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: 80022

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – NOV. / DEC. 2025
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.	State the principle of torque production in a synchronous reluctance machine.	2	K2	CO1
2.	Derive an expression for the speed of the rotating mmf vector in a synchronous reluctance motor.	2	K2	CO1
3.	Is it possible to vary the air gap field in a PMSM motor? If so, how?	2	K2	CO2
4.	How is torque angle maintained at 90 degree in a permanent magnet synchronous motor?	2	K2	CO2
5.	State the main cause of torque ripples in a PMBLDC motor.	2	K2	CO3
6.	How is the rotor position evaluated for the control PMBLDC motors?	2	K2	CO3
7.	Write about L-θ profile of a switched reluctance motor.	2	K2	CO4
8.	What kind of a position sensor is required for the operation of switched reluctance motor?	2	K1	CO4
9.	Define "pull in torque" of a stepper motor.	2	K2	CO5
10.	What is meant by detent torque in a stepper motor operation?	2	K1	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.			Questions	Marks	KL	CO
11.	a)	i.	List the requirements in designing the rotor of a synchronous reluctance motor.	5	K2	CO1
		ii.	Explain the working of a three phase SyRM supplied with three phase-balanced voltage to its stator.	8		
			(OR)			
	b)		Sketch a block diagram with relevant sensors and signal processing modules and explain about the constant direct axis current control of a SyRM.	13	K2	CO1
12.	a)	i.	For a cylindrical rotor PM synchronous machine, derive the expression for the torque developed at the air gap, assuming that the torque angle is maintained at 90 degree by rotor position feedback.	8	K3	CO2
		ii.	List down the key features of the power processing and signal processing modules required for the control of PMSM.	5		
			(OR)			
	b)		In a sinusoidal waveform, permanent magnet brushless servomotor phase-to-phase resistance is 8.0 ohms and the ph to ph inductance is 16 mH. The voltage constant, which is the ratio of the peak phase voltage induced to the rotational speed is 25V/1000 rpm: p = 2 and n = 10,000 rpm. Calculate the terminal voltage if the load is such that the motor draws 10 A rms per phase. Calculate the power factor of the operation.	13	K3	CO2
13.	a)	i.	With the help of 3 numbers of Hall effect sensors, show that the switching sequence of three phase inverter (120 degree mode) can be drawn up for driving the BLDC motor in both CW and CCW directions.	10	K3	CO3
		ii.	Explain how the speed and torque control of BLDC motor be accomplished with the above scheme.	3		
			(OR)			
	b)	i.	A brushless permanent magnet four-pole three-phase motor has the following parameters. Torque constant = 0.229 N-m/A, Voltage constant = 24 V/1000 rpm, phase-to-phase resistance = 8.4 Ω, ph to ph winding inductance = 16.8 mH. The above motor produces a trapezoidal back emf. The torque constant is obtained as the ratio of max torque produced to the current flowing through two of the phases. Voltage constant is the ratio of peak ph to ph voltage to the rotational speed. If the motor is operating at a speed of 3000 rpm and delivering a torque of 0.25 N-m plot the idealized phase current waveforms.	10	K3	CO3

		ii.	Estimate the minimum output voltage (L-L), the switch mode converter is required to supply to the motor if the maximum speed is 5000 rpm and the torque is 0.25 N-m.			
14.	a)	i.	Explain the construction and working of SRM and summarize the conditions fot successful operation of the SRM.	6	K2	CO4
		ii.	List down the constraints to be satisfied for obtaining optimum L-θ profile in terms of slot and tooth dimensions of the rotor and stator.	7		
			(OR)			
	b)		A three phase SRM has six poles and four rotor teeth. Draw the feasible zone for stator and rotor pole arcs. Design the pole arc and rotor tooth arc. Sketch the L-θ profile.	13	K2	CO4
15.	a)		Compare permanent magnet stepper motors and VR stepper motors by listing down their advantages and the disadvantages.	13	K2	CO5
			(OR)			
	b)	i.	A stepper motor is operating at a pulse rate of 5000 pulse/sec. It travels 100 degree in 0.02 sec. Find its resolution.	5	K2	CO5
		ii.	A five-phase stepper motor has 40 teeth. It drives a lead screw having a pitch of 10 threads per cm. The lead screw in turn, produces a linear motion of a cutting tool. The input pulse is applied 10 times. Find the distance covered by the cutting tool.	8		

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	The need of using rotor position sensors in a BLDC motor is avoidable. Using the Trapezoidal back emf (measured line-line voltage at the terminals of the motor) the rotor position can be evaluated, thus making the motor control sensor-less. Can you elaborate this idea?	15	K3	CO3
		(OR)			
	b)	Illustrate with an example about space vectors in a rotating machines. Decode the use of space vectors in poly-phase motor control operations.	15	K3	CO2