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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Electrical and Electronics Engineering **Duration: 3 hrs.**
Course Code: 19EE4PCMC1 **Max Marks: 100**
Course: Electrical Machine - I **Date: 15.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) A certain three phase load is small to warrant the installation of full three phase transformer bank. Suggest a suitable transformer connection and describe the same. Show how much load this arrangement can carry without exceeding he ratings. **06**

b) A 500 kVA, single phase transformer delivers load at 400 V. It has 1 % resistance drop and 5% reactance drop. Find the values of resistance and reactance in Ohms. **04**

c) The following readings are obtained from tests on a 30kVA, 3000/110 V transformer: **10**

OC Test	3000V	0.5 A	350 Watt
SC Test	150 V	10A	500 Watt

Calculate the efficiency and voltage regulation of the transformer at full load and 0.8 power factor lagging.

OR

2 a) Three single phase transformers having transformation ratio k and identical voltage, VA ratings are available. It is required to obtain **06**
i) additional step up ii) additional step down by some factor. Draw Transformer connection diagrams to achieve the same. Deduce the expression for the ratio of secondary to primary line voltages in each case.

b) The Copper losses of a 100 kVA, 11000/317 V, single phase transformer is 0.62kW at full load on HV side and 0.48 kW at full load on LV side. Calculate the primary and secondary winding resistances. **04**

c) The open circuit and short circuit tests on a 10 kVA, 500/250 Volt, 50 Hz single phase transformers gave the following results: **10**

OC Test	500 V	2 A	100 Watt
SC Test	25 V	20A	90 Watt

Compute the parameters of the approximate equivalent circuit referred to the primary side. Find the load at which maximum efficiency occurs and the value of maximum efficiency.

UNIT - II

3 a) Compare the copper requirement of an auto transformer and two winding transformer of same VA ratings **08**

b) A 20 kVA, 440/220 V transformer with an equivalent impedance of 0.01 ohm is to operate in parallel with a 15 kVA, 440/220 V transformer with an equivalent impedance of 0.015 ohm. The two transformers are connected in parallel and made to carry a combined load of 25 kVA. Assume both the impedances to have the same angle. **08**

i) Find the individual load currents **ii)** What percentage of the rated capacity of each transformer is used.

c) Draw the diagram of an off load tap changer with a movable arm used with transformers **04**

UNIT - III

4 a) Derive the torque equation of a three-phase induction motor under running conditions in terms of a constant k. Obtain the condition for maximum torque and give the expression for maximum torque. **06**

b) Draw the connection diagram of an auto transformer starter for a star connected three phase cage rotor induction motor. Obtain the expression for starting torque in terms of full load torque with auto transformer starter. **07**

c) "The induction motor tends to get over heated at reduced speeds in speed control by variation of supply voltage method." **07**

Justify the above statement with the help of relevant equations. List the drawbacks of speed control by variation of supply voltage method.

OR

5 a) Obtain the relationship between rotor input, rotor cu-losses and rotor power developed in a three-phase induction motor. **06**

b) Draw the connection diagram of a star delta starter for a star connected three phase cage rotor induction motor. Obtain the expression for starting torque in terms of full load torque with star –delta starter. **07**

c) Sketch the torque –slip characteristics of a three-phase induction motor with variation of supply frequency with V/f ratio remaining constant. Obtain an expression for starting torque at any frequency f in terms of nominal voltage at nominal frequency. Comment on the effect of increasing frequency on the starting torque. **07**

UNIT - IV

6 a) Draw the circle diagram of a three-phase delta connected, 30 HP, 500 V, 4 pole 50 Hz, cage rotor induction motor. Given below is the measurements of line current and voltage and readings of the two Wattmeter connected to measure the input power. **12**

No load Test	500 V	8.3 A	+2.85 kW	-1.35kW
Blocked Rotor Test	100 V	32 A	-0.75kW	+2.35kW

Find from the circle diagram for full load

i) Line current ii) Power Factor iii) Efficiency

b) Show the arrangement of rotor conductors in a double cage rotor motor. Sketch its torque –slip characteristics and explain its operation. **08**

UNIT - V

7 a) Explain double revolving field theory as applied to single phase induction motors. Sketch the torque-slip characteristics of single-phase induction motor and explain **10**

b) A 220V, 6 pole, 50 Hz, single phase induction motor has the following equivalent circuit parameters as referred to the stator. Stator resistance and reactance **10**

R_1= 3 Ohm, X_1=5 Ohm, rotor resistance and reactance referred to the stator side R_2' = 1.5 ohm and X_2'= 2 ohm. Neglect the magnetizing current. When the motor runs at 97% of synchronous speed, compute the ratio of

i) Forward induced stator EMF to backward induced stator EMF
ii) Forward torque to backward torque

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