Kafrelsheikh University — Final Exam of september-2018-2019
Faculty of Engineering — Department of Electrical Engineering
Subject: **Elective Course 2 (Electrical Drives)** course code: EPM4120 Full Mark: 90 Marks
Year: Fourth Electrical Power (R.2007) Number of pages: 2 Time allowed: 3 hours
Exam Date: 31 /12/2018

This exam measure the following ILOS (a.19, b.15, c.15, and c.17)

Please, answer all of them; assume any missing data; manage your time.

Q1: (15 Marks)

a) List the factors affecting the selection of electric drives. [5 Marks]

b) A motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with u=0.1 and efficiency of 0.9. The load has a moment of inertia of 10 kg.m^2 and torque of 10 N.m. Other load has translational motion and consists of 1000 kg weight to be lifted up at a uniform speed of 1.5 m/s. coupling between this load and the motor has an efficiency of 0.85. Motor has inertia of 0.2 kg.m^2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred to the motor shaft and power developed by the motor. [10 Marks]

Q2: (15 Marks)

(a) Draw a typical temperature rise–time curve and derive equation for temperature rise in an electric drive. [5 Marks]

(b) A drive has following parameters: J =10 kg.m^2, T_d = 100 - 0.1 n, T_L = 0.05 n N.m. where n is the speed in rpm.

Initially the drive is operating in steady state. Now it is to be reversed. For this motor characteristic is changed to T = -100 – 0.1 n N.m. Calculate the time of reversal. [10 Marks]

Q3: (20Mark)

(a) What is meant by Ward Leonard method? [5 Marks]

(b) A 500 V, 45 kW, 600 rpm dc shunt motor has full load efficiency of 0.9. The field resistance is 200 Ω. The field current is maintained constant. Armature reaction and brush drop may be neglected. Calculate the rated armature current and hence, find the speed under each of the following conditions at which the machine develops an electromagnetic torque equal to the rated value.

i. regenerative braking
ii. Plugging with external resistance of 5.5 Ω.
iii. Dynamic braking with external resistance of 2.3 Ω. [15 Marks]

Q4: (20 Marks)

(a). Draw the 4-quadrant chopper drive circuit and wave forms [10 Marks]

(b) A 15-hp 220-V 2000-rpm separately excited dc motor controls a $T_L = 45$ N.m at a speed of 1200 rpm. The field circuit resistance is $R_f = 110\ \Omega$, the armature circuit resistance is $R_a = 0.25\ \Omega$, and $k_v = 0.7032$ V/A-rad/s The field voltage is $V_f = 220$ V. The viscous friction and no-load losses are negligible. The armature current may be assumed continuous and ripple free. Determine the (a) E_g; (b) required armature voltage, V_a and (c) rated armature current of the motor. [10 Marks]

Q5: (20 Marks)

a) Compare between rotor voltage injection and voltage / frequency technique for controlling the induction motor speed. Support your answer with speed-torque and speed-current curves in each case. [7 Marks]

b) 380V, two-poles, 50Hz, Y-connected induction motor has an inductive reactance of 2.64Ω and a stator resistance of 0.034Ω. The rotor resistance referred to the stator is 0.05Ω. The motor is driving a constant-torque load of 70 N.m at speed of 3000 RPM. Assume that this torque includes the rotational components. Calculate the maximum and minimum setting frequency of the variable frequency drive (VFD) if the maximum allowed current of the motor is 115% of the motor starting current? [13 Marks]

With my best wishes

Dr. Eng./ Mohamed I. Abd EL_Wanis

Dr. Eng./ Shref emam