Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) / S5 (WP) (R) / S3 (PT) (S,FE) Examination November 2024 (2019 Scheme)

Course Code: EET 307

Course Name: SYNCHRONOUS AND INDUCTION MACHINES

Max. Marks: 100 Duration: 3 Hours

(GRAPH SHEET NEEDED)

PART A

(Answer all questions; each question carries 3 marks) Marks

1		Explain the effect of harmonics in pitch factor and distribution factor.	3
2		Sketch the phasor diagram of a cylindrical pole type alternator with lagging and leading power factor load.	3
3		X_d and X_q are different for salient pole alternators where as they are same for cylindrical rotor alternators. Comment on the statement	3
4		Identify the voltage regulation method which is known as the optimistic method and explain why it is known so.	3
5		Enlist the starting methods of synchronous motor and describe any one method.	3
6		Sketch the torque slip characteristics of three phase induction motor and show the variation of rotor resistance in the characteristics.	3
7		Explain the phenomenon of crawling in three phase induction motor	3
8		Describe the pole-changing method for speed control of the induction motor.	3
9		Compare synchronous generator and induction generator.	3
10		Illustrate how starting torque is developed in split phase induction motor.	3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11	a)	Explain the advantages of stationary armature over rotating armature types	6
	b)	A 4-pole, 50 Hz star-connected alternator has a flux per pole of 0.12 Wb. It has 4 slots per pole per phase, conductors per slot being 4. If the winding coil span is 150° , calculate open circuit line voltage and open circuit phase voltage .	8
12	a)	Derive the emf equation of alternator.	5

b) An 8-pole, 3-phase, 60° spread, double layer winding has 72 coils in 72 slots. The coils are short pitched by two slots. Calculate the winding factor for the fundamental and third harmonic. 9

Module -2

13 a) A 3-phase, star-connected, 1000 kVA, 11000 V alternator has rated current of 52.5 A. The ac resistance of the winding per phase is 0.45 Ω. 8

The test results are given below:

OC test: Field current =12.5A, Voltage between lines= 411V

SC test: Field current =12.5A, Line current = 52.5A

Determine the full-load voltage regulation of the alternator at (a) 0.8 pf lagging and (b) 0.8 pf leading.

b) Explain the slip test of alternator. 6

14 A 3.5 MVA, Y connected alternator rated at 4160 V at 50 Hz has open circuit characteristics given by the following data: 14

Field current (A):	50	100	150	200	250	300	350	400
Line EMF (V)	1620	3150	4160	4750	5130	5370	5550	5650

A field current of 200 A is found necessary to circulate full load current on short circuit of the alternator. Calculate by (i) Synchronous Impedance method and (ii) Ampere -turn method, the full load voltage regulation at 0.8 pf lagging . Neglect armature resistance.

Module -3

15 a) Synchronous motor is not self starting. Justify the statement. 6

b) A 440 V, 50 Hz, 6-pole, 3 phase induction motor draws an input power of 76 kW from the mains. The rotor emf makes 120 complete cycles per minute. Its stator losses are 1 kW and rotor current per phase is 62 A. Calculate (a)speed (b) rotor copper losses (c) rotor resistance per phase (d) torque developed. 8

16 a) Sketch the power angle characteristics of synchronous machine and explain. 6

b) The power input to a 6-pole, 50 Hz, 3-phase induction motor is 700 W at no-load and 10 kW at full-load. The no-load copper losses may be assumed negligible 8

while the full-load stator and rotor copper losses are 295 W and 310 W respectively. Calculate the full-load speed, shaft torque and efficiency of the motor assuming rotational and core losses to be equal.

Module -4

17	a)	A 30hp, 500 V, 50 Hz, 4 pole, 3 phase mesh connected induction motor has the following data: (i) No load test: 500 V, 8.3 A, 1500 W (ii) SC test :100 V, 32 A, 1600 W (iii) Rotor copper loss at standstill is equal to half of the total copper loss Sketch the circle diagram and estimate the full load current and power factor.	14
18	a)	Elaborate the working of Double cage induction motor with relevant sketches. Also draw the torque slip characteristics of the Double cage induction motor	9
	b)	Explain the dynamic braking of the Induction motor.	5

Module -5

19	a)	Describe with neat figure, the operation of Induction Generator	8
	b)	Why Single phase induction motors are not self-starting?	6
20	a)	Explain with neat sketches about the different types of single-phase induction motors with their applications.	14

***