Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R) (FT/WP) Examinations April 2026 (2024 Scheme)

Course Code: PCEET402
Course Name: SYNCHRONOUS AND INDUCTION MACHINES

Max. Marks: 60 Duration: 2 hours 30 minutes

Graph sheets shall be provided

PART A

(Answer all questions. Each question carries 3 marks)

		CO	Marks
1	Derive the expression for distribution factor of a 3-phase alternator.	1	(3)
2	Sketch a neat phasor diagram of a synchronous generator supplying an inductive load.	1	(3)
3	Discuss the operating principle of a synchronous motor	2	(3)
4	Draw and explain power angle characteristics of salient pole synchronous generator	1	(3)
5	Describe the operating principle of an autotransformer starter used for starting an induction motor.	3	(3)
6	Sketch the torque–slip characteristics of an induction motor and mark key points.	3	(3)
7	Apply the principle of plugging to explain how an induction motor can be brought to a quick stop.	4	(3)
8	Describe the double revolving field theory of a single-phase induction motor.	5	(3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

9	a)	Define armature reaction and analyse its characteristics under a zero-power factor leading load.	1	(4)
	b)	A 3-phase, 12-pole alternator has a stator with 108 slots, each slot containing 6 conductors arranged in two layers. The conductors of each phase are	1	(5)

connected in series. The alternator runs at 500 rpm. The resultant air-gap flux is sinusoidally distributed with a maximum value of 4×10^{-2}Wb per pole. The coil span is 160° electrical. Calculate the induced EMF per phase.

10 a) An 11 kV, 1000 kVA, three-phase star-connected alternator has an armature resistance of 2 Ω per phase. The OCC and ZPF characteristics are given. Determine the voltage regulation of the alternator at full load and 0.8 power factor lagging using the Potier method. 1 (9)

Field Current (A)	40	50	110	140	180
Open circuit Line Voltage (V)	5800	7000	12500	13750	15000
ZPF Line voltage (V)	0	1500	8500	10500	12500

Module -2

11 a) Draw the phasor diagram of a salient pole synchronous generator operating at lagging power factor, neglecting armature resistance 2 (3)

b) With a neat sketch, explain the dark lamp method of synchronizing alternators, and state the necessity of paralleling alternators. 2 (6)

12 a) A 3-phase star-connected alternator has a synchronous impedance of $2 + j12\ \Omega$ per phase. It is operating at a constant line voltage of 11 kV and its field current is adjusted to give an excitation voltage of 10.5 kV. Calculate: (i) Maximum power output (ii) Armature current at maximum power output (iii) Power factor at maximum power output (iv) Armature current at maximum power input and (v) Power factor at maximum power input. 2 (9)

Module -3

13 a) Deduce the approximate equivalent circuit of a three-phase induction motor from the transformer analogy. 3 (6)

b) Explain the need for starters in induction motors and mention their importance during starting. 3 (3)

14 a) Test on a 7.46 kW, 200V, 50 Hz 3 phase slip ring star connected induction motor showed on no load, the motor took 7.7A at a pf of 0.195 lag, while 3 (9)

blocking the rotor the current was 47.6 A at 0.454 pf lagging with the applied voltage reduced to 100V. Draw the circle diagram and find (i) Maximum power factor (ii) Maximum output and (iii) Maximum torque. Missing data if any, may be assumed suitably.

Module -4

15	a)	Explain the principle of dynamic braking with reference to induction motors.	5	(5)
	b)	Describe the working of a line-excited induction generator with neat figure.	5	(4)
16	a)	Explain how starting torque is developed in a split-phase induction motor. Also draw the phasor diagram.	5	(4)
	b)	Explain how speed control is achieved in a 3-phase induction motor using V/f control.	4	(5)

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