Menoufiya University *Faculty of Engineering* *Shebin El-Kom* *May Examination* *Academic Year: 2014-2015*	*Year: M. Sc.* *Department: Electrical Engineering* *Subject: Theories of Electrical Machines, ELE 602* *Time Allowed: 3 hours* *Date: 30/5/2015*

Allowed Tables and Charts: None

Answer only (5) of the following

Question (1) ***(20 Marks)***

Transform the balanced two – phase induction machine of *Figure Q1a* to axes stationary relative to the stator as shown in *Figure Q1b*.

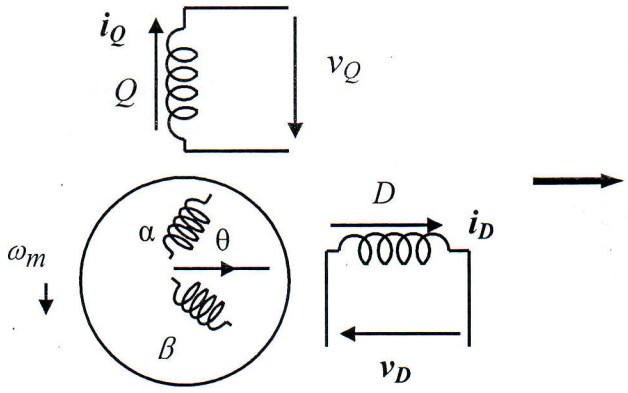

Figure Q1a

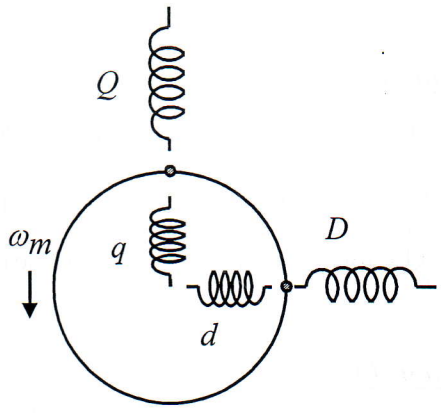

Figure Q1b

Question (2) ***(20 Marks)***

Write the basic voltage equations of a two phase salient pole synchronous machine, shown in Figure p2. Find the different inductances stated in voltage equations. Examine the machine when the axis of α – phase winding coincide with that of the D winding. Examine the machine when the axis of α – phase winding is perpendicular to that of the D winding.

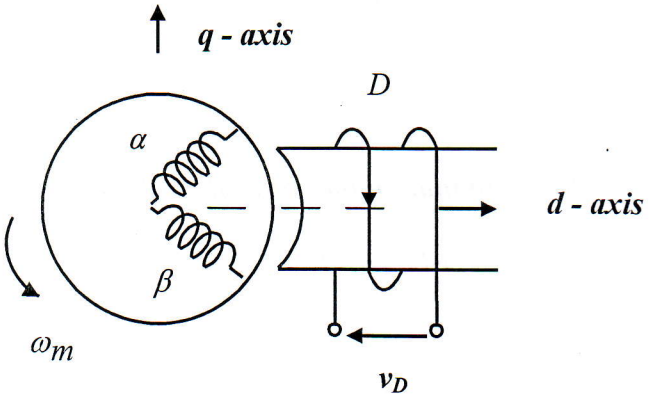

Figure p2

Please turn over

Question (3) ***(20 Marks)***

A 2.2 kW, 400 V, 3 – phase, 50 Hz, 1500 rpm, squirrel cage induction motor is to be started by a star – delta starter. This motor has the following constants: $R_1 = 8.37\ \Omega$, $R_2' = 7.83\ \Omega$, $x_1 = 18.4\ \Omega$, $x_2' = 18.4\ \Omega$, $X_m = 400\ \Omega$. The full load slip is 5.3%. Determine the full load electromagnetic torque, stator input current and power factor using both (i) approximate and (ii) exact equivalent circuits, as well as (iii) the general machine theory. Neglect both iron and mechanical losses.

Question (4) ***(20 Marks)***

Calculate the torque of a 3 – phase, 4 - pole induction motor, 50 Hz when it is fed from: (i) symmetrical 3 phase 400 V supply at 0.05 slip, (ii) asymmetrical 3 phase voltages to neutral, and running with the same speed where the three voltages are $V_a = 240\angle 0^\circ$, $V_b = 183\angle 228^\circ$, $V_c = 183\angle 132^\circ$, and motor parameters are $x_s = x_r' = 4\,\Omega$, $R_s = R_r' = 1\,\Omega$, $X_m = 100\,\Omega$.

Question (5) ***(20 Marks)***

A balanced, star - connected, three – phase induction machine has $R_s = R_r' = 1\ \Omega$, $X_s = X_r' = 110\ \Omega$ and $X_m = 100\ \Omega$. Find the electromagnetic torque curve for s = 0.9 and balanced supply voltage of 400 V (line), 50 Hz, using both (i) classical theory and (ii) general machine theory.

Question (6) ***(20 Marks)***

A 2 – phase, 4 – pole servomotor has the following parameters per phase $R_S = 350\ \Omega$, $R_r' = 250\ \Omega$ $x_S = x_r' = 50\ \Omega$, $X_m = 900\ \Omega$. This motor is operated with 115 V across the reference winding *(phase A)*, and 75 V across the control winding *(phase B)*, the latter leading the former by 90°. Calculate the stator currents, output power, and motor - shaft torque at a slip of 0.5. The rotational losses under conditions given above are 0.7 W. Both the windings have equal number of turns.

Good Luck Every One

This examination measures the following ILOs

Question number	1	2	3	4, 6	5,6
Ilos	*a1-1, a3-1*	*b1-2, b2-1*	*C4-1*	*b1-2, b2-1*	*a1-1, a3-1, d2-1*