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3 Hours / 100 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory*.

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any TEN of the following: **20**

a) State Fleming's Right Hand Rule.

b) Why poles of dc machine are laminated?

c) State principle of operation of a d.c motor.

d) Give two methods to change the direction of rotation in dc motor.

e) Name the dc motors suitable for:

(i) Cranes

(ii) Hoists

(iii) Paper machines

(iv) Punches

f) Draw a neat connection diagram of dc shunt motor showing the direction of all the currents.

g) Define transformation ratio of a transformer in terms of current and voltage.

Marks

h) A 50 kVA transformer has 800 watts of copper loss on full load. Calculate its copper loss at 50% full load.

i) Define commercial efficiency and all day efficiency of a transformer.

j) Compare core type transformer and shell type transformer on the following parameters:

(i) No. of windows

(ii) Type of winding used

k) Compare a bank of three single phase transformer with the three phase transformer on the following points:

(i) Number of cores

(ii) Space occupied

(iii) Weight

(iv) If one of the phase is inoperative.

l) State any two conditions for parallel operation of 3-phase transformers.

2. Attempt any FOUR of the following: **16**

a) State at least one function and the material used for the following parts of dc generator:

(i) Yoke

(ii) Field winding

(iii) Commutator

(iv) Brushes

b) A four pole generator, having wave wound armature winding has 51 slots, each slot containing 20 conductors. What will be the voltage generated in the machine when driven at 1500 rpm assuming the flux per pole to be 7.0 mWb?

c) What is back emf? Also explain its significance in DC motor.

Marks

d) A 230 V dc shunt motor has a field resistance of 230 ohm and armature resistance of 0.25 ohm, running at 1500 rpm, taking 20 A from the supply. When a resistance of 230 Ω is added in series with the field circuit, the torque remains unchanged. Find speed and current taken under this condition.

e) Draw and explain the following characteristics of DC shunt motor:

(i) Torque vs Armature current

(ii) Speed vs Torque

f) Explain with the help of neat diagram the following methods of speed control for DC series motor:

(i) Field diverter method

(ii) Tapped field method

3. Attempt any <u>FOUR</u> of the following: **16**

a) Derive the emf equation of a transformer.

b) A single phase transformer has 300 turns on its primary side and 750 turns on its secondary side, the maximum flux density in the core is 1 Wb/m^2, calculate:

(i) The net cross sectional area of the core.

(ii) The emf induced in the secondary side

The primary of the transformer is connected to 440 V, 60 Hz supply.

c) Explain with neat diagram, three phase to two phase conversion (Scott connection) of 3 phase transformer.

d) Explain why rating of a transformer is in kVA and not in kW?

e) State the different types of losses occurring in a transformer. Give their location and also suggest remedies to minimize these losses.

f) A 400 V/100 V transformer taken a no load current of 5 Amp at 0.2 lagging pf. Secondary winding supplies a load of 100 A at 0.8 pf lagging. Find the primary input current.

Marks

4. Attempt any FOUR of the following: 16

a) A 25 kVA, 4000/200 V, 50 Hz transformer has $R_1 = 3.45\,\Omega$, $R_2 = 0.009\,\Omega$, $X_1 = 5.2\,\Omega$ and $X_2 = 0.051\,\Omega$. Calculate the equivalent resistance and equivalent reactance referred to:

(i) Primary

(ii) Secondary

b) A 600 kVA single phase transformer when working at unity pf, has an efficiency of 92% at full load and also at half load. Determine its efficiency when it operates at unity pf and 60% of full load.

c) For a 1 kVA, 230/115 V, 50 Hz, 1-ϕ transformer, draw the experimental set up to conduct open circuit test on it. Determine the range of instruments to be used for their OC Test.

d) A 5 kVA, 250/500 V, 50 Hz, 1-phase transformer gave following test results:

(i) No load: 250 V; 0.75 A; 60 W (LV side)

(ii) Short circuit - 9 V; 6A; 21.6 W (HV side)

Calculate the equivalent circuit components and insert them on the diagram.

e) Draw the complete phasor diagram of a transformer at a load of:

(i) 0.8 pf lagging

(ii) 0.8 pf leading

f) Derive the condition for maximum efficiency of a transformer.

Marks

5. Attempt any FOUR of the following: **16**

a) In a 20 kVA, 1000/400 V, 1-ϕ, 50 Hz transformer, iron and full load copper loss are 300 W and 500 W respectively. Calculate the efficiency at:

(i) Full load and 0.8 pf lagging and

(ii) Half load and unity pf.

b) The total full load loss of a 150 kVA transformer is 4.5 kW which is divided equally between iron and copper loss. The transformer is loaded as follows during the 24 hours of the day. Calculate the all day efficiency.

No. of hours	Loading
3 hours	Full load
4 hours	Half load
17 hours	No load

(Assume pf to be unity throughout the day)

c) Two single phase transformers A and B rated at 250 kVA each are operated in parallel on both sides. Percentage impedances for A and B are (1 + j6) and (1.2 + j4.8) respectively. Compute the load shared by each when the total load is 500 kVA at 0.8 pf lagging.

d) Give any four selection criteria for:

(i) Distribution transformer

(ii) Power transformer

e) With the help of neat diagram, describe the procedure to carry out phasing out test on a 3 phase transformer. Also state the purpose of conducting this test on 3 phase transformer.

f) Identify the following vector group:

(i) Ddo

(ii) Dy5

(iii) Yy6

(iv) Yz11

Marks

6. Attempt any FOUR of the following: **16**

a) Draw the connection diagram and phasor diagram for Star-Delta 3 ϕ transformer. Give any two advantages of this connection.

b) Compare two winding transformer with auto transformer on the following parameters:

(i) Movable contact

(ii) Symbol

(iii) Copper saving

(iv) Electrical isolation

(v) Cost

(vi) Efficiency

(vii) Regulation

(viii) One application each

c) Explain why should a current transformer is never operated with an open secondary.

d) Describe the method for measurement of high voltage in an a.c. circuit using potential transformer.

e) Draw a neat diagram of welding transformer. Also state any two special features of this transformer.

f) Explain any two functions of isolation transformer.