Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, April / May 2024

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VI Semester

EE5010 - SPECIAL ELECTRICAL MACHINES

(Regulation 2019)

Time:3hrs Max.Marks: 100

CO1	Analyze given magnetic circuit and understand operation, characteristics and control of PMBLDC motor
CO2	Understand the construction, operation performance characteristics of PMSM and its power controllers
CO3	Understand the construction, operation and control of SRM drive and its power controllers
CO4	Understand the construction, operation, characteristics and control of stepper motor
CO5	Understand the operation & characteristics of other special electrical machines.

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10x2=20Marks)

(Answer all Questions)

Q. No.	Questions	Marks	CO	BL
1	Mention some applications of PMBLDC motors	2	1	1
2	List out the normally used Permanent magnet material.	2	1	2
3	Differentiate Sine wave PMBL motor and AC Synchronous motor.	2	2	4
4	What is meant by synchronous reactance?	2	2	2
5	Give the expression for torque of a switched reluctance motor.	2	3	1
6	What are the Commonly used Sensorless Control Technique in SRM Drives?	2	3	1
7	What is the required resolution for a stepper motor that is to operate at a pulse frequency of 6000 pps and a travel of 180° in 0.25μsec.	2	4	5
8	What is slewing in stepper motors?	2	4	2
9	Why is compensating winding required in an AC Series motor?	2	5	2
10	Plot the Torque speed Characteristic of hysteresis Motor	2	5	6

PART- B (5x 13=65Marks)

(Restrict to a maximum of 2 subdivisions)

Q. No.		Questions	Marks	CO	BL
11 (a)		Discuss the magnetic circuit analysis relevant to PMBLDC motor. Also draw the characteristics.	13	1	3
		OR			
11(b)	(i)	Derive the expression for permeance coefficient.	5	1	3
	(ii)	A PMBLDC motor has torque constant of 0.12 Nm/A referred to DC supply. Find the motor's no-load speed	8		5

		in r.p.m when connected to 48 V DC supply. Find the stall current and stall torque if armature resistance is 0.15 Ω/phase and total voltage drop in controller is 2 V			
12 (a)		Write the principle of operation and derive the EMF equation of a Permanent Magnet Synchronous Motor.	13	2	2
		OR			
12(b)	(i)	Describe the construction of Phasor diagram of Permanent Magnet Synchronous Motor.	6	2	2
	(ii)	Explain in detail the vector control of permanent magnet synchronous motor.	7		
13 (a)	(i)	Sketch the inductance profile of SRM and explain.	6	3	3
	(ii)	What is the step angle of 3 phase of Switched Reluctance motor having 12 stator poles and 8 rotor Poles. What is the Commutation frequency in each phase at a speed of 6000 r.p.m.	7		5
		OR			
13 (b)		Explain the principle of operation of switched Reluctance motor and draw the converter circuit for three phase SRM	13	3	2
14 (a)		Explain the mechanism of static torque production in a Variable reluctance Stepper motor	13	4	2
		OR			
14 (b)		Draw and explain drive circuits and their performance characteristics for stepper motor	13	4	4
15 (a)		Write a note on (i) AC series Motor (ii) Hysteresis motor	7 6	5	4
		OR			
15 (b)	(i)	What are linear motors? How are they different from rotary motors? Explain the application areas of linear motors.	6	4	3
	(ii)	Explain the principle of operation of linear induction motor.	7		

PART- C (1x 15=15Marks)

(Q.No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16.	Plot the mechanical characteristics of Switched Reluctance motor and discuss the type of control strategy used for different regions of the curve.	15	3	6