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Name of Examination : **Winter 2020** - (Preview)

Course Code & Course Name : **EE301U - AC Machines**

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Maximum Marks : **60**

Duration : **3 Hrs**

[Edit](#) [Print](#) [View Answer Key](#) [Close](#) **Answer Key Submission Type:** Marking scheme with model answers and solutions of numerical

Instructions:

1. All questions are compulsory.
2. Illustrate your answer with suitable figures/sketches wherever necessary.
3. Assume suitable additional data; if required.
4. Use of logarithmic table, drawing instruments and non programmable calculators is allowed.
5. Figures to the right indicate full marks.

1) Solve any three sub-questions

- a) A 3-phase, Y connected, round rotor synchronous generator rated at 10kVA, 230V has a Synchronous reactance of 1.2Ω per phase and an armature resistance of 0.5Ω per phase. Calculate: [6]
- a) The percentage voltage regulation at full-load with 0.8 lagging power factor.
 - b) The percentage voltage regulation at full-load with 0.8 leading power factor.
 - c) The power factor such that the regulation is zero on full load.
- b) Draw approximate equivalent circuit of three phase induction motor. Explain how parameters of this circuit can be determined. [6]
- c) With neat diagram explain the slip test. [6]
- d) What is universal motor? Briefly describe Construction, Operation and Applications of this motor [6]

2) Solve any three sub-questions

- a) Explain detail about the Starting Methods of 1 phase induction motor. [6]
- b) Explain armature reaction of an alternator and its effect on main flux at various power factor. [6]
- c) An induction motor draws 25 A from a 460-V, three-phase line at a power factor of 0.85, lagging. The stator copper loss is 1000 W, and the rotor copper loss is 500 W. The "rotational" losses are friction and windage = 250 W, core loss = 800 W, and stray load loss = 200 W. Calculate (a) the air-gap power, P_g , (b) the developed mechanical power, DMP, (c) the output horsepower, and (d) the efficiency. (ii) If the frequency of the source in part (i) is 60 Hz, and the machine has four poles, find (a) the slip, (b) the operating speed, (c) the developed torque, and (d) the output torque. [6]
- d) With a neat sketch, explain the working of variable reluctance type stepper motor. Also mention its applications. [6]

3) Solve any three sub-questions

- a) A 3600 rpm, 60 Hz, 13.8 kV synchronous generator has a synchronous reactance of 20Ω . The generator is operating at rated voltage and speed with the per phase excitation voltage $E_a=11.5\text{kV}$ and the torque angle $\delta=15^\circ$ Calculate: [6]
- a) Stator current.
 - b) Power factor.
 - c) Total output power.
 - d) The maximum power that can be converted from mechanical to electrical form without loss of synchronism.
 - e) The value of armature current for the condition stated in (d).
- b) Two 3-phase, 6.6-kV, star-connected alternators supply a load of 3000 kW at 0.8 p.f. lagging. The synchronous impedance per phase of machine A is $0.5 + j10\Omega$ and of machine B is $0.4 + j12\Omega$. The excitation of machine A is adjusted so that it delivers 150 A at a lagging power-factor, and the governors are so set that the load is shared equally between the machines. Determine the current, power factor, induced e.m.f. and load angle of each machine. [6]
- c) A 50 HP, 230 V, 3-phase, 50 Hz induction motor with star connected stator winding gave the following test results: (i) No load test: applied line voltage 230 V, line current 25 A, wattmeter reading 1500 Watt. (ii) Blocked rotor test: applied line voltage 75 V, line current 50 A, wattmeter readings 3000 Watt. Calculate the parameters of the equivalent circuit. [6]
- d) What is universal motor? Briefly describe the Construction, Operation and Applications of this motor [6]

- 4) An induction motor draws 25 A from a 460-V, three-phase line at a power factor of 0.85, lagging. The stator copper loss is 1000 W, and the rotor copper loss is 500 W. The "rotational" losses are friction and windage = 250 W, core loss = 800 W, and stray load loss = 200 W. Calculate (a) the air-gap power, P_g , (b) the developed mechanical power, DMP, (c) the output horsepower, and (d) the efficiency. (ii) If the frequency of the source in part (i) is 60 Hz, and the machine has four poles, find (a) the slip, (b) the operating speed, (c) the developed torque, and (d) the output torque. [6]

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