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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV/DEC 2023

ELECTRICAL AND ELECTRONICS

V Semester

EE5501 & Electrical Machines II

(Regulation 2019)

Time: 3hrs

Max.Marks: 100

CO 1	Understand the concepts of windings, MMFs and rotating magnetic fields
CO 2	Understand the operation of ac machines
CO 3	Analyse the performance characteristics of ac machines
CO 4	Analyse the starting and speed control of ac machines
CO 5	Understand the field applications of ac machines

BL – Bloom's Taxonomy Levels

(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	Define pitch factor	2	CO1	L1
2	What are the advantages of distributed winding?	2	CO1	L1
3	Why Single phase induction motor is not self-starting?	2	CO2	L2
4	Mention the relation between electrical and mechanical degree.	2	CO2	L2
5	A 3-phase, 6 pole induction motor is connected to 400 V, 60 Hz supply. Determine: . (i) Actual speed of the motor when running at 4% slip (ii) Frequency of emf induced in rotor	2	CO3	L2
6	The power input to a 3-phase induction motor is 8 kW. The stator losses total 0.15 kW. Find the total mechanical power developed if the motor is running with a slip of 4%.	2	CO3	L2
7	What is the need for star delta starter for three phase induction motor?	2	CO4	L1
8	Mention different speed control methods of three phase squirrel cage induction motor.	2	CO4	L1
9	What are the applications of Shaded pole motors?	2	CO5	L1
10	Define hunting.	2	CO5	L1

PART- B (5 x 13 = 65 Marks)

(Restrict to a maximum of 2 subdivisions)

Q. No	Questions	Marks	CO	BL
11 (a)	The stator of a three-phase, 8-pole synchronous generator driven at 750 rpm has 72 slots. The winding has been made with 36 coils having 10 turns per coil. Calculate the rms value of the induced emf per phase if the flux per pole is 0.15 Wb, sinusoidally distributed. Assume that full-pitch coils have been used. Derive the expression used.	13	CO1	L4
OR				
11 (b)	A three-phase, star-connected synchronous generator driven at 750 rpm is required to generate a line-to-line voltage of 440 V at 50 Hz on open circuit. The stator is wound with 2 slots per pole per phase and each coil has 4 turns. Calculate the useful flux per pole.	13	CO1	L4

12 (a)	How a field produced by a single phase ac supply can be analysed?	13	CO2	L3
OR				
12 (b)	Prove that analytically and graphically, a rotating magnetic field is generated with a three phase winding supplied by a three phase source.	13	CO2	L3
13 (a)	A 3 phase star connected 6.6 kV, 20 pole 50 Hz induction motor has rotor resistance of 0.12 Ω and standstill reactance of 1.12 Ω . The motor has speed of 292.5 RPM at full load. Calculate slip at maximum torque and ratio of maximum torque to full load torque. Derive the ratio between maximum torque to full load torque.	3+6+4	CO3	L4
OR				
13 (b)	A 400 V, 40 hp, 50 Hz, 4 pole delta-connected induction motor No-load test: 400 V, 20 A, 1200 W Blocked-rotor test: 100 V, 45 A, 2800 W Draw the circle diagram and determine (a) the line current and power factor at rated output; (b) the maximum output; (c) the maximum torque; Assume stator and rotor copper losses to be equal at standstill.	4+4+5	CO3	L4
14 (a)	A 230 V, 50 Hz, 6-pole, single-phase induction motor has the following equivalent circuit parameters: $R_1 = 2 \Omega$, $X_1 = 3 \Omega$, $R_2 = 5 \Omega$, $X_2' = 3 \Omega$, $X_m = 100 \Omega$ Friction and windage loss including core loss = 60 W The motor is running at 960 rpm on load. Calculate (a) line current; (b) input power; (c) power factor; (d) developed power; (e) shaft output power; (f) efficiency.	2+2+3 +3+3	CO3	L4
OR				
14 (b)	The main and auxiliary winding impedances of a 50 Hz, capacitor-start single-phase induction motor are $Z_{lm} = 3 + j2.7$ Ohms and $Z_{la} = 7 + j3$ Ohms respectively. Determine the value of the capacitor to be connected in series with the auxiliary winding to achieve a phase difference of 90° between the currents of the two windings at start.	13	CO4	L3
15 (a)	A 1200 KVA, 0 V, 50 Hz, three-phase, star-connected alternator has armature resistance of 0.25W per phase. A field current of 40 A produces a short circuit current of 200 A and an open-circuit emf of 1100 V line-to-line. Calculate the regulation on (a) full-load 0.8 power factor lagging, and (b) full-load 0.8 leading power factor.	13	CO2	L3
OR				
15 (b)	Explain the power-angle characteristics of synchronous generator.	13	CO5	L3

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL																
16.	<p>The no-load test performed on a 1000 kVA, 3000 V, 50 Hz, three-phase star connected alternator gave the following readings:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>If (A)</td> <td>15</td> <td>30</td> <td>50</td> <td>75</td> <td>90</td> <td>120</td> <td>150</td> </tr> <tr> <td>V/ph (V)</td> <td>345</td> <td>690</td> <td>1200</td> <td>1675</td> <td>1900</td> <td>2130</td> <td>2200</td> </tr> </table> <p>The effective armature resistance is 0.25 ohms. When short-circuit test was conducted, a field current of 50 A was required to</p>	If (A)	15	30	50	75	90	120	150	V/ph (V)	345	690	1200	1675	1900	2130	2200	15	CO3	L5
If (A)	15	30	50	75	90	120	150													
V/ph (V)	345	690	1200	1675	1900	2130	2200													

