D 1100EET307122101 Pages: 3

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2022 (2019 Scheme)

Course Code: EET 307

Course Name: SYNCHRONUS AND INDUCTION MACHINES

Max. Marks: 100 Duration: 3 Hours

PART A

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

1	Compare salient pole and cylindrical rotor type of alternators.	(3)
2	Briefly explain the term pitch factor in an alternator and derive an expression for it.	(3)
3	Draw the phasor diagram of a salient pole type alternator with lagging power factor load.	(3)
4	X_d and X_q are different for salient pole alternators where as they are same for cylindrical rotor alternators. Justify.	(3)
5	Synchronous motor is not self starting. Why?	(3)
6	A 3 phase, 50 Hz induction motor, has a full load speed of 700 rpm and a no load speed of 740 rpm. (a) How many poles does the machine have? (b) Find the slip and rotor frequency at full load? (c) What is the speed of the rotor field at full load (i)with respect to rotor (ii)with respect to stator	(3)
7	Consider a 3 phase Induction motor with a normal torque speed characteristics. Neglecting the effects of stator resistance and leakage reactance, discuss the approximate effect on the characteristics if the applied voltage is kept constant, but the frequency is halved.	(3)
8	Briefly explain crawling in Induction motor	(3)
9	Explain the principle of operation of induction generator	(3)
10	Enumerate few applications of single phase induction motor	(3)

PART B

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

Module -1

11 a) Explain the causes of harmonics in an alternator? How it can be minimised? (6)

b) A 3-phase, 4 pole, 50 Hz, synchronous generator has 48 slots in which double layer winding is housed. Each coil has 10 turns short pitched by an angle of 36^o electrical. Flux/pole is 0.025 Wb (sinusoidally distributed). Then, for a 3phase, Y connection, find (i) the line to line induced emf (ii) the fifth harmonic component of line to line induced emf. (8)

12 a) Explain the effect of armature flux on main field flux when an alternator is operating at (i) lagging pf. (ii) Unity pf (iii) Leading pf. (10)

b) Derive the emf equation of an alternator. (4)

Module -2

13 a) Explain the ASA method of determining the voltage regulation of alternator. (7)

b) A 1500 kVA, 6600 V, 3 phase , star connected alternator with a resistance of 0.4 ohm and reactance of 6 ohm per phase delivers full load current at power factor 0.8 lagging and normal rated voltage. Estimate the terminal voltage for the same excitation and load current at 0.8 p.f leading. (7)

14 a) Explain the MMF method of determining the voltage regulation of alternator. (7)

b) A 10 kVA, 440 V, 50 Hz, 3 phase, star connected, alternator has the open circuit characteristics as below (7)

I_f (A)	1.5	3	4	5	8	11	15
V_{oc} (L-L)	150	300	380	440	550	600	635

With full load zero power factor, the excitation required is 14 ampers to produce 500 volts terminal voltage. On short circuit 4 ampers excitation is required to produce full load current. Determine the full load voltage regulation at 0.8 pf lagging by ZPF Method.

Module -3

15 a) Sketch and explain V and inverted V curves of synchronous motor (7)

b) Derive the expression for electromagnetic torque developed for induction motor (7)

16 a) Explain the principle of operation of synchronous motor with neat sketch (7)

b) The power input to the rotor of a 440v, 50 Hz, 6 pole, 3 phase induction motor is 80 kW. The rotor electromotive force is observed to make 100 complete (7)

alternations per minute. Calculate (a) the slip; (b) the rotor speed; (c) the mechanical power developed; (d) the rotor copper loss per phase; (e) the rotor resistance per phase if the rotor current is 65 A.

Module -4

17 a) Justify the necessity of starters in three phase induction motors (4)

b) Draw the no load and short circuit diagram for a 20 h.p., 400 V, 50 Hz, 3 phase star-connected induction motor from the following data (line values): (10)

No load test : 400 V, 9A, $\cos\phi = 0.2$

Short circuit test : 200 V, 50 A, $\cos\phi = 0.4$.

From the diagram find (a) the line current and power factor at full load, and (b) the maximum horse power.

18 a) Explain dynamic braking of induction motors (4)

b) Determine approximately the starting torque of an induction motor in terms of full load torque when started by means of (a) star-delta switch; (b) an auto-transformer with 50% tapping. Ignore magnetizing current. The short circuit current of the motor at normal voltage is five times the full load current, and the full load slip is 5%. (10)

Module -5

19 a) Explain grid connected operation of induction generator. (6)

b) Explain the principle behind split phase method of starting of single phase induction motor (8)

20 a) Explain double revolving field theory of single phase induction motor (8)

b) Explain the principle of operation of shaded pole motor (6)

***