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B.Tech. DEGREE EXAMINATION, DECEMBER 2023
Fifth Semester

18EEE306T – SPECIAL ELECTRICAL MACHINES
(For the candidates admitted from the academic year 2020-2021 to 2021-2022)

Note:

- (i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
- (ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours

Max. Marks: 100

PART – A (20 × 1 = 20 Marks)

Marks BL CO PO

Answer **ALL** Questions

- | | | | | |
|---|---|---|---|---|
| 1. _____ material is used for the construction of a variable reluctance stepper motor with salient poles. | 1 | 1 | 1 | 1 |
| (A) Paramagnetic | | | | |
| (B) Ferromagnetic | | | | |
| (C) Diamagnetic | | | | |
| (D) Non-magnetic | | | | |
| 2. A stepping motor is a _____ device. | 1 | 1 | 1 | 1 |
| (A) Mechanical | | | | |
| (B) Electrical | | | | |
| (C) Analogue | | | | |
| (D) Incremental | | | | |
| 3. Which of the following is not a component of stepper motor? | 1 | 1 | 1 | 1 |
| (A) Windings | | | | |
| (B) Rotor | | | | |
| (C) Commutator | | | | |
| (D) Stator | | | | |
| 4. For a given stepper motor rotational speed is determined solely by _____. | 1 | 1 | 1 | 1 |
| (A) Shaft load | | | | |
| (B) Step pulse frequency | | | | |
| (C) Polarity of stator current | | | | |
| (D) Magnitude of stator current | | | | |
| 5. Switched reluctance motor design is based on the _____. | 1 | 1 | 2 | 1 |
| (A) PM stepper motor | | | | |
| (B) Hybrid stepper motor | | | | |
| (C) Variable reluctance stepper motor | | | | |
| (D) Claw tooth stepper motor | | | | |
| 6. The torque of a SRM corresponds to motoring mode then $dL/d\theta$ is _____. | 1 | 1 | 2 | 1 |
| (A) Positive | | | | |
| (B) Negative | | | | |
| (C) Zero | | | | |
| (D) Infinite | | | | |
| 7. The power controllers used for SRM is _____. | 1 | 1 | 2 | 1 |
| (A) Chopper | | | | |
| (B) C-dump circuit | | | | |
| (C) L/R drive | | | | |
| (D) Bilevel circuit | | | | |
| 8. Rotor position sensor is mounted on the _____ of SRM. | 1 | 1 | 2 | 1 |
| (A) Shaft | | | | |
| (B) Rotor | | | | |
| (C) Winding | | | | |
| (D) Stator | | | | |

9. Identify the sensor, which one is mostly used in BLDC motor. 1 1 3 1
 (A) Phototransistor (B) Encoder
 (C) Hall effect (D) Current
10. The back emf of the PMBLDC motor is _____. 1 1 3 1
 (A) Sinusoidal (B) Trapezoidal
 (C) Square (D) Triangular
11. _____ commutation required in BLDC motor. 1 1 3 1
 (A) Electronic (B) Mechanical
 (C) Both mechanical and (D) Either mechanical or electronic electronic
12. Among the following, which one is the torque equation of BLDC motor? 1 1 3 1
 (A) $4B_g r l T_{ph}$ (B) $4B_g r l T_{ph} I$
 (C) $4B_g l T_{ph}$ (D) $4B_g l T_{ph} I$
13. Which PM rotor construction is employed in PMSM motor? 1 1 4 1
 (A) Surface mounted PM (B) Interior PM only
 (C) Buried PM only (D) Both buried and interior PM
14. Identify the following, which one is the torque equation of ideal PMSM? 1 1 4 1
 (A) $\pi A B r l \sin \alpha$ (B) $\pi A B r l \sin \alpha$
 (C) $\pi A r l \sin \alpha$ (D) $\pi B r l \sin \alpha$
15. How many number of switches will conduct for every 60° during the 180° mode conduction in PMSM. 1 1 4 1
 (A) 1 (B) 2
 (C) 3 (D) 4
16. PMSM are extensively used in _____. 1 1 4 1
 (A) Welding (B) High speed and high power drive
 (C) Printing press (D) Grinder applications
17. The phase difference between two windings of AC servo motor is 1 1 5 1
 (A) 60° (B) 90°
 (C) 120° (D) 180°
18. The speed of the universal motor is usually reduced by _____. 1 1 5 1
 (A) Gearing (B) Belt
 (C) Bares (D) Chains
19. In a single phase repulsion motor power factor is 1 1 5 1
 (A) Always leading (B) High at low speed
 (C) High at high speed (D) Always unity
20. The synchronous speed of a linear induction motor does not depend on _____. 1 1 5 1
 (A) Width of pole pitch (B) Number of poles
 (C) Supply frequency (D) Stator

PART – B (5 × 4 = 20 Marks)

Answer ANY FIVE Questions

	Marks	BL	CO	PO
21. A variable reluctance stepper motor has 8-stator slots and 6-rotor slots. Calculate step angle and its resolution.	4	2	1	1
22. Draw and explain the torque-speed characteristics of SRM.	4	2	2	1
23. Write short notes on permanent magnets used in electrical machines.	4	2	3	1
24. Compare the PMSM and BLDC motor with respect to rotor magnet design.	4	2	4	1
25. Draw the circuit employed in speed control of universal motor for sewing machine application.	4	1	5	1
26. Explain in briefly about the open loop operation of stepper motor.	4	1	1	1
27. Explain why the BLDC motor is called as electronically commutated motor.	4	1	3	1

PART – C (5 × 12 = 60 Marks)

Answer ALL Questions

	Marks	BL	CO	PO
28. a. Explain the construction and operation of multi-stack hybrid stepper motor with neat diagram.	12	1	1	1
(OR)				
b. Explain the closed loop operation of microprocessor controlled stepper motor.	12	1	1	1
29. a. Derive the expression for switched reluctance motor and prove that torque value is directly proportional to square of the current.	12	2	2	1
(OR)				
b. Draw and discuss the suitable converter circuit for 3-phase SR motor whose converter has most advantageous under demagnetization effect during commutation.	12	2	2	1
30. a. Identify the type of winding used in BLDC motor with 180° magnetic arcs and 120° square wave current. Design a BLDC constructional layout and also sketch the inverter firing sequence with phase current waveform.	12	2	3	1
(OR)				
b. Discuss the sensorless operation of a BLDC motor with neat block diagram and list out the application of BLDC motor.	12	1	3	1
31. a. Derive the emf equation of an ideal PMSM with neat flux density distribution waveform.	12	1	4	1

(OR)

b. With neat block diagram, explain the closed loop operation of PMSM with required sensors. 12 1 5 1

32. a. Deduce the expression for the torque of repulsion motor with single stator winding whose value is directly proportional to square of the current. 12 1 5 1

(OR)

b. Discuss the operation of linear induction motor with neat constructional diagram and also list out the applications. 12 1 5 1

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