Reg. No.																

Question Paper Code	14781

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Seventh Semester

Electrical and Electronics Engineering

20EEEL713 - SPECIAL ELECTRICAL MACHINES

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	The purpose of the rotor position detection in a stepper motor system is _____ a) to determine the step angle b) to Synchronize the motors rotation c) to provide feedback for closed-loop control d) to regulate the motor's speed	1	K1	CO1
2.	The speed of rotation of the stepper motor depends on ____ a) torque b) number of input pulses c) frequency of input pulses d) solenoid	1	K1	CO1
3.	Explain the main difference between full-step and half-step in a stepper motor a) In full-step two phases are on and in half-step only one phase is on. b) More resonance is evident in half-step c) More power required for full-step d) Half-step offers better resolution	1	K2	CO1
4.	For a three-phase switched reluctance motor having 10 stator poles and 4 rotor poles, select the commutation frequency in each phase at a speed of 6000 rpm listed below a) 200 Hz b) 400 Hz c) 800 Hz d) 1600 Hz	1	K3	CO2
5.	In sensor less operation of an SRM, Explain which method is used to initialize the rotor position? a) Rotor position estimation based on the initial current flow b) Mechanical alignment of the rotor with the stator poles c) Estimation based on the motor's rated speed and inertia d) Manual input of the rotor position during motor startup	1	K2	CO2
6.	In variable reluctance principle of operation, when air gap is minimum_____ a) Reluctance minimum, inductance maximum b) Both reluctance and inductance minimum c) Both reluctance and inductance maximum d) No change in reluctance and inductance	1	K1	CO2
7.	Magnetic circuit analysis in Permanent Magnet Brushless D.C. (PMBLDC) motors is used to determine the _____. a) Mechanical load angle b) Torque-speed characteristics c) Copper losses d) Magnetic flux distribution	1	K1	CO3
8.	Permanent magnet brushless DC motor develop _____ a) Unipolar trapezoidal induced emf b) Bipolar trapezoidal induced emf c) Bipolar triangular induced emf d) Sinusoidal induced emf	1	K3	CO3

9.	Identify the torque developed in PMBLDC motor, which is proportional to the _____	1	K3	CO3
	a) Back EMF constant b) Stator winding resistance			
	c) Load torque d) Armature current			
10.	Torque developed in permanent magnet machines depends upon	1	K3	CO4
	a) Electric loading b) Magnetic loading			
	c) Both electric and magnetic loading d) None of the mentioned			
11.	Illustrate why Neodymium boron iron is most widely used in permanent magnets? _____	1	K2	CO4
	a) Low cost and ease availability b) Powerful attractiveness and cost			
	c) Ease of availability d) None of the mentioned			
12.	The electronic commutator acts as an _____ whose frequency is related to rotor speed	1	K2	CO4
	a) Ideal Inverter b) Ideal Converter			
	c) Ideal Chopper d) None of the mentioned			
13.	The variation of reluctance R_l with space angle θ_r depends on the shape of _____	1	K1	CO5
	a) stator poles b) rotor poles			
	c) stator or rotor poles d) both stator and rotor poles			
14.	Outline how the direction of rotation can be reversed in a hysteresis motor?	1	K2	CO5
	a) by changing the field winding polarity b) by changing the armature winding polarity			
	c) by changing the direction of current flow in the field winding d) by changing the direction of current flow in the armature winding			
15.	Identify the zero torque developed in a repulsion motor, when _____	1	K3	CO5
	a) Brush axis is 45^0 electrical to field axis b) Brush axis coincides with the field axis			
	c) Brush axis is 90^0 electrical to field axis d) Both (b) and (c)			
16.	Identify the maximum average torque for a reluctance motor, which occurs when δ = _____._____	1	K3	CO5
	a) 45° b) 90°			
	c) 0° d) 180°			

PART – A (ii) (Short Answer Questions)
(8 × 3 = 24 Marks)
Answer ALL Questions

17.	Identify the modes of excitation in a stepper motor.	3	K3	CO1
18.	Distinguish the half step and full step operation of a stepper motor	3	K4	CO1
19.	Demonstrate the speed-torque characteristics of switched reluctance motor with neat diagram.	3	K3	CO2
20.	Construct the switched reluctance motor using C-dump converter.	3	K3	CO2
21.	List the advantages of brushless dc motors compared to the conventional dc motors	3	K4	CO3
22.	Identify the rotor geometrics in PM synchronous motor.	3	K3	CO4
23.	Analyze the self-control method in PMSM.	3	K4	CO4
24.	Write the applications of linear induction motor in industry.	3	K3	CO5

PART - B (Descriptive Answer Questions)
(5 × 12 = 60 Marks)
Answer ALL Questions

25.	a)	With necessary diagrams, develop the mechanism of torque production in VR stepper motor.	*12*	*K3*	*CO1*
		OR			
	b)	Analyze the constructional features and excitation modes of a Permanent Magnet Stepper Motor.	*12*	*K3*	*CO1*
26.	a)	Analyze the working principle of sensor less closed loop control of SRM with a neat block diagram.	*12*	*K3*	*CO2*
		OR			
	b)	Develop the mathematical expressions for voltage and torque in a Switched Reluctance Motor and enlighten their significance.	*12*	*K3*	*CO2*
27.	a)	Analyze the torque and EMF equations for a PMBLDC motor and elucidate their significance.	*12*	*K4*	*CO3*
		OR			
	b)	Sketch and analyze the constructional features of a PMBLDC motor with its principle of operation.	*12*	*K4*	*CO3*
28.	a)	Construct the microprocessor-based control of permanent magnet synchronous motor with its schematic diagram and narrate its applications.	*12*	*K3*	*CO4*
		OR			
	b)	Organize the principle of operation of a sine wave PM synchronous machine with its phasor diagram and derive its torque equation.	*12*	*K3*	*CO4*
29.	a)	With neat diagrams, Analyze the characteristics of Hysteresis motor.	*12*	*K4*	*CO5*
		OR			
	b)	Sketch and analyze the torque–speed characteristics of synchronous reluctance motor and its applications.	*12*	*K4*	*CO5*