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M.E. DEGREE EXAMINATIONS: OCTOBER/NOVEMBER – 2008

Third Semester

POWER ELECTRONICS AND DRIVES

P07PEE 01 Special Electrical Machines

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

Answer ALL Questions:-

PART A (20 X 1 = 20 Marks)

1. The rotor of Synchronous reluctance motor consists of
   A. Field winding excited by DC source.
   B. Three phase winding excited by AC source
   C. Permanent magnet fitted in rotor
   D. No winding in the rotor

2. The following loss does not exists in the Synchronous reluctance motor
   A. Rotor copper loss B. Stator copper loss
   C. Frictional loss. D. Core loss

3. When the stator is excited, the rotor of Synchronous reluctance motor
   B. Rotor tending to align tangential with the revolving magnetic filed.
   C. Rotor align with static field of stator
   D. Rotor tending to align with the axis of the revolving field.
   E. Rotor will move insteps depend on excitation.

4. In the poly phase Reluctance motor, rotor has
   A. Same number of stator poles B. Twice the number of stator poles
   C. Rotor poles are half the stator poles.
   D. No poles are induced in the rotor.

5. Switched reluctance motor is
   A. Single excited single salient motor.
   B. Double excited double salient motor
   C. Single excited double salient motor
   D. Single excited smooth cylindrical motor

6. The need of rotor position sensor is
   A. To control the conduction period of semiconductor devices.
   B. To provide commutation and feed back signal.
   C. To energize both rotor and stator coils.
   D. To control stepping angle.

7. Energy ratio is ratio of
   A. Input energy to the output energy transferred.
   B. Output energy transferred to the input energy.
   C. Mechanical energy stored to the stored energy stored
   D. Mechanical energy transferred to the sum of mechanical energy and energy stored.

8. The torque equation of Switched reluctance motor is
   A. $T = \frac{1}{2} I^2 d\theta/dt$ B. $T = \frac{1}{2} L I^2 d\theta/dt$
   C. $T = \frac{1}{2} I L^2 d\theta/dt$. D. $T = \frac{1}{2} I L \omega d\theta/dt$

9. The Permanent magnet synchronous motor also called as
   A. Double salient single excited motor. B. Hybrid motor
   C. Brushless permanent magnet sine wave motor
   D. Single excited double salient motor.

10. In PMSMSNW motor the emf induced due to permanent magnet filed
   A. Depend on the speed and frequency
   B. Does not depend speed or frequency
   C. Depend on residual field.
   D. Depend on synchronous impedance.

11. In the self control operation of PMSM motor
   A. The armature field always moves at the same speed as the rotor
   B. The armature field always moves faster than that of the rotor
   C. The speed of the rotor is always faster than the armature.
   D. Armature field is fixed and main filed moves at synchronous speed.

12. In permanent magnet brushless motor
   A. Stator is made of permanent magnet and rotor core consists of laminated steel stampings.
   B. Stator is made of silicon steel stampings and rotor is made up of forged steel and accommodates permanent magnet.
   C. Stator and rotor consists of permanent magnets
   D. Stator and rotor made up of forged steel core

13. The starting torque of PMBLDC motor is
   A. $T_{st} = (K_T R_{ph})/2$. B. $T_{st} = (2 K_T V)/ R_{ph}$
   C. $T_{st} = (2 K_T V / R_{ph} + R_m)$ D. $T_{st} = (K_T V)/2 R_{ph}$

14. The commutation process is achieved in PMBLDC machine is by
   A. Electro mechanical commutator fitted in the rotor
   B. Electronic commutator fitted in the stator
   C. Mechanical commutator fitted in the rotor.
   D. Hard drawn commutator fitted in the stator.

15. For the same ampere conductors, in the 120° pole arc machine the copper loss is
   A. 1.5 times than in the 180° pole arc machine.
   B. The copper loss is same in both 120° and 180° pole arc machines.
   C. Copper loss is negligible compared to 180° pole arc machine.
   D. Copper loss us one third of 180° pole arc machine.

16. The material used for Hall IC pallent is
   A. Nickel Cadmium
   B. Gallium Arsenide
   C. Bismuth Germanium
   D. Silicon Carbide.

17. In the stepper motor during half step operation mode
    A. Only two phases ON
    B. Only one phase is ON other phases left unexcited.
    C. One phase is ON for some duration and two phases ON during some other duration.
    D. All the phases are excited simultaneously.

18. In micro stepping of stepper motor, the torque of the motor is
    A. Maintained constant as in one phase ON sequence.
    B. Half of the torque
    C. Twice the torque as is one phase ON sequence
    D. One fourth of the torque as one phase ON sequence.

19. In hybrid stepper motor permanent magnet fitted in
    A. Rotor only. B. Both stator and rotor
    C. Stator only. D. No magnet is required in this type of motor.

20. Can stack motor is a
    A. PMDC motor with a sort of metal can in the stator.
    B. Stepper motor with a sort of metal can in the stator.
    C. PMSM motor with a sort of metal can in the rotor.
    D. SRM motor sort of metal can in the stator

PART B (5 X 16 = 80 Marks)

21. (a) i) Explain the constructional details and principle of operation of a Vernier motor (8)

ii) Explain the Speed – Torque characteristics of Synchronous reluctance motor. (8)

(OR)

21. (b) i) Derive the Torque equation of a Synchronous reluctance motor. Also draw the Torque versus Torque angle characteristics. (8)

ii) Explain with necessary phasor diagram, the working of Synchronous reluctance machine as a) Generator and b) Motor. (8)

22. (a) i) What are the various switching circuits for SRM?. Explain C dump drive circuit with neat circuit diagram. (10)

ii) Mention any three merits and demerits of Switched reluctance motor (6)

(OR)

22. (b) i) Derive the torque equation of Switched reluctance motor. (8)

ii) Explain the torque – speed capability curve of Switched reluctance motor. (8)

23. (a) i) Explain the vector control method of Permanent magnet synchronous motor. (12)

ii) Write the expression for torque and power input of PMSM. (4)

(OR)

23 (b) i) Explain with necessary circuit diagram, the Microprocessor based control of Permanent magnet synchronous motor. (12)

ii) Mention any four merits of PMSM. (4)

24 (a) i) A brushless permanent magnet DC motor ha a no load speed of 6000 rpm when connected 120 V DC supply. The armature resistance is 2.5Ω. Rotational and iron losses may be neglected. Determine the speed when the supply voltage is 60 V and the torque is 0.5 Nm. No load speed when the supply voltage is 120 V is 6000 rpm. (10)

ii) Compare the electronic commutator and mechanical commutator applicable to DC machines. (6)

(OR)

24 (b) i) A three phase 4 pole brushless PM motor has 36 stator slots. Each phase winding is made up of three coils per pole with turns per coil. The coil span is seven slots. If the flux is 1.8 mWb; calculate the induced EMF at 3000 rpm. (8)

ii) How BLPM motors are classified? Explain any one method and mention its merits and demerits. (8)

25 (a) i) A single stack three phase VR motor has a stepping angle of 15°. Find the number of its stator and rotor poles. (8)

ii) Explain the speed – torque characteristics of stepper motor. Explain clearly the various torques. (8)

(OR)

25. (b) i) Explain the principle of operation of micro stepping of stepper motor. (8)

ii) A stepper motor has step angle of 2.5°. Find a) resolution b) Number of steps required for the shaft to move 25 revolutions and c) shaft speed if stepping frequency is 3600 pulses/sec. (8)

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