North South University
Dept. of Electrical & Computer Engineering
Final Exam, Summer 2020
EEE 363 (Electrical Machines)
Marks 45
Time: 1 hr. 50 min

Attempt any **THREE** out of FOUR questions [*Figures in the margin denote full marks*]

1. (a) Briefly explain the effect of load change on a synchronous motor with the help of vector diagram. How can you increase the pull-out torque of a synchronous motor? What is 'slipping poles'? [4+1+2]

(b) A 480 V 60 Hz, 400 hp, 0.80 pf leading, 6-pole, delta-connected synchronous motor has a synchronous reactance of 1.2 ohm and negligible armature resistance. Ignore friction, windage and core losses. **(i)** If this motor is initially supplying 350 hp at 0.85 pf lagging, what are the magnitudes and angles of E_A and I_A? **(ii)** How much torque is this motor producing? **(iii)** If field excitation is increased by 20%, what would be the new magnitude of E_A and the torque angle? [3+2+3]

2. (a) Briefly explain how the initial current inrush comes into play in a transformer. Derive the condition for maximum efficiency of a transformer. [5+2]

(b) A 1000 VA, 230/115 V transformer has been tested with the following results:

Open-circuit test	**Short-circuit test**
$V_{oc} = 230V$ $I_{oc} = 0.45A$ $P_{oc} = 30W$	$V_{sc} = 19.1V$ $I_{sc} = 8.7A$ $P_{sc} = 42.3W$

Find (i) the equivalent circuit parameters referred to the low-voltage side of the transformer, (ii) Full load voltage regulation at 0.85 power factor lagging load. [4+4]

3. (a) Two generators are supplying a load. Both the generators have a no-load frequency of 61.5 Hz and the slope s_p of 1 MW/HZ. If they are supplying a real load of 2.0 MW at 0.8 pf lagging, what would be the system frequency and power sharing between two generators? What measures can be taken to make the frequency 60 HZ. If an additional 1.0 MW load is connected to the existing one what would the system frequency be. [3+2+3]

(b) By using necessary diagrams show that the induced torque in an ac machine can be expressed by the following formula: [7]

$$\tau_{ind} = k\vec{B}_R x \vec{B}_{net}$$

4. (a) Briefly explain why a synchronous motor requires starting mechanism. Is there any starting problem associated with the induction motor? How do you overcome it? [4+1+2]

(b) A 208 V, 60 Hz, 2-pole, Y-connected induction motor is rated at 16 hp. Its equivalent circuit components have the following values:

(R1 = 0.200 ohm, X1 =0.410 ohm); (R2 = 0.120 ohm, X2 = 0.410 ohm); Xm = 15.0 ohm. Rotor slip is 4.5% at the rated voltage and frequency. Mechanical and core losses are 230W and 200W respectively. Find (a) rotor speed (b) line current and motor p.f (c) Air-gap and converted power (d) Induced torque. [2x4]