Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: EE202

Course Name: SYNCHRONOUS AND INDUCTION MACHINES

Max. Marks: 100 Duration: 3 Hours

Graphs sheets shall be supplied.

PART A

Answer all questions, each carries 5 marks. Marks

1 Explain the term pitch factor in an alternator and derive an expression for it. Also discuss the effect of short pitching on harmonics. (5)

2 Define armature reaction. Explain the effect of armature reaction on the terminal voltage of an alternator at zero leading power factor load. (5)

3 Explain why X_d and X_q are different for salient pole alternators whereas they are the same for the smooth rotor machines. (5)

4 Explain the working of a synchronous condenser. (5)

5 How would you rate the performance of an autotransformer starter with a DOL starter used in an induction motor? (5)

6 Equivalent circuit parameters of a 3 phase induction motor can be determined from no load and blocked rotor tests. Justify. (5)

7 Explain the principle of shaded pole induction motor with suitable diagram. (5)

8 Using equivalent circuit prove that the induction machine becomes a generator when the machine is driven above synchronous speed. (5)

PART B

Answer any two full questions, each carries 10 marks.

9 a) Differentiate between salient pole type and cylindrical type alternator with sketches. (5)

b) Derive the EMF equation of an alternator. (5)

10 The open-circuit test data for a 3-phase, 3.5 MVA, 4.16 kV, 50 Hz star connected synchronous generator are given below. (10)

Open-circuit characteristic:

I_f (A)	50	100	150	200	250	300	350	400	450
V_{OC} (line) (kV)	1.62	3.15	4.16	4.75	5.13	5.37	5.55	5.65	5.75

A field current of 200A is found necessary to circulate full load current on short circuit of the alternator. The machine supplies full-load at a p.f. of 0.8 lagging. Determine its voltage regulation by (i) EMF method (ii) MMF method. Neglect resistance.

11 a) Show that the output emf wave of an alternator do not contain even harmonics. (5)

b) Find the distribution factor and pitch factor of a 3 phase 4 pole 24 slots alternator having its armature coils short pitched by one slot. (5)

PART C

Answer any two full questions, each carries 10 marks.

12 a) Derive the expression for mechanical power developed in a cylindrical rotor type synchronous motor. (6)

b) A 2.3kV, 3 phase star connected synchronous motor has Z_s = (0.2 + j 2.2) ohms per phase. The motor is operating at 0.5pf leading with a line current of 200A. Determine the induced emf per phase. (4)

13 a) Derive an expression for developed torque in a 3-phase induction motor and find the condition for maximum torque. Also sketch the torque-slip curve. (6)

b) A 746KW, 3-phase, 50Hz, 16 pole induction motor has a rotor impedance of (0.02+j0.15) ohm at stand still. Full load torque is obtained at 360 rpm. Calculate (i) the ratio of maximum to full load torque and (ii) the speed corresponding to max torque. (4)

14 a) Explain the effect of change in excitation in parallel operation of alternators. (6)

b) The power input to a 500V, 50Hz, 6-pole, 3-phase induction motor running at 975 rpm is 40KW. The stator losses are 1KW and the friction and windage losses total 2KW. Calculate: (i) the slip (ii) the rotor copper loss (iii) shaft power and (iv) the efficiency. (4)

PART D

Answer any two full questions, each carries 10 marks.

15 Draw the circle diagram for a 3.73kW, 200V, 50Hz, 4 pole 3 phase star connected induction motor from the following data : (10)

No load Test :	200V, 5A, 350W
Blocked Rotor Test:	100V, 26A, 1700W

Rotor copper loss at stand still = half of the total copper loss

Construct the circle diagram and estimate: (i) full load current, (ii) power factor at full-load and (iii) maximum torque in terms of full-load torque.

16 a) Explain the phenomenon crawling as applied to induction motor. (5)

b) Explain how pulling into step is achieved in synchronous induction motor. (5)

17 a) Differentiate between plugging and regenerative braking as applied to induction motors. (4)

b) If the standstill impedance of the outer cage of a double cage induction motor is (2+j0.4) ohm and of the inner cage is (0.4+j2) ohm, compare the relative torques of two cages (i) at standstill (ii) at a slip of 5%. (6)

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