ANNA UNIVERSITY COIMBATORE

B.E. / B.TECH. DEGREE EXAMINATIONS : MAY / JUNE 2010

REGULATIONS : 2007

FOURTH SEMESTER : EEE

070280026 - SYNCHRONOUS AND INDUCTION MACHINES

TIME : 3 Hours **Max.Marks : 100**

PART – A

(20 x 2 = 40 MARKS)

ANSWER ALL QUESTIONS

1. How does electrical degree differ from mechanical degree?
2. Where the damper windings are located? What are their functions?
3. How ampere-turn method differ from synchronous impedance Method?
4. Why is short pitch winding preferred over full-pitch winding?
5. What is phase swinging?
6. What could be the reasons if a 3-phase synchronous motor fails to start?
7. How the synchronous motor can be used as s synchronous condenser?
8. What is meant by pull out torque?
9. What are the advantages and disadvantages of circle diagram method of predetermining the performance of 3 –phase IM?
10. How does the shaft torque differ from the torque developed in 3-phase Induction motor?
11. What is an induction generator?
12. What is cogging of induction motor?
13. How the tandem operations of induction motor start?
14. Draw the torque-slip characteristics of a variable frequency constant V/F control 3 phase induction motor.
15. A 50 Hz, induction motor wound for pole-amplitude modulation has 20 initial poles and the modulating function has 8 poles. Find the motor speed.
16. What is the need of starter for induction motor?

17. Draw the torque-speed characteristics of single winding 1Φ induction motor.
18. How to improve the power factor of the universal motor.
19. What is the significance of servomotor?
20. Write the slip equation for the forward and backward rotating field.

PART – B

(5 x 12 = 60 MARKS)

ANSWER ANY FIVE QUESTIONS

21. Draw the open-circuit and short circuit characteristics using the data given below for a 150 MW,13kv,0.85 pf,50Hz generator.

I_f(A)	200	450	600	850	1200
$V_{oc(line)}$(kv)	4	8.7	10.8	13.3	15.4

Short circuit characteristics: I_f = 750 A, I_{sc} = 8000A.

i) Determine the unsaturated synchronous reactance of the machine

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iii) Find the excitation emf and voltage regulation using the synchronous reactance.

22. (a) A 3300 V, star connected synchronous motor is operating at constant terminal voltage and constant excitation. Its synchronous impedance is 0.8+j5 ohm. It operates at a power factor of 0.8 leading when drawing 800 kw from the mains. Find its power factor when the input is increased to 1200 kw, excitation remains constant. 8

(b) Explain the applications of synchronous condensers in power systems operations. 4

23. (a)Develop the approximate equivalent circuit model of a 3 phase induction motor. 8

(b) A 6 pole, 50Hz, 3 phase IM running on full load develops a useful torque of 160 Nm when the rotor emf makes 120 complete cycles per minute. Calculate the shaft power output. If the mechanical torque lost in friction and that for core loss is 10Nm, compute 1) the copper-loss in the rotor windings 2)the input to the motor and 3)the efficiency. The total stator loss is given to be 800 W. 4

24. (a) What is the need of starter to start the induction motor? 2

(b)Explain the various types of starters used to start the 3 phase induction motor. 10

25. (a) Explain the double field revolving theory. 6

(b) Explain the operation of variable reluctance stepper motor. 6

26. The following data were obtained for the OCC of a 10 MVA,13kv,3-phase,50hz,star connected generator:

I_f(A)	50	75	100	125	150	162.5	200	250	300
$V_{oc(line)}$(kv)	6.2	8.7	10.5	11.8	12.8	13.2	14.2	15.2	15.9

An excitation of 100 A causes the full-load current to flow during the short-circuit test. The excitation required to give the rated current at ZPF and rated voltage is 290 A.

1) Calculate the adjusted synchronous reactance of the machine.

2) Calculate the leakage reactance of the machine assuming the resistance to be negligible.

3) Determine the excitation required when the machine supplies full-load at 0.8 pf lagging by using the leakage reactance and drawing the mmf phasor diagram. What is the voltage regulation of the machine?

27. (a) A 6-pole,50 hz, 3-phase induction motor has a rotor resistance of 0.25 ohms per phase and a maximum torque of 10 Nm at 875 rpm. Calculate 1) the toque when the slip is 5% and 2) the resistance to be added to the rotor circuit to obtain 60% of the maximum torque at starting. Explain why two values are obtained for this resistance. Which will be used? The stator impedance to be negligible. 6

(b) Explain the Torque – slip characteristics of a double caged induction motor with its construction details. 6

28. A 400 v,3-phase,star connected induction motor gave the following test results:

No – load	400 V	8.5 A	1,100 W
Blocked Rotor	6.2	8.7	10.5

Determine the ohmic values of the components in the circuit model and calculate the line current and power factor when the motor is operating at 5% slip. The stator resistance per phase is 1.5 ohm and the standstill leakage reactance of the rotor winding referred to the starter is equal to that of the winding.

*****THE END*****