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**Question Paper Code : 91000**

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

Fifth/Sixth/Seventh/Eighth Semester

Electrical and Electronics Engineering

EE 3009 — SPECIAL ELECTRICAL MACHINES

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ( $10 \times 2 = 20$  marks)

1. What is meant by holding torque.
2. State two advantages and two limitations of stepper motors.
3. List any two methods of rotor position measurement in SRMs.
4. State the need for sensorless control in SRMs.
5. Write the impact of magnetic saturation in permanent magnet motors.
6. Sketch the back-emf waveform of a permanent magnet brushless DC motor.
7. Compare surface-mounted and interior Permanent Magnet Synchronous Machines (PMSMs) in terms of torque production.
8. List any two major applications of synchronous reluctance motors.
9. Differentiate linear induction motor from rotary induction motor.
10. Compare the torque production mechanisms in a hysteresis motor with AC series motor.

PART B — ( $5 \times 13 = 65$  marks)

11. (a) Derive the expression for torque prediction in stepper motors and explain its significance.

Or

- (b) Explain the design procedure for a stepper motor control system in a robotic arm application.

12. (a) Describe the current control strategy for SRM drives, focusing on its impact on performance.

Or

- (b) Elucidate the inductance-based estimation method for rotor position sensing in SRMs.
13. (a) Explain the method of designing current controller for BLDC motor.

Or

- (b) Derive a per-phase transfer function for BLDC motor relating angular speed and input voltage.
14. (a) Derive the EMF equation of a PMSM and explain how it influences control strategies at different speeds.

Or

- (b) Describe the torque production in synchronous reluctance motors and the impact of d- and q-axis inductances on it.
15. (a) Analyze the effect of frequency on the torque and speed characteristics of an AC series motor.

Or

- (b) With a neat sketch explain the starting characteristics of physteresis motors.

**PART C — (1 × 15 = 15 marks)**

16. (a) A 4-phase Switched Reluctance Motor operates with the following parameters:

Phase inductance: 15 mH

Supply voltage: 100 V

Load torque: 2 Nm

Motor speed: 1500 rpm

Calculate the following:

- (i) The current required to produce the given torque (5)
- (ii) The electrical power supplied to the motor (5)
- (iii) The mechanical power output of the motor. (5)

Or

- (b) Explain the construction, operating principle, commutation sequence of Permanent Magnet Brushless DC Motor with neat sketches.