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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; July / August - 2022

Electrical Machines - I

Time: 3 hrs *Max. Marks: 100*

Course Outcome

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. One question from each unit for maximum of 2 marks.*
*ii) **PART-B** Answer any **TWO** sub questions (from a, b, c) from each unit for a Maximum of 18 marks.*

Q. No.	Questions	Marks	BLs	COs
	I : PART - A	**10**		
I a.	Why flux density in the core of a distribution transformer is restricted to lower values.	2	L1	CO1
b.	What is the cu-loss of a transformer at half load given its full load copper loss is 400 W?	2	L1	CO2
c.	What is the (KVA) capacity of open delta connection, if each transformer is rated for 10 kVA?	2	L1	CO3
d.	What is the slip of an induction motor at starting?	2	L1	CO4
e.	Why rotor core losses are neglected in 3-ph Induction motors?	2	L1	CO5
	II : PART - B	**90**		
	UNIT - I	**18**		
1 a.	What is an ideal transformer? State the assumptions mode for an Ideal transformer. Draw the vector diagram of an ideal transformer with only core losses for, i) lagging pF ii) leading pF load.	9	L2	CO1
b.	A 50 kVA, 4400/220 V transformer has $R_1 = 3.45\ \Omega$, $R_2 = 0.009\Omega$, the values of reactance are $X_1 = 5.2\ \Omega$, and $X_2 = 0.015\ \Omega$, Calculate for the transformer; i) Equivalent resistance as referred to primary ii) Equivalent resistance referred to secondary iii) Equivalent reactance as referred to both primary and secondary iv) Equivalent impedances as referred to both primary and secondary v) Total cu-loss at full load	9	L3	CO1

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c.	Obtain an expression for weight of conductor in a auto transformer to weight of conduction in a two winding transformer. State the basis for comparison. Show how much is the saving in conductor material.	9	L2	CO1

UNIT - II **18**

2 a.	What is voltage regulation of a transformer? Deduce an expression for voltage regulation of transformer with the help of a suitable vector diagram? Obtain the condition for maximum voltage regulation and zero voltage regulation.	9	L2	CO2
b.	The efficiency of a 400 kVA single phase transformer is 98.77% when delivering full load at 0.8 pf and 99.13% at half load and unity power factor. Calculate; i) Iron losses ii) The full load copper losses	9	L2	CO2
c.	Two single phase transformer with equal turns have impedance of (0.5+j3) ohms and (0.6+j10) ohms with respect to the secondary. If they operate in parallel, Determine how they will share total load of 100 kW at 0.8pF lagging? Comment on the load shared.	9	L3	CO2

UNIT - III **18**

3 a.	Explain the principle of operation of a three winding transformer. How do you obtain parameters of equivalent circuit Draw equivalent circuit of three winding transformer.	9	L3	CO3
b.	Two single phase furnaces A and B are supplied at 100 V by means of Scott-connected transformers from a 3 phase, 6 kV system. Furnace A is supplied from the teaser transformer. Calculate the line currents on the three phase side when furnace A takes 500 kW at UPF and furnace B 600 kW at 0.8 pF(lag). Draw vector diagram.	9	L3	CO3
c.	i) Describe Δ-y three phase transformer connection state its advantages and disadvantages. ii) A Transformer has a Δ-connected primary and star connected secondary working at 50 Hz supply. The line voltages of primary and secondary being 6.6 kV and 400V respectively. The line current of the primary side is 8 A and the secondary side has a balanced load of 0.6 pF lagging. Determine; I) The output of the transformer II) The line current on the secondary side	9	L3	CO3

Contd…3

UNIT - IV **18**

4 a.	What is the need for starters in case of 3ph-induction motors? With the help of a neat sketch, describe the working of a star-delta starter state advantages and disadvantages.	9	L2	CO4
b.	Describe about frequency control method of speed control of 3 ph. IM? What is the effect of lowering frequency on maximum torque, slip at maximum torque and starting torque?	9	L3	CO4
c.	i) Derive an expression for torque developed by an inductor motor. ii) A 3 phase induction motor has starting torque of 100% and a maximum torque of 200% of full load torque. Find ship corresponding to maximum torque and slip at full load.	9	L3	CO4

UNIT - V **18**

5 a.	With the help of neat diagrams, explain the working of shaded pole type motor? What are the disadvantages?	9	L2	CO5
b.	Sketch the power flow diagram of a three phase induction motor. Bring out the relationship between rotor input, Power developed and rotor cu-losses.	9	L2	CO5
c.	A 400 V, 3 phase, 50Hz, star connected induction motor has the following test results: No-load test: 400V 8.5 A 1100W Blocked Rotor test: 180 V 45A 5799W Calculate the line current and power factor when operating at 4% slip The stator resistance per phase is 0.5Ω.	9	L3	CO5

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