(Pages : 3) **B – 5992**

Reg. No. : .....

Name : .....

Sixth Semester B.Tech. Degree Examination, April 2017
(2013 Scheme)
13.602 : INDUCTION MACHINES AND SPECIAL ELECTRICAL MACHINES (E)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions :

1. Draw the torque – slip characteristics of a three phase induction motor and mark starting torque, maximum torque and the slip at which torque is maximum.
2. Why are the slots of induction motor skewed ?
3. Explain cogging in an induction generator.
4. Why high power induction motors should not be started directly ?
5. Explain how starting torque is achieved in double cage induction motors. State two specific applications of such motors.
6. What is the significance of cascaded connection of induction motors ?
7. How a single phase induction motor is made as self starting motor ?
8. Explain the working principle of AC servo motors.
9. Draw the torque-speed characteristics of switched reluctance motors.
10. State the application areas of brushless DC motor. **(10×2=20 Marks)**

P.T.O.

PART – B

Answer **any one full** question from **each** Module.

MODULE – I

11. a) Derive the condition for maximum torque and hence obtain the value of maximum torque of a three phase induction motor. **7**

b) Show how increase in rotor circuit resistance will increase the starting torque of an induction motor. What should be the maximum limit of such increase of rotor circuit resistance ? **7**

c) A 20 hp, 4 pole, 50 Hz, 3 phase induction motor has friction and windage loss of 3% of the output. For full load slip of 4%, calculate for full load
   i) Rotor copper loss
   ii) Rotor input and
   iii) Output torque. **6**

OR

12. a) Explain with neat sketches, how rotating magnetic field is developed when 3 phase balanced supply is given to the stator windings of a 3 phase induction motor. Give the frequency of such field and its magnitude. **10**

b) The rotor of a three phase induction motor has a resistance of 0.04 Ω per phase and standstill reactance of 0.2 Ω per phase.
   i) Calculate the external resistance to be connected in the rotor circuit in order to get half of the maximum torque at starting.
   ii) By what percentage will this external resistance change the current and p.f. at starting ? Neglect stator impedance. **10**

MODULE – II

13. a) What are the various methods of braking of a 3-phase induction motor ? Explain any one method with a circuit diagram. **6**

b) Draw its equivalent circuit and torque speed characteristics of a double cage induction motor. **6**

c) It is desired to install a 3-phase squirrel cage induction motor restricting the maximum line current drawn from a 400 V, 3 phase supply to 120 A. If the starting current is 6 times full load current, what is the maximum permissible full load kVA of the motor when
   i) It is directly connected to the mains
   ii) It is connected through an auto-transformer with a tapping of 60%. **8**

OR

14. a) Explain different starting methods of 3 phase induction motors. **12**

    b) The rotor of a 4 pole, 50 Hz slip ring induction motor has a resistance of 0.2 Ω and reactance of 1 Ω per phase and runs at 1440 rpm at full load. Calculate the external resistance per phase which must be added to reduce the speed to 1200 rpm, the torque remaining same in both the cases. **8**

MODULE – III

15. a) Which are the methods employed to make the single phase induction motor self-starting ? Explain with neat sketches. **10**

    b) Draw the equivalent circuit of a single phase induction motor and discuss the procedure for determining the parameters of the equivalent circuit. **10**

OR

16. a) With the help of suitable diagram explain how unidirectional torque is produced in an A.C. single phase series motor. Draw the phasor diagram. **10**

    b) A 230 V, 50 Hz, split-phase induction motor has main winding resistance of 5 Ω and inductive reactance of 12 Ω and starting winding resistance of 12 Ω and inductive reactance of 5 Ω. Determine at start

    i) The current in the main winding
    ii) The current in the starting winding
    iii) The line current
    iv) Phase displacement between the two winding currents and
    v) The power factor. **10**

MODULE – IV

17. a) Explain construction and operation of variable reluctance stepper motors. **8**

    b) Explain the working principle of brushless DC motors. **6**

    c) Discuss how electronic commutation is implemented in such machines. **6**

OR

18. a) Derive torque equation of reluctance motors. Draw the torque-slip characteristics. **8**

    b) Explain with a neat diagram, the working principle of linear induction motors. **6**

    c) Discuss on different types of linear induction motors and their applications. **6**