Reg. No | | | | | | | | | | AY 24

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

M.Tech. (First Semester – Regular/Supplementary) Examinations, January – 2026

24MPEPC11002 – MODELING AND ANALYSIS OF ELECTRICAL MACHINES
(Power Electronics)

Time: 3 hrs   Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions

		CO #	Blooms Level
a.	Define electromagnetic energy conversion with an example.	CO1	K1
b.	Why is reference frame transformation used in AC machine analysis?	CO2	K2
c.	What are dynamic equivalent circuit parameters of a synchronous machine?	CO3	K1
d.	Distinguish between surface-mounted and interior permanent magnet synchronous machines.	CO4	K2
e.	Write the general expression for electromagnetic torque in a doubly excited system.	CO1	K1

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions

		Marks	CO #	Blooms Level
2. a.	Derive the general expression for stored magnetic energy and co-energy in a nonlinear magnetic system.	5	CO1	K3
b.	Using energy and co-energy concepts, derive the torque expression for a doubly excited magnetic system.	5	CO1	K4
	(OR)			
c.	Explain in detail the calculation of air-gap MMF and per-phase inductances of a three-phase machine using its winding and geometry data.	5	CO1	K4
d.	Derive the voltage and torque equations of a DC machine starting from basic electromagnetic principles.	5	CO1	K3
3.a.	Derive the Park's transformation matrix for a three-phase machine and show how phase quantities are transformed into d–q–0 components.	5	CO2	K3
b.	Starting from the phase-variable model, derive the dynamic d–q model of a three-phase induction machine in an arbitrary reference frame.	5	CO2	K4
	(OR)			
c.	Derive the d–q model of a salient-pole synchronous machine and explain the physical meaning of d- and q-axis quantities.	5	CO2	K4
d.	Compare phase-variable and d–q models in terms of complexity, accuracy and suitability for digital simulation and control design.	5	CO2	K4
4.a.	Explain the procedure for determining dynamic equivalent circuit parameters of a synchronous machine from open-circuit, short-circuit and sudden short-circuit tests.	5	CO3	K3
b.	Describe the dynamic modelling of a two-phase asymmetrical induction machine and highlight the role of auxiliary winding.	5	CO3	K4
	(OR)			
c.	Discuss the dynamic behaviour of single-phase induction motors and explain how the double-revolving-field theory is used to model them.	5	CO3	K4

d.	Develop the equivalent circuit of a single-phase induction motor based on double-revolving-field theory and discuss its torque–speed characteristics.	5	CO3	K4
5.a.	Explain the construction and operating principle of a surface-mounted PMSM with square-wave back EMF. Compare it with a sinusoidal PMSM.	5	CO4	K4
b.	Derive the dynamic model of a PMSM in the rotor reference frame and explain how it is used for vector control.	5	CO4	K4
	(OR)			
c.	Describe in detail the self-controlled operation of PMSM using a voltage source inverter and its impact on torque ripple and speed control.	5	CO4	K4
d.	Explain the construction, torque production mechanism and operating modes of a switched reluctance motor (SRM) with suitable waveforms.	5	CO4	K4
6.a.	Discuss the significance of energy and co-energy concepts in analyzing electromechanical devices and actuators.	5	CO1	K4
b.	Explain how reference frame theory simplifies the analysis of transient behavior in AC machines under unbalanced and dynamic conditions.	5	CO3	K4
	(OR)			
c.	Explain how saturation and cross-magnetization effects can be incorporated into synchronous machine dynamic models.	5	CO2	K4
d.	Discuss the control strategies used in SRM drives for torque ripple reduction and high-speed operation.	5	CO4	K4

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