



GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

(An Autonomous Institute of Government of Maharashtra)

National Highway No.6, JALGAON – 425 002

Phone No.: 0257-2281522

Website : www.gcoe.ac.in

Fax No.: 0257-2281319

E-mail : princoe@rediffmail.com



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

Course Code & Course Name : **EE301 - 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) What are the advantages of salient pole type of construction used for synchronous machines? [3]
- b) What is hunting? What are its effects? [3]
- c) Why auxiliary winding is used in 1-phase induction motor? [3]
- d) Why the efficiency of a three-phase induction motor is less than that of a three-phase transformer? [3]

2) Solve any three sub-questions.

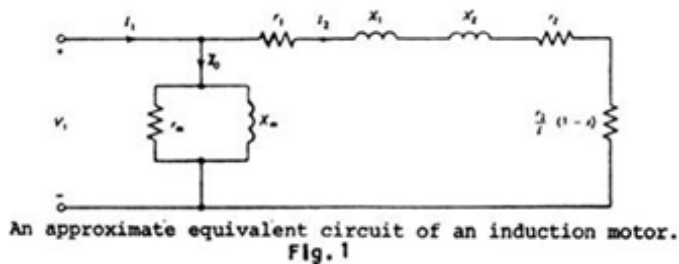
- a) Compare salient pole rotor with cylindrical pole rotor. [4]
- b) A 2,000-kva 2,300-volt three-phase alternator operates at rated kilovolt-amperes at a power factor of 0.85. The d-c armature-winding resistance at 75°C between terminals is 0.08 ohm. The field takes 72 amp at 125 volts from exciter equipment. Friction and windage loss is 18.8 kw, iron losses are 37.6 kw, and stray-load losses are 2.2 kw. Calculate the efficiency of the alternator. (Assume that the effective armature-winding resistance is 1.3 times the d-c value.) [4]
- c) A 2300-V, three-phase synchronous motor driving a pump is provided with a line ammeter and a field rheostat. When the rheostat is adjusted so that the a-c line current is a minimum, the ammeter reads 8.8A. Approximately what horsepower is being delivered to the pump? How should the rheostat be adjusted so that the motor is operating at 0.8 power-factor leading? How many kVARs is the motor supplying to the system at 0.8 power factor leading? [4]
- d) Two 60-cycle motors are connected in concatenation to drive a load. If machine 1 has six poles and machine has eight poles, (a) calculate the speed of the combination if the slip is 0.075. (b) At what other speeds can the load be driven if each motor is operated separately, assuming the same value of slip? [4]

3) Solve any three sub-questions.

- a) Explain armature reaction of an alternator and its effect on main flux at various power factor. [5]
- b) A 3-phase, 100-h.p., 440-V, star-connected synchronous motor has a synchronous impedance per phase of $0.1 + j1\Omega$. The excitation and torque losses are 4 kW and may be assumed constant. Calculate the line current, power factor and efficiency when operating at full load with an excitation equivalent to 400 line volts. [5]
- c) The results of the no-load and blocked-rotor tests on a three phase, Y-connected induction motor are as follows: [5]

No-load test:	line-to-line voltage	= 220 V
	total input power	= 1000 W
	line current	= 20 A
	friction and windage loss	= 400 W
Blocked-rotor test:	Line-to-line voltage	= 30 V
	total input power	= 1500 W
	line current	= 50 A

Calculate the parameters of the approximate equivalent circuit shown in Figure 1.



- d) Explain detail about the Starting Methods of 1 phase induction motor. [5]

4) Solve any four sub-questions

- a) 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]
- b) A 75-HP, three-phase, six-pole, 60-Hz, Y-connected, cylindrical-rotor synchronous motor has synchronous reactance of 9.6Ω per phase. Its rated terminal voltage is 500 v per phase. (a) Find the value of excitation voltage that makes maximum torque to be 120 percent of rated torque. (b) The machine is operated with the excitation voltage set as in part (a). For rated load torque, find the armature current, the power factor, and the torque angle. [6]
- c) A 5-hp, 60-cycle, 115-volt; eight-pole; three-phase induction motor was tested, and the following data were obtained : [6]

No-load test : $V_{NL} = 115$; $P_1 = 725$; $P_2 = -425$; $I_{NL} = 10$

Load test : $V_L = 115$; $P_1 = 3,140$; $P_2 = 1,570$; $I_L = 27.3$; $\text{rpm}_{\text{rotor}} = 810$

D-c stator resistance between terminals = 0.128Ω

Calculate: (a) the horsepower output; (b) the torque; (c) the percent efficiency; (d) the power factor of the motor for the given load values.
- d) What is universal motor? Briefly describe the Construction, Operation and Applications of this motor [6]
- e) 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]

