W/D/TY

Reg. No:

VIT
Vellore Institute of Technology

Final Assessment Test – April 2025

Course: BEEE215L - DC Machines and Transformers

Class NBR(s): 0954 Slot: B1

Time: Three Hours Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions

(10 X 10 = 100 Marks)

1. A closed magnetic circuit of cast steel contains a 6 cm long path of cross-sectional area 1 cm^2 and a 2 cm path of cross-sectional area 0.5 cm^2. A coil of 200 turns is wound around the 6 cm length of the circuit and a current of 0.4 A flows. Determine the flux density in the 2 cm path, if the relative permeability of the cast steel is 750.

2. A 4-pole lap-connected armature of a d.c. shunt generator is required to supply the loads connected in parallel:
   - 5 kW Geyser at 250 V, and
   - 2.5 kW Lighting load also at 250 V.

   The Generator has an armature resistance of 0.2 ohm and a field resistance of 250 ohms. The armature has 120 conductors in the slots and runs at 1000 rpm. Allowing 1 V per brush for contact drops and neglecting friction, find
   a) Flux per pole,
   b) Armature-current per parallel path.

3. A shunt generator delivers 195 A at terminal p.d. of 250 V. The armature resistance and shunt field resistance are 0.02 Ω and 50 Ω respectively. The iron and friction losses equal 950 W. Find
   a) E.M.F. generated
   b) Copper losses
   c) output of the prime motor
   d) commercial, mechanical and electrical efficiencies.

4. Justify the need for starters in DC motors. Describe the components of a 4-point starter and explain its working principle with the aid of a diagram. Additionally, highlight the key differences between 3-point and 4-point starters.

5. A 250-V shunt motor has an armature current of 20 A when running at 1000 r.p.m. against full load torque. The armature resistance is 0.5 Ω. What resistance must be inserted in series with the armature to reduce the speed to 500 r.p.m. at the same torque and what will be the speed if the load torque is halved with this resistance in the circuit? Assume the flux to remain constant throughout and neglect brush contact drop.

6. The following data refer to a I-phase transformer:
Turn ratio 19.5: 1; R1 = 25 Ω; X1 = 100 Ω; R2 = 0.06 Ω; X2 = 0.25 Ω. No-load current = 1.25 A leading the flux by 30°.
The secondary delivers 200 A at a terminal voltage of 500 V and p.f. of 0.8 lagging. Determine by the aid of a vector diagram, the primary applied voltage, the primary p.f. and the efficiency.

7. Explain the concept of an autotransformer. How does it differ from a conventional transformer? Derive the expression for copper savings in an autotransformer and explain its advantages.

8. Write Short notes on:
   i) Scott connection in transformer
   ii) off load and on load tap changers in transformer

9.a) The Hopkinson's test on two similar shunt machines gave the following full load data:
- Line voltage = 110 V Field currents are 3 A and 3.5 A
- Line current = 48 A Arm. resistance of each is 0.035 Ω
- Motor arm. current = 230 A

Calculate the efficiency of each machine assuming a brush contact drop of 1 volt per brush.

OR

9.b) A 1-phase, 10-kVA, 500/250-V, 50-Hz transformer has the following constants:
- Reactance: primary 0.2 Ω; secondary 0.5 Ω
- Resistance: primary 0.4 Ω; secondary 0.1 Ω
- Resistance of equivalent exciting circuit referred to primary, R_0 = 1500 Ω.
- Reactance of equivalent exciting circuit referred to primary, X_0 = 750 Ω.

What would be the reading of the instruments when the transformer is connected for the open circuit and short-circuit tests?

10.a) Explain the necessity and advantages of operating DC generators in parallel. Describe the conditions to be fulfilled for parallel operation of two DC generators. What are the causes and effects of hunting in parallel operation?

OR

10.b) Describe the Ward Leonard method of speed control for DC motors. Explain the working principle, advantages, and disadvantages of this method. How does the Ward Leonard method provide smooth and wide-range speed control? Draw a neat diagram to illustrate the setup.

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