Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 80005

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – NOV. / DEC. 2024
Seventh Semester
Electrical and Electronics Engineering
U19EEV22 – SPECIAL ELECTRICAL MACHINES
(Regulation 2019)

Time: Three Hours | Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	What is the key difference between the conventional synchronous motor and a synchronous reluctance motor?	2	K1	CO1
2.	Define the quadrature axis synchronous inductance in a synchronous reluctance motor. How does this parameter play a role in developed torque?	2	K1	CO1
3.	Illustrate the BH curves of permanent magnets used in permanent magnet synchronous motor and indicate its operational parameters.	2	K2	CO2
4.	Illustrate the phasor diagram of a salient pole PMSM with armature resistance neglected.	2	K2	CO2
5.	How a flux weakening mode of speed control is applied in brushless permanent magnet DC motor.	2	K1	CO3
6.	How the back emf constant is related to the motor torque constant in a brushless permanent magnet DC motor ?	2	K1	CO3
7.	Infer the switching operation of SRM from motoring mode to generating mode.	2	K2	CO4
8.	Why rotor position feedback is required for the operation of a synchronous reluctance motor?	2	K1	CO4
9.	What do you understand by 'Synchronism' in a stepper motor?	2	K1	CO5
10.	Interpret the statement: The motor, suited for position control applications in open loop mode is 'Stepper Motor'.	2	K2	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	With the help of phasor diagrams and per phase equivalent circuit for d and q axis, derive the equation for torque developed in a three phase Synchronous Reluctance motor (neglect losses).	13	K3	CO1
		(OR)			
	b)	A three phase 4 pole 50 Hz 230 V star connected motor has direct axis and quadrature axis synchronous reactances of 22.5 Ω and 3.5 Ω respectively. The Load Torque is 12.5 N-m. Find i. Torque angle ii. Line current iii. Power factor. Neglect rotational losses and copper losses.	13	K3	CO1
12.	a)	Derive the EMF & Torque equation for a 3 phase salient pole Permanent magnet synchronous motor when supplied with a balanced three phase sinusoidal voltage.	13	K3	CO2
		(OR)			
	b)	Explain vector control scheme for a PMSM with a neat block diagram, necessary signal and power processing modules.	13	K2	CO2
13.	a)	Illustrate the power and control schematic of a BLDC motor with trapezoidal back emf that uses a position decoder for 120° conduction of the 3-phase stator. Explain the functioning of the controller in achieving Speed -Torque characteristics from the BLDC motor, similar to a DC motor.	13	K2	CO3
		(OR)			
	b)	i. Derive the expression for the back emf developed in a two pole, three phase BLDC motor with 120°, conduction.	5	K3	CO3
		ii. A BLDC motor has a no-load speed of 6000 rpm when connected to 120 V DC source. Armature resistance is 2.5 Ω. Find the speed when it is supplied with 60 V and developing a torque of 0.5 N-m. The no load current is 1 A.	8	K3	CO3
14.	a)	Consider 8/6 pole SRM machine and sketch the relative positions of rotor tooth and a stator pole when the rotor tooth moves across the stator pole. Draw the L-θ profile for this traverse and indicate the current and torque profile on the same time base, for motoring and generating modes of operation.	13	K3	CO4
		(OR)			
	b)	Explain the control schemes of SRM with neat diagrams.	13	K2	CO4

15.	a)	Consider a VR stepper motor with stator 3 phase 6 pole configuration, connected in 2 coil groups and rotor with four poles. It has the following modes of operation. (i) Full step operation (1 phase on mode) (ii) Full step operation (2 phase on mode) (iii) Half step operation (alternate 1 phase ON and 2 phase ON) Explain the operation with truth table, clearly indicating the stator phase(s) energized and the rotor shaft angular position.	13	K2	CO5
		(OR)			
	b)	i. A stepper motor has a step angle of 1.8^0. Find a. resolution b. no of steps required for 50 revolutions c. shaft speed if the stepping frequency is 5000 pulses /sec	6	K3	CO5
		ii. Explain the closed loop control of a stepping motor with neat diagrams.	7	K2	CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	What do you understand by 'Synchronism' in Synchronous motors? Explain how this is achieved in conventional synchronous motor as against in sine wave permanent magnet brushless motor. Clearly explain the process of synchronization in the later case (Sine wave BLDC motor with self-control) with necessary measuring and control schemes.	15	K3	CO2
		(OR)			
	b)	Identify any one application of synchronous reluctance motor and switched reluctance motor and explain their operation in the selected applications.	15	K2	CO4
