M.E. DEGREE EXAMINATIONS: DECEMBER– 2008

First Semester

POWER ELECTRONICS AND DRIVES

P07PE101 Modeling and Analysis of Electrical Machines

Time: Three Hours   **Maximum Marks: 100**

Answer ALL Questions:-

PART A (20 × 1 = 20 Marks)

1. Continuous energy conversion equipment is

   A) Motor   B) Transducer   C) Sensor   D) Relay

2. The area between the $\lambda - i$ curve and the horizontal axis is known as

   A) Field energy   B) Co energy   C) Kinetic energy   D) Kinematic energy

3. Example of a multiply excited system

   A) Transducer   B) Reluctance motor   C) Relay   D) Generator

4. In distributed winding, the winding factor K_w is given by

   A) $K_w = K_b / K_p$ B) $K_w = K_b K_p$ C)) $K_w = K_p / K_b$ D) $K_w = \sqrt{K_b K_p}$

5. The rotor of a six pole synchronous generator is rotating at a mechanical Speed of 1200 r/min. The frequency of the generated voltage is

   A) 50 Hz   B) 25 Hz   C) 60 Hz   D) 120 Hz

6. Which of the following machine is used as a frequency changer

   A) Induction motor   B) Synchronous motor   C) Stepper motor   D) DC motor

7. The relative speed between stator and rotor mmf is

   A) N_s B) less than N_s C) Greater than N_s D) Zero

8. Slip power recovery scheme is an example of

   A) Stator reference frame model
   B) Rotor reference frame model
   C) Synchronously rotating reference frame model
   D) All the above

9. In vector control scheme, the induction motor is considered as

   A) Separately excited dc shunt motor   B) Self excited dc shunt motor
   C) Synchronous motor   D) Stepper motor

10. Rotor balancing is done on induction motor before final assembly to avoid
    A) Eccentrics in rotor   B) Eccentrics in bearings
    C) Eccentrics in stator   D) Eccentrics in air gap

11. The number of slots in the stator and rotor are unequal to avoid

A) Cogging torque   B) Crawling torque   C) Reluctance torque
D) Electromagnetic torque

12. In an unsaturated synchronous motor, the short circuit ratio in terms of its synchronous reactance X_s is

A) $1/X_s^2$ B) $1/X_s$ C) X_s D) X_s^2

13. Single phase induction motor works under the concept of

A) Double field revolving theory   B) Rotating magnetic field
C) Two reaction theory   D) Poly phase magnetic field

14. The stator winding of a single phase induction motor is split into two parts in order to

A) Improve efficiency   B) Improve power factor
C) Develop starting torque   D) Increase speed

15. A three phase synchronous motor provided with damper winding is started as a three phase

A) Synchronous motor   B) Synchronous Alternator
C) Induction motor   D) Induction Generator

16. The main winding and auxiliary winding placed on the stator of a single phase induction motor are spaced _____ electrical degrees apart

A) 0   B) 90   C) 120   D) 60

17. Due to permanent magnet rotor PMSM is designed to operate at _____ power factor at full load

A) Unity   B) Lagging   C) Leading   D) Zero

18. In SRM the reluctance torque is produced to move the rotor toward

A) Minimum resistance position   B) Maximum resistance position
C) Minimum reluctance position   D) Maximum reluctance position

19. Switched Reluctance Motor is an example of

A) Singly excited system   B) Doubly excited system
C) Multiply excited system   D) Unexcited system

20. In self controlled operation of Permanent Magnet Synchronous Motor the parameter to be controlled is

A) Induced current   B) Induced voltage
C) Applied current   D) Applied voltage

PART B (5 × 16 = 80 Marks)

21. (a). (i) Derive the magnetic force and torque developed in singly excited system from its co energy. (8)

21. (a). (ii) The magnetic flux density on the surface of an iron face is 1.6 T which is a typical saturation level value for ferromagnetic material. Find the force density on the iron face. (8)

(OR)

21. (b). (i) Derive the torque developed in a multiply excited magnetic system (10)

21. (b). (ii) The $\lambda - i$ characteristics of singly excited electromagnetic relay is given by

$$i = \lambda^2 + 2\lambda(1-x)^2 \ ; x < 1.$$

Find the force on the armature as a function of λ. (6)

22. (a). From first principles derive the voltage and torque equations of a three phase symmetrical induction machine. (16)

(OR)

22. (b). For a 2 pole, 3 phase, wye connected cylindrical pole synchronous machine, derive the expression for per phase winding inductances. (16)

23. (a). Discuss the reference frame theory in a step by step basis and show how a three phase symmetrical induction machine model is transformed into a two phase machine model. (16)

(OR)

23.(b). (i). Explain how Park's transformation transform equations in a,b,c variables to d,q,o variables. (8)

23.(b). (ii) Obtain the equivalent circuit of three phase synchronous machine with reference frame fixed in rotor. (8)

24. (a). Develop a model for an unsymmetrical two phase induction motor and derive the voltage and torque equations. (16)

(OR)

24.(b). What is frequency response test? Explain the methodology for the determination of synchronous machine parameters. (16)

25. (a). (i) Describe the construction and operation of a Permanent Magnet Synchronous Motor. (8)

25. (a). (ii)Derive the expressions for voltage and torque of a Permanent Magnet Synchronous Motor. (8)

(OR)

25. (b) Describe the principle of operation of a SRM. What are the advantages of SRM drive over other AC motor drives? (16)

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