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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R, S) / S3 (PT) (R, S) Examination December 2023 (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		The stator winding of an alternator has 48 slots. A 4 pole, three phase winding is made on the stator. Each coil spans 11 slots. Calculate the pitch factor.	(3)
2		Derive an expression for distribution factor in an alternator.	(3)
3		Draw the phasor diagram of a cylindrical pole type alternator for (i) lagging power factor load (ii) leading power factor load.	(3)
4		X_d is greater than X_q in salient pole machine. Justify	(3)
5		Explain the working of synchronous condenser.	(3)
6		"Power factor of three induction motor is low at starting but it improves as the machine is loaded". Justify the statement.	(3)
7		Briefly explain the phenomenon of cogging in three phase induction motor	(3)
8		Explain the effect of varying the rotor resistance on torque-slip curve of three phase induction motor	(3)
9		Sketch the torque-slip curve of single phase induction motor	(3)
10		Mention few application of capacitor start capacitor run induction motor	(3)

PART B

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

Module -1

11	a)	Derive the emf equation of an alternator	(4)
	b)	A 50 Hz, 600 r.p.m, salient pole alternator has a sinusoidal flux density having a maximum value of 1 Wb/m^2. The alternator has 180 slots wound with 2-layer, 3-turn coils. The coil span is 15 slots and phase spread is 60^o. The armature diameter is 1.25 m and core length 0.45 m. find (i)flux/pole (ii) pitch factor (iii) distribution factor (iv) peak value of emf per conductor (v) peak value of emf per coil (vi) r.m.s phase voltage if the machine is star-connected.	(10)

12 a) List the advantages of stationary armature type alternators over rotating armature types (6)

b) A 12 pole , 3 phase, star-connected alternator has 72 slots. The flux per pole is 0.0988 Wb. Calculate : (8)

(i) the speed of rotation if the frequency of the generated e.m.f is 50 Hz.

(ii) the terminal e.m.f for full-pitch coils and 8 conductors per slot

(iii) the terminal e.m.f if the coil span is reduced to 2/3 of the pole pitch.

Module -2

13 a) The regulation obtained by EMF method is always greater than actual value. Justify (5)

b) A 550V, 55 kVA, 1-phase alternator has an effective resistance of 0.2 ohm. A field current of 10 A produces an armature current of 200 A on short circuit and an electromotive force of 450 V on open circuit. Calculate (a) the synchronous impedance and reactance, and (b) the full load regulation with power factor 0.8 lagging. (9)

14 a) Explain the advantage of determining voltage regulation by ASA method over other methods. (5)

b) A 3.5 MVA, Y connected alternator rated at 4160 volts at 50 Hz has open-circuit characteristics given by the following data: (9)

Field current (A)	50	100	150	200	250	300	350	400
Line E.M.F (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 the full load regulation at 0.8 pf lag of alternator by Optimistic method. Neglect armature resistance.

Module -3

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

b) Estimate the stator current, equivalent rotor current, efficiency, and power factor at a slip of 5% for an three phase induction motor with the following data (7)

Stator impedance: (1+j3) ohm

Equivalent rotor impedance at stand still : (1+j2) ohm

No load shunt impedance (10+j50) ohm

Voltage per phase = 250 V.

Use approximate equivalent circuit. Assume mechanical losses to be zero.

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

b) A three phase induction motor with star connected rotor has an induced electromotive force of 60 V between slip-rings at stand-still on open circuit with normal voltage applied to the stator. The resistance and standstill reactance of each rotor phase are 0.6 ohm and 4 ohm respectively. Calculate the current per phase in the rotor (a) when at stand still and connected to a star connected rheostat of resistance 5 ohm and reactance 2 ohm per phase; (b) when running short circuited with 4% slip. (7)

Module -4

17 a) Explain star-delta method of starting of 3 phase induction motor with a neat sketch (7)

b) A 3 h.p, induction motor with full load efficiency and power factor of 0.83 and 0.8 respectively, has a short circuit current of 3.5 times full load current . Estimate the line current at the instant of starting the motor from a 500 V supply by means of a star-delta switch. Ignore the magnetizing current. (7)

18 a) Explain any one method of speed control applicable to three phase induction motor (7)

b) The cages of a double-cage induction motor have stand still impedances of 3.5+j1.5 ohm and 0.6+j7.0 ohm respectively. The full-load slip is 6%. Find the starting torque at normal voltage in terms of full-load torque. Neglect stator impedance and magnetizing current. (7)

Module -5

19 a) Draw and explain equivalent circuit of single phase induction motor. (7)

b) Explain the self excited operation of induction generator. (7)

20 a) Explain the working of split phase and capacitor start single phase induction motor (8)

b) Mention few applications of single phase induction motor (6)

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