives I **Code:** EE424 **Semester:** 2nd 2014/2015

Dr. Rania Assem **Eng:** Ahmed Hebala

Sheet (4)

DC Motor PE Control

Q.1 (Sharkawi Ex5.2 P.137)

A 50 hp, 60 Hz, three-phase, Y-connected induction motor operates at full load at a speed of 1764 rpm. The rotational losses of the motor are 950 W, the stator copper losses are 1.6 kW, and the iron losses are 1.2 kW. Compute the motor efficiency.

Q.2 (Sharkawi Ex5.3 P.140)

A 50 hp, 440 V, 60 Hz, three-phase, four-pole induction motor develops a maximum torque of 250% at slip of 10%. Ignore the stator resistance and rotational losses. Calculate the following:

a. Speed of the motor at full load
b. Copper losses of the rotor
c. Starting torque of the motor

Q.3 (Sharkawi Ex5.4 P.143)

An induction motor has a stator resistance of 3 Ω, and the rotor resistance referred to the stator is 2 Ω. The equivalent inductive reactance $X_{eq} = 10\ \Omega$. Calculate the change in the starting torque if the voltage is reduced by 10%. Also, compute the resistance that should be added to the rotor circuit to achieve the maximum torque at starting.

Q.4 (Sharkawi Ex7.1 P.191)

A three-phase, Y-connected, 30 hp (rated output), 480 V, six-pole, 60 Hz, slip ring induction motor has a stator resistance $R_1 = 0.5\ \Omega$ and a rotor resistance referred to stator $R'_2 = 0.5\ \Omega$. The rotational losses are 500 W and the core losses are 600 W. Assume that the change in the rotational losses due to the change in speed is minor. The motor load is a constant-torque type. At full-load torque, calculate the speed of the motor. Calculate the added resistance to the rotor circuit needed to reduce the speed by 20%. Calculate the motor efficiency without and with the added resistance. If the cost of energy is $0.05/kWh, compute the annual cost of operating the motor continuously with the added resistance. Assume that the motor operates 100 hours a week.

Q.5 (Sharkawi Ex7.5 P.210)

For the motor given in Example 7.1, assume that the load torque is constant and equal to 120 Nm. Ignore the rotational losses and calculate the motor speed at full voltage. Repeat the computation if the voltage is reduced by 20%.

Q.5 (Sharkawi Ex7.6 P.213)

A 480 V, two-pole, 60 Hz, Y-connected induction motor has an inductive reactance of 4 Ω and a stator resistance of 0.2 Ω. The rotor resistance referred to the stator is 0.3 Ω. The motor is driving a constant-torque load of 60 Nm at a speed of 3500 rpm. Assume that this torque includes the rotational components.

a. Compute the maximum frequency of the supply voltage that would not result in stalling the motor.
b. Calculate the motor current at 60 Hz, and at the maximum frequency.
c. Calculate the power delivered to the load at 60 Hz, and at the maximum frequency.

Q.6 (Sharkawi Ex7.7 P.213)

Repeat Q.5 if the frequency is decreased to 50 Hz

Q.7 (Sharkawi Ex7.8 P.213)

Repeat Q6 but with 50 Hz and constant V/f ratio.