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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; May/June - 2018

Electrical Machines - I

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Explain the construction of shell and core type single phase transformer. 6

b. Explain the concepts of transformer on load with suitable vector diagram for leading power factor. 6

c. A 33 kVA, 2200/200 V 50 Hz single phase transformer has the following parameters :

Primary winding: $R_1 = 2.4\ \Omega$ and $X_1 = 6\ \Omega$; Secondary winding: $R_2 = 0.03\ \Omega$ and $X_2 = 0.07\ \Omega$. 8

Find; i) Primary resistance and Leakage accountancy referred to secondary

ii) Secondary resistance and Leakage reactance referred to primary

iii) Equivalent resistance and Equivalent reactance referred to both primary and secondary

iv) Full load ohmic loss.

2 a. Derive an expression for copper saving in an auto transformer as compared to two winding transformer. 6

b. With a neat diagram, explain the construction and working of constant voltage transformer. 6

c. A single phase transformer 3300/400 V has the following details :

$R_1 = 0.75\ \Omega$, $X_1 = 3.6\ \Omega$, $R_2 = 0.011\ \Omega$ and $X_2 = 0.045\ \Omega$.

The secondary winding is connected to a coil having resistance of 4.5 Ω and Inductive resistance of 3.2 Ω. Calculate the secondary terminal voltage and the power consumed by the coil. 8

UNIT - II

3 a. Derive an expression for regulation of a transformer for lagging power factor. 6

b. A transformer has its maximum efficiency of 0.98 at 15 kVA, UPF. During a day it is loaded as;

i) 12 hr : 2 kW at 0.5 PF lag ii) 06 hr: 12 kW at 0.8 PF lag iii) 06 hr: 18 kW at 0.9 PF lag 8

Find its all day efficiency.

c. Two single phase transformer share a load of 400 kVA at 0.8 PF lag. Their equivalent impedances referred to secondary winding are (1+J2.5) Ω and (1.5+J3) Ω respectively. Calculate the load shared by each transformer. 6

4 a. With neat circuit diagram, explain regenerative test for determining the efficiency of a transformer. 6

b. A 10 kVA , 2500/250 V, single phase transformer have the following test results :

OC test: 250 V, 0.8 A, 50 W; SC test: 60 V, 3 A, 45 W; Calculate;

i) Efficiency at 75% and 125% of FL at 0.8 PF lag 8

ii) The load at which maximum efficiency occurs and also the value of efficiency @ 0.8 PF

iii) Regulation and secondary terminal voltage under rated load at 0.8 PF lag and 0.8 PF lead

Contd…2

c. Show the condition at which efficiency of transformer is maximum? 6

UNIT - III

5 a. With the help of circuit and Phasor diagram, explain how 2-phase supply can be obtained from 3-phase supply using Scott connection? 12

b. Show that open delta communication has a kVA rating of 58% of rating of the normal delta-delta connection. 8

6 a. A single phase 3 winding transformer have the following results from three short circuit test :

Secondary shorted, primary exited : 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 12

The ratings of winding are as follows :

Primary 100 kVA, 3300 V; Secondary 50 kVA, 1100 V; Tertiary 50 kVA, 400 V.

Find the resistances and leakage reactance of star equivalent circuit.

b. List out the advantages of three phase transformer. 4

c. Mention the conditions to be satisfied for parallel connection of 3-phase transformers. 4

UNIT - IV

7 a. With suitable sketches, explain the construction of squirrel cage and slipping induction motor. 8

b. Derive an expression for torque developed by an induction motor. 6

c. A 24 pole 50 Hz star connected IM has rotor resistance of 0.016 Ω per phase and rotor reactance of 0.265 Ω per phase at stand still. It is achieving its full load torque at a speed of 247 rpm. Calculate the ratio of, i) Full load torque to maximum torque ii) Starting torque to maximum torque. 6

8 a. With relevant sketches, explain the concepts of rotating magnetic field in 3-phase induction motor. 8

b. With neat circuit, explain the working of star-delta starter. 6

c. An 18650 W, 4 pole, 50 Hz, 3 phase IM has friction and windage loses of 2.5% of the output. The full load slip is 4% compute for full load, i) Rotor C_u loss ii) Rotor input iii) Shaft torque. 6

UNIT - V

9 a. Draw the circuit diagram of a 20 HP, 50 Hz, 3 phase star connected IM with the following data :

No load test : 400 V, 9 A, 0.2 PF lagging; Blocked rotor test: 200 V, 50 A, 0.4 PF lagging

Determine the line current and efficiency for full load condition from the circle diagram.

(Choose the scale of 1 cm = 5 A). 12

b. With neat circuit and phase diagram, explain the working of capacitor start IM. Also sketch torque-speed characteristics. 8

10 a. Explain the principle of operation of a single phase IM using double revolving field theory. 10

b. Write a short note on :

i) Split phase induction motor 6

ii) Cogging and Crawling in induction motor 4

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