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Question Paper Code : 11189

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Second Semester

Electrical Drives and Embedded Control

PX 5251 — SPECIAL ELECTRICAL MACHINES

(Common to M.E. Power Electronics and Drives)

(Regulation 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why is the PMBLDC motor called electronically commutated motor?
2. Mention any two applications of PMBLDC motor.
3. What is meant by self control?
4. What is meant by vector control?
5. Why rotor position sensor is essential for the operation of switched reluctance motor?
6. What are the basic requirements of power semiconductor switching circuits?
7. What is the step angle of a four phase stepper motor with 12 stator teeth and 3 rotor teeth?
8. Define slewing.
9. Write down the torque equation of AC series motor.
10. List any two differences between linear electric motor and rotary motor.

PART B — (5 × 13 = 65 marks)

11. (a) Sketch the structure of controller for PMBLDC motor and explain the functions of various blocks. (13)

Or

(b) A PMBLDC motor has a no load speed of 6000 rpm when connected to 120V dc supply. The armature resistance is 25 Ω. Rotational and iron losses may be neglected. Determine the speed when the supply voltage is 60V and torque is 0.5 Nm. (13)

12. (a) Explain the microprocessor based control of PMSM with a neat block diagram. (13)

Or

(b) A 3 phase, 16 pole synchronous motor has a star connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.03 webers, sinusoidally distributed and the speed is 375 rpm. Find the frequency and the phase and line emf. Assume full pitched coil. (13)

13. (a) Explain with a neat sketch, construction and working principle of SRM. (13)

Or

(b) A switched reluctance motor with six stator poles and four rotor poles has a stator pole arc of 30° and rotor pole of are 32°. The aligned inductance is 10.7 mH and unaligned inductance is 1.5 mH. Saturation can be neglected. Calculate the instantaneous torque when the rotor is 30° before the aligned position and the phase current is 7A. Neglect fringing. (13)

14. (a) Explain the modes of operation of variable reluctance stepper motor. (13)

Or

(b) What is the stepper motor torque T_m required to accelerate an initial load of 2×10^{-4} Kg m^2 from 500 Hz to 1500 Hz in 50 ms. The frictional torque is 0.03 N-m and step angle is 1.18°. (13)

15. (a) Explain the principle and construction of linear induction motor and mention the application with merits and demerits. (13)

Or

(b) A 75 W, 2 pole, 50 Hz, 230 V single phase series motor having salient poles have the following data: total resistance R = 25 Ω, total reactance 261 Ω, mutual reactance =121 Ω on the direct axis. Stray power loss = 15 W. Calculate current, power factor and mechanical output power when running at 6000 rpm. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Design and describe the different types of power controllers used for SRM drive with neat diagram. (15)

Or

(b) A stepper motor driven by a bipolar drive circuit has the following parameters: Winding inductance = 30 mH, rated current = 3A, DC supply = 45 V, total resistance in each phase = 15 Ω. When the transistors are turned off, determine

(i) the time taken by the phase current to delay to zero and

(ii) the proportion of the stored inductive energy returned to the supply. (15)