

B. E. Instrumentation and Electronics Engg. 2<sup>nd</sup> Year, 2<sup>nd</sup> Semester Examination-2019

## ELECTRICAL MACHINES-II

Time: Three hours

Full Marks: 100

Question Number		Marks
<b>Unit-I</b> (Answer any <u>one</u> ; Marks: 10)		
1.	Two squirrel cage Induction Motors A and B are identical in all respects, except that they have any one of the following differences in construction: a) Motor A has open stator slots but motor B has semi-closed stator slots. b) Motor A has semi-closed rotor slots but motor B has closed rotor slots c) Motor A has longer air-gap than motor B For each of the three differences listed above, discuss which of the two motors have i) higher starting torque ii) higher breakdown torque	5+5  10
2.	Give the constructional details of salient pole synchronous machine.	
<b>Unit-II</b> (Answer any <u>two</u> ; Marks: 30) (Q3-Q5 must be answered consecutively)		
3.	Draw the torque slip characteristic of an Induction motor working at rated voltage and frequency. Explain and draw this characteristic, with respect to the normal one, if the following change is made: i) Applied stator voltage is reduced to half at rated frequency ii) Both the applied voltage and frequency are reduced to half.	5+5+5
4.	Define voltage regulation of an Alternator. Draw the phasor diagram of a loaded Alternator for the following conditions: i) Unity power factor load ii) Leading power factor load	3+6+6
5.	a) Skewed rotor slots in Induction machine eliminate cogging and reduce the influence of space harmonics in the air gap-Explain b) Derive the expressions for Synchronizing Power and Synchronizing Torque of Salient pole as well as of Cylindrical rotor Synchronous Generator.	5+10
<b>Unit-III</b> (Answer any <u>two</u> ; Marks: 30) (Q6-Q8 must be answered consecutively)		
6.	a) Why is it necessary to employ special starting arrangements for Induction motors. b) Calculate the relative values of starting currents and starting torques for a 3-phase squirrel cage Induction motor, when it is started by: i) star-delta starter and ii) auto-transformer starter with 60% tapping	5+5+5

7. Draw the speed-torque and speed –current characteristics for different values of frequency. Discuss the effects of increasing frequency on performance of Induction motor. What are the effects of excessively high and low frequency?

5+5+5

8. a) What is hunting in synchronous motor? What are the causes of hunting?  
b) Explain V curves in a Synchronous motor.

3+6+6

#### Unit-IV

(Answer any *three*; Marks: 30)

(Q9-Q13 must be answered consecutively)

9. For a 3-phase Induction motor, the rotor ohmic loss at maximum torque is 16 times that at full load torque. The slip at full torque is 0.03, if stator resistance and rotational losses are neglected, then calculate a) The slip at maximum torque, b) The maximum torque in terms of full-load torque and c) The starting torque in terms of full load torque.

10

10. A 420V, 6 pole, 50 Hz, star connected Induction motor has stator impedance of  $0.07+j0.30$  ohm and standstill rotor impedance referred to stator is  $0.08+j0.37$  ohm. The magnetizing current is neglected. Determine a) the maximum internal power developed and corresponding slip and b) the maximum internal torque and the slip at which it occurs.

10

11. A 3-phase, 400V, 50 Hz Induction motor takes a power input of 35 kW at its full load speed of 890 rpm. The total stator losses are 1 kW and the friction and windage losses are 1.5kW. Calculate a) slip b) rotor ohmic losses c) shaft power d) shaft torque and e) efficiency.

10

12. A 440V, 50Hz delta-connected salient pole synchronous generator has  $X_d=0.5$  ohm and  $X_q=0.1$  ohm per phase. The generator is delivering 800A at 0.8 lagging power factor. Determine the excitation emf neglecting armature resistance.

10

13. A 2000 kVA, 3-phase, star connected 11 kV, 4 pole, 50 Hz synchronous generator has synchronous reactance of 15% and is connected to an infinite bus. Determine the synchronizing power and the synchronizing torque per mechanical degree of phase displacement (i) at no load, and (ii) at full load 0.8 power factor lagging.

10