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Question Paper Code : 40463

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

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 × 2 = 20 marks)

1. A stepper motor has a step angle of 1.8°. Determine the resolution and the number of pulses required to rotate the shaft through 72°.

2. How is the monofilar winding different from bifilar winding used for stepper motors?

3. Identify the different modes of operation of switched reluctance motor.

4. Compare switched reluctance motor and stepper motor.

5. A permanent magnet DC motor has a stalling torque of 1 Nm. The stall current is 5A. Determine the no load speed of the motor in rpm when this motor is fed from 28 V DC supply.

6. Distinguish between conventional DC motor and permanent magnet brushless DC motor.

7. What motive is there to name the permanent magnet brushless DC motor as self-synchronous machine?

8. List out some applications of brushless permanent magnet DC motor.

9. Identify the reason for increasing the saliency ratio in synchronous reluctance motor.

10. List out the advantages of Hysteresis motor.

PART B — (5 × 13 = 65 marks)

11. (a) Sketch the static and dynamic characteristics of stepper motor. Explain in detail each term involved. What would happen if the stepper motor is stopped in slewing mode?

Or

(b) A variable reluctance stepper motor is operated in full step single phase on mode. Draw the excitation table for clockwise direction of rotation and describe its working. How would you change the direction of rotation? Draw the corresponding excitation table.

12. (a) You are assigned to design a converter circuit that has (n+1) switching devices for a switched reluctance motor, where 'n' is the number of phase windings. Draw the converter circuit and explain its working with neat phase current waveform. Why are feedback diodes required? Give the advantages and disadvantages.

Or

(b) (i) A switched reluctance motor with six stator poles and four rotor poles has a stator pole arc of 30° and rotor pole arc of 32°. The aligned inductance is 12mH and the unaligned inductance is 2.8mH. Saturation can be neglected. Calculate the instantaneous torque when the phase current is 7A. Neglect fringing. (7)

(ii) Sketch the waveforms corresponding to the PWM mode of switched reluctance motor and describe its operation. (6)

13. (a) Draw the circuit of power controller employed for the brushless. permanent magnet DC motor, Discuss in detail its working to achieve the desired speed and to limit the current within permissible value.

Or

(b) Develop the equation of torque developed in a permanent magnet brushless DC motor and draw the torque-speed characteristics.

14. (a) How is the induced emf related to flux in a practical permanent magnet synchronous motor? Deduce the relationship between the two.

Or

(b) Draw the phasor diagram of permanent magnet synchronous motor and derive its torque equation.

15. (a) How does a linear induction motor differ from an induction motor? Explain its working with relevant characteristics. Also mention the applications.

Or

(b) What is the type of material used in the rotor of Hysteresis motor? Describe its construction with a suitable diagram. Explain its working with the torque speed characteristics.

PART C — (1 × 15 = 15 marks)

16. (a) Draw the bipolar drive circuit of stepper motor with diode-resistor suppression circuit and explain its working with a neat current and voltage waveform. Also clearly discuss in detail the role of diode-resistor suppression circuit used in it.

Or

(b) (i) How is electromagnetic excitation different from permanent magnet of permanent magnet synchronous motor? (6)

(ii) How is the synchronous reluctance motor different from permanent magnet synchronous motor? Discuss in detail the working of synchronous reluctance motor and deduce its characteristics. (9)