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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; August - 2023

Electrical Machines - I

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

***CO1**: **Analyze** the basic operation and construction of different types of transformers*
***CO2**: Illustrate the various performance parameters of a single phase and three phase transformer*
***CO3**: Evaluate and assess the various tests to be conducted on a transformer*
***CO4**: Analyze the construction, operation and performance of various types of single phase induction motors*
***CO5**: Analyze the construction, operation and performance of various types of three phase induction motors*

***Note**: I) **PART - A** is compulsory. **Two** marks for each question.*
*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs
	I : PART - A	**10**		
1 a.	Mention the two types of a 1- φ transformer.	2	L1	CO1
b.	Give the expression for regulation and efficiency of a 1-φ transformer.	2	L1	CO2
c.	List out the advantages of 3- φ transformer.	2	L1	CO3
d.	Give an expression for torque developed by an induction Motor.	2	L1	CO4
e.	What is meant by cogging and crawling in an Induction Motor?	2	L1	CO5
	II : PART - B	**90**		
	UNIT - I	**18**		
2 a.	Derive an expression for EMF induced in a 1-φ transformer. Explain the concept of transformer on load with suitable vector diagram for lagging power factor.	9	L3	CO1
b.	Explain the construction of a core type 1-φ transformer. Derive an expression for copper saving in an auto transformer, compared to two winding transformer.	9	L2	CO1
c.	A 50 kVA, 4400/220 V transformer has R_1 = 3.45 Ω, R_2 = 0.09 Ω, X_1= 5.2 Ω, X_2 = 0.015 Ω, calculate; i) Equivalent resistance referred to primary and secondary ii) Equivalent reactance referred to primary and secondary iii) Equivalent impedance referred to primary and secondary iv) Total ohmic loss	9	L3	CO1
	UNIT - II	**18**		
3 a.	Derive an expression for regulation of a transformer for; i) Lagging power factor ii) Zero power factor	9	L3	CO2
b.	Explain the losses in a transformer. Derive the condition at which efficiency of the transformer is maximum.			

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c.	A 5 kVA, 500/250 V, 50 Hz, 1-φ transformer have the following data: OC test : 500 V, 1 A, 50 W (LV side) SC test : 25 V, 10 A, 60 W (LV side) Determine; i) Efficiency on full load @ 0.8 p.f. lag ii) Voltage regulation on FL @ 0.8 p. f lead iii) Efficiency on 60% of FL @ 0.8 p.f lead iv) Draw the equivalent circuit referred to primary	9	L3	CO2

UNIT - III **18**

4 a.	With the help of circuit and phasor diagram, explain how 2-φ supply can be obtained from 3-φ supply using Scott connection.	9	L3	CO3
b.	Show that open-delta connection has a kVA rating of 58% of the rating of the normal delta-delta connection.	9	L2	CO3
c.	A 1-φ, 3- winding transformer have the following results from three short circuit test: Secondary shorted, primary excited: 125 V, 25 A, 700 W Tertiary shorted, primary excited: 130 V, 25 A, 800 W Tertiary shorted, secondary excited: 30 V, 120 A, 830 W The rating of windings are as follows: Primary : 100 kVA, 3300 V Secondary : 50 kVA, 1100 V Tertiary: 50 kVA, 400 V Find the resistance and leakage reactance of star-equivalent circuit.	9	L3	CO3

UNIT - IV **18**

5 a.	With relevant sketches, explain the concepts of rotating magnetic field in 3-φ Induction Motor.	9	L2	CO4
b.	Explain the necessity of a starter. With neat circuit, explain Direct Online (DOL) starter for a 3-φ Induction Motors.	9	L2	CO4
c.	Derive an expression for torque developed by an Induction motor. A 24 pole, 50 Hz, star connected Induction Motor has rotor resistance of 0.016Ω per phase and rotor reactance of 0.265 Ω per phase at standstill. It is achieving its full load torque at a speed of 247 rpm. Calculate the ratio of full load torque to maximum torque.	9	L3	CO4

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UNIT - V **18**

6	a.	Explain the principle of operation of a 1-φ Induction Motor using double revolving field theory.	9	L2	CO5
	b.	Write a note on; i) Cogging and crawling in Induction Motor ii) Split- phase Induction Motor	9	L2	CO5
	c.	Draw the circle diagram of 15 kW, 50 Hz, 400 V, 4-pole, 3-φ, star-connected Induction Motor with the following data: No load test: 400 V, 9 A, 1310 W Blocked rotor test: 200 V, 50 A, 7100 W Determine line current and efficiency (choose the scale of 1 cm = 6 A).	9	L4	CO5

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