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

Question Paper Code : 41013

04/05/18 AN

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Seventh Semester
Electrical and Electronics Engineering
EE6703 – SPECIAL ELECTRICAL MACHINES
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Mention any two advantages of synchronous reluctance motors.
2. Define 'Reluctance Torque' with reference to synchronous reluctance motor.
3. What are the different modes of excitation in a stepper motor ?
4. What is meant by Lead angle in stepper motors ?
5. What is the need for shaft position sensor for Switched Reluctance Motor ?
6. Draw the speed-torque characteristics of Switched Reluctance Motor.
7. List any four permanent magnet materials.
8. State some important applications of Permanent Magnet Brushless DC Motors.
9. Write the important features of Permanent Magnet Synchronous Motor.
10. State the types of power controllers for Permanent Magnet Synchronous Motor.

PART – B **(5×16=80 Marks)**

11. a) Explain the constructional details and working principle of synchronous reluctance motor with neat diagrams. **(10+6)**

(OR)

b) Explain the phasor diagram and characteristics of synchronous reluctance motor. **(10+6)**

12. a) i) Describe the principle of operation of hybrid stepper motor. **(8)**

ii) Explain briefly a closed-loop operation system using a microprocessor for a hybrid stepping motor. **(8)**

(OR)

b) i) Explain the mechanism of static torque production in a variable reluctance stepping motor. **(10)**

ii) Describe the dynamic characteristics of a variable reluctance stepper motor. **(6)**

13. a) Draw the cross sectional view of switched reluctance motor and explain the principle of operation. State the advantages of switched reluctance motor. **(10+6)**

(OR)

b) Draw and explain four converter topologies for a 3-phase SRM. Write the merits and demerits of each topology. **(16)**

14. a) i) Explain the magnetic circuit analysis of permanent magnet brushless DC motor on open-circuit. **(10)**

ii) Derive the EMF equation of permanent magnet brush less DC motor. **(6)**

(OR)

b) i) Draw and explain the general structure of a controller for a permanent magnet brush less DC motor. **(8)**

ii) Describe the torque/speed curve of the ideal burshless DC motor. **(8)**

15. a) For an ideal sine wave permanent magnet motor, derive the EMF and Torque equations. **(8+8)**

(OR)

b) i) Describe the construction of phasor diagram of surface-magnet sine wave motor. **(8)**

ii) Explain the torque/speed characteristic of sine wave motor. **(8)**

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

Question Paper Code : 52966

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

Seventh Semester

Electrical and Electronics Engineering

EE 6703 — SPECIAL ELECTRICAL MACHINES

(Regulation 2013)

(Common to PTEE 6703 – Special Electrical Machines for B.E. (Part-Time) – Sixth Semester – Electrical and Electronics Engineering – Regulation 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention some applications of synchronous reluctance motor.
2. Compare SyRM and Induction motor.
3. Draw the block diagram of the drive system of a stepping motor.
4. State some applications of stepper motor.
5. State the principle of operation of switched reluctance motor.
6. What are the types of power controllers used for SRM?
7. What are the advantages of brushless dc motor drives?
8. List the permanent magnet materials used in PMBLDC motors.
9. What are the types of PMSM?
10. Why PMSM operating in self controlled mode is known commutatorless dc motor?

PART B — (5 × 13 = 65 marks)

11. (a) Explain the construction and principle of working of a universal motor and mention its applications.

Or

(b) Draw the phasor diagram and explain the performance characteristics of repulsion motor.

12. (a) Explain the operating principles, constructional features of three different types of stepper motor.

Or

(b) Explain the various modes of excitation of PM stepper motor with a bridge driver scheme.

13. (a) Describe the various power controller circuits applicable to switched reluctance motor and explain the operation of any one scheme with suitable circuit diagram.

Or

(b) Draw a schematic diagram and explain the operation of a "C"-dump converter used for the control of SRM.

14. (a) With relevant waveforms, derive the expression for torque and emf of PM brushless DC motor.

Or

(b) Describe the operation of power controllers for PMBLDC motor with neat diagram.

15. (a) Enumerate the design considerations of permanent magnet synchronous motor.

Or

(b) With necessary phasor diagram and circle diagram, describe torque speed characteristics of PMSM.

PART C — (1 × 15 = 15 marks)

16. (a) A brushless PM sinewave motor has an open circuit voltage of 173V at its corner point speed of 3000 rpm. It is supplied from a p.w.m. converter whose maximum voltage is 200V rms. Neglecting resistance and all other losses, estimate the maximum speed at which maximum current can be supplied to the motor.

Or

(b) Derive the relationship between magnetic field intensity and flux density by performing the magnetic circuit analysis of a brushless dc motor on open circuit.

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

Question Paper Code : 50495

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017
Seventh Semester
Electrical and Electronics Engineering
EE 6703 – SPECIAL ELECTRICAL MACHINES
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Compare synchronous reluctance motor and induction motor.
2. Classify the different types of synchronous reluctance motor.
3. Name the various modes of excitation in stepper motor.
4. Distinguish the half step and full step operations of a stepper motor.
5. Illustrate the different modes of operation of switched reluctance motor.
6. Give the advantages of sensorless operation of switched reluctance motor.
7. What is the principle of operation of PMBLDC motor.
8. Write down the torque equation of PMBLDC motor.
9. What are the types of PMSM ?
10. State the power controllers for PM synchronous machines.

PART – B (5×16=80 Marks)

11. a) i) Discuss in detail about the construction and working of synchronous reluctance motor with neat diagrams. (8)

ii) Draw and explain phasor diagram with characteristics of synchronous reluctance motor. (8)

(OR)

b) Describe the constructional features and operation of variable reluctance synchronous reluctance motor. (16)

12. a) Draw and explain the drive circuits and their performance characteristics for stepper motor. **(16)**

(OR)

b) With a neat block diagram explain microprocessor control of stepper motor. **(16)**

13. a) Explain with a neat circuit any two configuration of power converters used for the control of switched reluctance motor. **(16)**

(OR)

b) Explain with a neat diagram the constructional details and working of rotary switched reluctance motor. **(16)**

14. a) Discuss in detail about magnetic circuit analysis of PMBLDC motor. Also draw its characteristics. **(16)**

(OR)

b) Prove that the torque equation in BLDC motor is similar to that of conventional DC motor. **(16)**

15. a) Derive the expression for power input and torque of a PMSM. Explain how its torque speed characteristics is obtained. **(16)**

(OR)

b) Explain the construction and working principle of operation of PMSM. **(16)**

13/12/18 (FN)

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

Question Paper Code : 20468

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Seventh Semester

Electrical and Electronics Engineering

EE 6703 — SPECIAL ELECTRICAL MACHINES

(Regulations 2013)

(Common to PTEE 6703 – 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. Draw the torque-angle characteristics of synchronous reluctance motor.

2. What is reluctance torque in synchronous reluctance motor?

3. Classify the different types of stepping motors.

4. Define detente torque.

5. What are the types of rotor position sensors in switched reluctance motor?

6. What are the advantages of switched reluctance motor?

7. Why is the PMBLDC motor called electronically commutated motor?

8. Compare conventional DC motor and PMBLDC motor.

9. What are the features of permanent magnet synchronous motor?

10. Draw the phasor diagram of a permanent magnet synchronous motor.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Draw the steady state phasor diagram of synchronous reluctance motor. (6)

(ii) Draw and explain the speed-torque characteristics of synchronous reluctance motor. (7)

Or

(b) Describe the constructional details and working principle of synchronous reluctance motor. (13)

12. (a) Describe the static and dynamic characteristics of stepper motor. (13)

Or

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

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

Or

(b) What are the different types of power controllers used for SRM and explain the operation of any two scheme with suitable circuit diagram. (13)

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

Or

(b) Derive EMF equation for PMBL square wave DC motor. (13)

15. (a) Explain about self controlled PMSM drive by employing load commutated thyristor inverter. (13)

Or

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

PART C — (1 × 15 = 15 marks)

16. (a) Discuss the applications areas of different special electrical machines? (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 = 15Ω. 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)

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22/11/19/FN

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.

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