Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 91501

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Seventh Semester

Electrical and Electronics Engineering

EE6703 – SPECIAL ELECTRICAL MACHINES

(Regulations 2013)

(Common to : PTEE6703 – Special Electrical Machines for B.E. (Part-Time) Sixth Semester – Electrical and Electronics Engineering – Regulations – 2014)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Mention the types of rotors in synchronous reluctance motor.
2. Identify the reason for increasing the saliency ratio in synchronous reluctance motor.
3. The stepper motor has a step angle of 1.8° and is driven at 4000 pps. Determine (a) Resolution (b) Rotor speed.
4. List out any four applications of stepper motor.
5. Why is rotor position sensor essential for the operation of switched reluctance motor ?
6. List out the basic requirements of power semiconductor switching circuits employed for switched reluctance motor.
7. Compare conventional DC motor with permanent magnet brushless DC motor.
8. A permanent magnet brushless DC motor has a no-load speed of 6000 rpm when connected to 120 V dc supply. Find the armature current when the load torque is 0.5 Nm.
9. Distinguish between ideal and practical brushless permanent magnet sine wave motors.
10. Draw the permissible operating region in the torque-speed characteristics of permanent magnet synchronous motor.

PART – B (5×13=65 Marks)

11. a) Explain the constructional features of a synchronous reluctance motor and discuss its working principle.

(OR)

b) A three phase 230V, 60Hz, 4 pole star connected synchronous reluctance motor with negligible armature resistance has X_{sd} = 22.5 Ω and X_{sq} = 3.5 Ω. The load torque is 12.5 Nm. The voltage to frequency ratio is maintained constant at rated value. If the supply frequency is 60Hz, determine (a) torque angle, (b) line current and (c) input power factor.

12. a) Describe in detail the construction and working of variable reluctance stepper motor.

(OR)

b) Draw and explain in detail the static and dynamic characteristics of stepper motor.

13. a) i) What is the relationship between torque and current in synchronous reluctance motor ? Derive the equation of torque developed in a switched reluctance motor. (7)

ii) A switched reluctance motor with six stator poles and four rotor poles has a stator pole arc of 40° and rotor pole arc of 42°. The aligned inductance is 12 mH and the unaligned inductance is 2.8 mH. Saturation can be neglected. Determine the instantaneous torque when the phase current is 7A. Neglect fringing. (6)

(OR)

b) What is the function of feedback diodes in the power converter circuit of switched reluctance motor ? Discuss in detail the working of the power converter circuit that makes use of two transistors and two diodes per phase for a three phase switched reluctance motor with suitable waveform.

14. a) Describe with suitable diagram the closed loop control scheme of permanent magnet brushless DC motor.

(OR)

b) Derive the torque equation and torque ratio of permanent magnet brushless DC motor.

15. a) Derive the emf equation of ideal and practical permanent magnet synchronous motor.

(OR)

b) i) Draw the phasor diagram of permanent magnet synchronous motor and there from derive the torque equation. **(6)**

ii) A 3 phase, 4 pole permanent magnet synchronous motor has 36 slots. Each phase winding is made up of three coils per pole with 20 turns per coil. The coil span is seven slots. If the fundamental component of magnetic flux is 1.8 mWb, calculate the open circuit phase emf at 3000 rpm. **(7)**

PART – C **(1×15=15 Marks)**

16. a) i) Draw a drive circuit for a three phase variable reluctance stepper motor that makes use of two different voltage levels and explain the same with neat graph representing current and voltage. **(8)**

ii) Calculate the step angle of a three phase switched reluctance motor having 8 rotor poles. Also determine the commutation frequency at each phase at the speed of 2400 rpm. For a stepper motor having the same step angle, calculate the number of stator and rotor poles. **(7)**

(OR)

b) Compare permanent magnet brushless DC motor with permanent magnet synchronous motor based on their performance parameters.
