

**North South University**  
Dept. of Electrical & Computer Engineering  
Final Exam, Sec-1, Fall 2020  
EEE 363 (Electrical Machines)  
Marks: 45  
Time: 1 hr. 35 min

There are FOUR questions, attempt any **THREE** [Figures in the margin denote full marks]

1. (a) Explain the operation principle of induction motor. Can you mention its various speed control mechanisms? [5+2]

(b) A 440 V, 50 Hz, 2-pole, Y-connected induction motor is rated at 100 hp. Its equivalent circuit components have the following values:

( $R_1 = 0.075 \text{ ohm}$ ,  $X_1 = 0.17 \text{ ohm}$ ); ( $R_2 = 0.065 \text{ ohm}$ ,  $X_2 = 0.17 \text{ ohm}$ ); ( $X_m = 7.2 \text{ ohm}$ )

Rotor slip is 4% at the rated voltage and frequency. Mechanical and core losses are 1.0 KW and 1.10 KW respectively. Find (a) rotor speed (b) line current and motor p.f (c) Air-gap and converted power (d) Induced torque. [2x4]

2. (a) Briefly explain the effect of governor set-points change on an alternator connected to a large power system with the help of vector diagram? Show the effect using house diagram as well. [5+2]

(b) A 2300 V, 1000 KVA, 60 Hz, Y-connected, 2-pole synchronous generator has the open circuit characteristics as given in the following table.

Field current, A	0	1	2	3	4	5	6	7	8	9	10
Open ckt terminal voltage, V	0	670	1300	1800	2230	2530	2680	2810	2850	2900	2950

This generator has synchronous reactance of 1.10 ohm and an armature resistance of 0.15 ohm. Under full load condition the friction and windage losses are 24 KW and the core losses are 18 KW. Ignore the field circuit losses and the stray losses of the generator. If the generator is connected to the load and the load draws full load current at 0.8 pf lagging, how much field current will be required to keep terminal voltage equal to 2300 V. How much power is the generator now supplying? How much power is supplied to the generator by the prime mover? If the generator's load is suddenly disconnected from the line, what will be the terminal voltage? [2x4]

3. (a) Explain how a synchronous motor can be employed for power factor correction? Can you point out some differences between a synchronous motor and an induction motor? [4+3]

(b) A 480 V 60 Hz, 400 hp, 0.80 pf leading, 6-pole, delta-connected synchronous motor has a synchronous reactance of 1.1 ohm and negligible armature resistance. Ignore friction, windage and core losses. (i) If this motor is initially supplying 350 hp at 0.80 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 18%, what would be the new magnitude of  $E_A$  and the torque angle? [3+2+3]

4. (a) What is the purpose of 'short circuit' and 'open circuit' test of a transformer? Briefly describe the procedure for 'short circuit' test with necessary diagram. [3+5]

(b) A 120-VA 130/13 V transformer is to be connected so as to form a step-up autotransformer. The conventional two-winding transformer has series resistance and reactance of 1% and 8% per unit respectively. A voltage of 120V is applied to the autotransformer's primary. Calculate (i) secondary voltage of the transformer, (ii) Rating advantage in autotransformer mode of operation. (iii) Series impedance per unit in this mode of operation. [2+3+2]