PVP 23

Code: 23EE3402

II B.Tech - II Semester – Regular / Supplementary Examinations
APRIL 2026

INDUCTION AND SYNCHRONOUS MACHINES
(ELECTRICAL & ELECTRONICS ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	Define slip in a 3-phase induction motor.	L1	CO1
1.b)	Distinguish between squirrel cage and slip ring induction motors (any two points).	L2	CO1
1.c)	Explain what is meant by V/f control of induction motor.	L4	CO4
1.d)	Define slip at which maximum torque occurs.	L2	CO2
1.e)	Define single-phase induction motor.	L1	CO1
1.f)	Explain why an auxiliary winding is required for the operation of a single phase induction motor.	L2	CO2
1.g)	Define distribution factor.	L1	CO3
1.h)	State the conditions for synchronization of alternators.	L2	CO5
1.i)	State the principle of operation of a synchronous motor.	L2	CO1
1.j)	Why is a synchronous motor not self-starting?	L2	CO3

PART – B

			BL	CO	Max. Marks
UNIT-I					
2	a)	Explain the constructional features of squirrel cage and slip ring induction motors.	L2	CO1	5 M
	b)	Explain the working principle of 3-phase induction motor.	L2	CO1	5 M
OR					
3	a)	Derive the expression for synchronous speed and slip.	L3	CO2	5 M
	b)	Draw and explain the equivalent circuit of a 3-phase induction motor.	L3	CO2	5 M
UNIT-II					
4	a)	Explain the phenomena of crawling and cogging in induction motors.	L4	CO4	4 M
	b)	A 15kW, 400 V, 4-pole, 50Hz, 3-phase star connected induction motor gave the following test results. No Load Test: 400V, 9A, 1310W Blocked Rotor Test: 200V, 50A, 7100W Stator to rotor ohmic drops at standstill are assumed equal. Draw the circle diagram and evaluate i. Full load line current and slip. ii. Full load power factor and torque. iii. Efficiency at full load.	L4	CO4	6 M
OR					

5	a)	Name different methods of starting of 3-phase induction motors and explain any one method.	L4	CO4	5 M
	b)	Derive the condition for maximum torque and expression for starting torque.	L4	CO4	5 M
		UNIT-III			
6	a)	Explain why a single-phase induction motor is not self-starting?	L2	CO2	2 M
	b)	Analyze any two starting methods used in single-phase induction motors.	L4	CO4	8 M
		OR			
7	a)	Explain the construction and working of shaded pole motor.	L2	CO1	5 M
	b)	Explain double revolving field theory of single-phase induction motor.	L2	CO2	5 M
		UNIT-IV			
8	a)	Explain the constructional features of salient pole and non-salient pole alternators.	L2	CO1	5 M
	b)	Derive the EMF equation of a synchronous generator.	L3	CO3	5 M
		OR			
9	a)	Explain armature reaction in synchronous generators under different load power factors with phasor diagrams.	L4	CO3	5 M

	b)	Find the value of K_d for an alternator with 9 slots per pole for the following cases: i. One winding in all the slots. ii. One winding using only the first 2/3 of the slots per pole. iii. Three equal windings placed sequentially in 60° group.	L4	CO5	5 M
		UNIT-V			
10	a)	Explain the construction and principle of operation of a synchronous motor.	L2	CO1	5 M
	b)	A 3-ϕ,150 kW, 2300 V, 50 Hz,1000 rpm salient-pole synchronous motor has X_d=32 Ω per phase and X_q=20 Ω per phase. Neglecting losses, calculate the torque developed by the motor if field excitation is so adjusted as to make the back e.m.f. twice the applied voltage and $\alpha=16^0$.	L4	CO5	5 M
		OR			
11	a)	Explain the effect of load variation on power angle and stability of synchronous motor.	L4	CO5	5 M
	b)	Derive the expression for power developed in a synchronous motor.	L3	CO5	5 M