Assignment - 1 (part-2)

Q1. A 400 V, 50 Hz, 945 rpm star connected squirrel cage induction motor has the following parametes:

$$R_1 = 2.0\ \Omega,\ r'_2 = 2.0,\ X_1 = 3.0\ \Omega,\ X'_2 = 4.0\ \Omega$$

Neglect the effect of the magnetizing branch and rotational losses (i.e assume X_m, R_c to be infinite)

The motor is connected to a three phase, 50 Hz ac supply. Determine the magnitude (rms) of stator voltage to be applied to the motor to drive a load at 800 rpm. The torque requirement of the load to run at 800 rpm is equal to half the rated torque of the motor. Find also the current that the motor will draw from the supply while driving this load.

Q2. A 400 V, 50 Hz, 1480 rpm, 3-phase, delta connected squirrel cage induction motor has the following parameters per phase referred to the stator:

$$R_1 = 0.0\ \Omega,\ ,\ X_1 = 0.0\ \Omega,\ X_m = 150\ \Omega,\ r'_2 = 0.145\ \Omega,\ X'_2 = 4.0\ \Omega$$

Neglect the effect of the rotational losses (i.e assume R_c to be infinite)

The machine is connected to a 400 V, 50 Hz three phase supply and is found to rotate in anticlockwise direction when viewed from a particular end of the machine. It is also found that the machine is developing 0.8 times the rated torque, however the direction of the developed torque is clockwise when viewed from the same end of the machine. Find the speed of the machine and the magnitude(rms) of the per phase stator current. Find the phase angle between the per phase stator current and the per phase stator voltage and subsequently represent it by drawing a phasor diagram showing the per phase stator current phasor and the per phase stator voltage phasor.

Q3) A 6 pole, 50 Hz, three phase, squirrel cage induction motor has per phase rotor resistance referred to the stator, $r'_2 = 0.25\Omega$ and it can develop maximum torque (T_{max}) of magnitude 10 Nm at 875 rpm while it is fed with rated voltage. Calculate the torque that will be developed when the slip is 5% and the stator is fed with rated voltage. Neglect stator impedance (i.e. $R_1 = X_1 = 0, X_m = \infty$) and rotational losses.

Q4) A 7.5 kW, 200 V, 50 Hz, 1480 rpm, delta connected, wound field induction motor has the following per phase parameters referred to the stator:

$R_1 = 0.1\Omega, X_1 = 0.21\Omega, X_m = \infty, R_2' = 0.145\Omega$ and $X_2' = 0.21\Omega$.

Per phase stator to rotor turns ratio (N_s/N_r) is 1. The machine is operated with rated voltage and frequency.

1) Find per phase external rotor resistance to be inserted so that the starting torque of the machine becomes equal to its rated torque.
2) Find per phase external rotor resistance to be inserted so that the machine runs at 1000 rpm while developing the rated torque.

Neglect rotational losses of the machine.

Q5) Ph-A, Ph-B and Ph-C stator windings (distributed) of a 2-pole three phase induction motor are energized by three currents which are shown in the figure. Mmf distribution of an individual phase is sinusoidal in space having amplitude of F_m when that particular phase is fed with a dc current of magnitude, I_d. What will be the nature of the resultant mmf wave that will be created in the air gap of the machine when three phases of the machine are fed by non sinusoidal currents as shown in the following figure? Rotor windings of the machine are deactivated (open circuited and hence no current flows in rotor conductors). Credit will not be awarded if your answer does not have a proper analytical basis.