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Question Paper Code : 10551

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

Sixth Semester

Electrical and Electronics Engineering

EE 8005 — SPECIAL ELECTRICAL MACHINES

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. A stepper motor has step angle of 3.6° . Calculate the number of steps required for the shaft to make 20 revolutions?
2. Name the various driver circuits used in stepper motor.
3. List the basic requirements of power semiconductor switching circuits employed for switched reluctance motor.
4. State the principle of operation of switched reluctance motor.
5. How does a permanent magnet brushless DC motor differ from a DC motor?
6. In a permanent magnet brushless DC motor, how the direction of rotation is reversed?
7. What is the necessity of digital controllers in permanent magnet synchronous motors?
8. Express the EMF and torque equations of permanent magnet synchronous motors.
9. What is a repulsion motor?
10. Mention the applications of Linear Induction motor?

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) Explain the theory of torque prediction in the case of infinitely permeable cores of stepper motors. (8)
- (ii) Draw and explain the controller block diagram of stepper motor. (5)

Or

- (b) (i) With neat diagrams, explain the modes of operation of single stack variable reluctance stepper motor. (8)
- (ii) Draw and explain the static characteristics of stepper motor. (5)
12. (a) (i) With neat diagrams, explain the construction and principle of operation of 6/4 switched reluctance motor. (8)
- (ii) Derive the expression for torque of a switched reluctance motor. (5)

Or

- (b) (i) A SRM with 6 stator poles and 4 rotor poles has a stator pole arc of 30° and rotor pole arc of 32° . The aligned inductance is 10.7mH and unaligned inductance is 1.5mH. Saturation can be neglected. Calculate the instantaneous torque when the rotor is 30° before the aligned position and phase current is 6A. What is the maximum energy conversion for one stroke, if the current is limited to 7A? Determine the average torque corresponding to this energy conversion. (8)
- (ii) With a neat diagram describe any one of the power converters used for the control of switched reluctance motor. (5)
13. (a) (i) A BLDC motor has a no load speed of 3000 rpm when connected to 120 V DC source. Armature resistance is 2.5Ω . Find the speed when it is supplied with 60V and developing a torque of 0.4 Nm. Neglect constant losses. The no load current is 0.8A. (8)
- (ii) Write short note on power converters used in permanent magnet brushless DC motor. (5)

Or

- (b) Elaborately discuss the permanent magnet materials used in brushless DC motor, their types, principle of operation and magnetic characteristics. (13)
14. (a) (i) For an ideal sine wave permanent magnet motor derive the torque and EMF equations. (8)
- (ii) With necessary diagrams, discuss about the digital controllers used for PMSM. (5)

Or

- (b) (i) With necessary phasor diagram and circle diagram, describe the torque speed characteristics of PMSM. (8)
- (ii) State the applications of PMSM. (5)
15. (a) (i) A vehicle is propelled by a linear induction motor. The motor has 100 poles with a pole pitch of 0.5 m. Find the vehicle speed in kmph when the vehicle is running with a slip of 0.25 at a frequency of 50 Hz. (8)
- (ii) With a neat diagram, explain the characteristics of hysteresis motor. (5)

Or

- (b) (i) Explain the construction and principle of operation of repulsion motor. (8)
- (ii) Derive the expression for linear force. (5)

PART C — ($1 \times 15 = 15$ marks)

16. (a) A 3 phase, 4 pole, 50 Hz, 230 V star connected synchronous reluctance motor has direct axis and quadrature axis synchronous reactance of 22.5Ω and 3.5Ω respectively. The load torque is 12.5 Nm. The voltage to frequency ratio is maintained constant at rated value. Find (i) torque angle, (ii) line current and (iii) power factor. Neglect rotational losses and armature resistance. Also derive the necessary equations used. (15)

Or

- (b) A stepper motor has a step angle of 1.8° and it is driven at 4000 pps. Determine (i) Resolution (ii) Motor speed (iii) Number of pulses required to rotate the shaft through 54° . Also derive the necessary equations used. (15)

