COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Electrical & Control Engineering
Lecturer : Dr. Maged Mahmoud
Course : Special Electrical Machines
Course Code : EE 521 **Marks** : 40
Date : 23/5/2015 **Time** : 2 hour

Final Exam

Answer all the following questions:

Question 1: [A4 | B11]

(a) 220v, 50Hz capacitor-start single phase induction motor has the following impedances for the main and auxiliary windings,

$Z_{main} = 4.2 + j\,3.1\ \Omega$

$Z_{auxiliary} = 9.5 + j\,2.2\ \Omega$

Find the phase angle between the main and auxiliary winding currents if a 150 uF capacitor is connected in series with the auxiliary winding. **[4 marks]**

(b) Sketch the rotor arrangement of surface and interior permanent magnet synchronous machines. For each rotor type, plot the magnet torque, reluctance torque and total torque as a function of the torque angle δ (from 0° to 180°), and point out the torque angle δ at which the maximum torque can be obtained. **[6 marks]**

Question 2: [A24 | B11]

(a) For a 3-phase, Y-connected brushless DC machine operating as a motor,

- Draw the back emf and current waveforms in one of the machine phases over one electrical cycle (0° - 360°).
- Calculate the total machine output power if the peak phase back emf = 180v and the peak current = 20 A. **[6 marks]**

(b) Compare the permanent magnet synchronous machine to the brushless DC machine in terms of,

- Back emf and current waveforms
- Torque density
- Torque ripple
- Inverter switching losses **[4 marks]**

Members of course Examination Committee:	Signature:	Date:
Lecturer:	DrMaged Mahmoud M. Ibrahim	18/5/2015
Course Coordinator :	Dr Ahmed Kadry	18/5/2015
Head of Department:	Prof. HamdyAshoor Hamdy	18/5/2015