Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐☐

Question Paper Code : 82110

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Second Semester

Power Electronics and Drives

PE 9223/PE 923/10233 PSE 41 — SPECIAL ELECTRICAL MACHINES

(Common to M.E. Power Management/M.E. Power Systems Engineering and
M.E. Electrical Drives and Embedded Control)

(Regulation 2009/2010)

Time : Three hours　　　　　　　　　　　　　　　　Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1.　Draw steady-state phasor diagram of synchronous reluctance motor.

2.　Differentiate Transversally Laminated Anisotropy (TLA) rotor from Axially Laminated Anisotropy (ALA) rotor used in synchronous reluctance motor.

3.　Sketch the relationship between the voltage and current in the one-step lead angle operation.

4.　What is the motor torque (T_M) required to accelerate an inertial load of 10^{-4} kg/m^2 from $\omega_1 = 100$ to $\omega_2 = 300$ rad/sec during 0.1 s, $T_f = 0.05$ Nm?

5.　Draw cross-sectional diagram of switched reluctance motor (3-phase, 6:4).

6.　State the principle of "vernier" used in switched reluctance motor.

7.　What are the major features of self-controlled permanent magnet synchronous machine?

8.　Write various methods used to mitigate cogging torque in permanent magnet synchronous motor.

9.　Compare features of electronic commutator with mechanical commutator.

10.　How does brushless D.C. motor differ from sinewave motor?

PART B — (5 × 16 = 80 marks)

11. (a) (i)   In detail explain torque-speed characteristics of synchronous reluctance motor. (8)

        (ii) Explain the torque production mechanism of synchronous reluctance motor and derive the expression of torque in synchronous reluctance motor. (8)

Or

     (b) Discuss the operation principle and constructional features of axial air gap and radial air gap synchronous reluctance motors. Also compare both types of synchronous reluctance motors. (16)

12. (a) (i)   Discuss about the torque-speed characteristics of stepper motor in detail. (8)

        (ii) What are the various modes of excitation used in stepping motor operation? Briefly discuss about any three methods. (8)

Or

     (b) In detail explain microprocessor based closed loop control of stepper motor. Draw detailed block diagram and control flowchart. (16)

13. (a) (i)   Discuss the mechanism of inductance variation with rotor position in switched reluctance motor. (8)

        (ii) Explain the phenomena of continuous torque production by commutation sequence in switched reluctance motor. (8)

Or

     (b) Write various converter circuits used for three-phase switched reluctance motor. Explain the operation of any four circuits. (16)

14. (a) (i)   Discuss the principle of vector control mechanism used in motor control applications (Step by step procedure). Draw necessary supporting diagram. (8)

        (ii) Explain the scheme of self-control for permanent magnet synchronous motor. What are the differences between self-controlled synchronous machine and D.C. motor? (8)

Or

     (b) Derive the expressions for the following with respect to permanent magnet synchronous motor.

        (i)   Electromagnetic force, (8)

        (ii) Electromagnetic torque. (8)

15. (a) (i) Draw general structure of a controller for a brushless permanent magnet D.C. motor. Explain its operation in detail. (8)

    (ii) Explain torque-speed characteristics of permanent magnet brushless D.C. motor. (8)

Or

(b) Write notes on the following relating to permanent magnet brushless D.C. Motor operation.

    (i) Hall Sensors, (4)

    (ii) Optical Sensors, (4)

    (iiii) Commutation, and (4)

    (iv) Multiphase brushless motor. (4)

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