

**NATIONAL INSTITUTE OF TECHNOLOGY, DELHI****Name of Examination: B. Tech. (Mid-Semester)****Branch: Electrical & Electronics****Semester: IV****Title of Course: Electrical Machines-I****Course Code: EEB251****Time: 2 Hrs****Maximum Marks: 25****Note: Attempt any five questions. All questions carry equal marks.**

Q1. A 75 KVA, 230/115 V, 60 Hz transformer when tested gave following results:

**Short Circuit Test:** 9.5 V, 326 A, 1200 W

**Open Circuit Test:** 115 V, 16.3 A, 750 W

Determine (a) equivalent impedance referred to HV side, (b) per-unit equivalent impedance, (c) voltage regulation at rated load and 0.8 p.f. lagging, (d) efficiency at rated load and 0.8 p.f. lagging and half rated load at unity p.f. (e) Maximum efficiency and current at which it occurs.

Q2. Define voltage regulation of a transformer. Derive (i) the accurate expression of voltage regulation for lagging power factor load, (ii) condition for zero voltage regulation, and (iii) condition for maximum voltage regulation. Draw relevant phasor diagram for each condition.

Q3. (a) Explain the Sumpner's Test for testing a single-phase transformer. (2 marks)

(b) Two single-phase transformers rated 600 kVA and 500 kVA respectively, are connected in parallel to supply a load of 1000 kVA at 0.8 lagging power factor. The resistance and reactance of the first transformer are 3% and 6.5% respectively, and of the second transformers 1.5% and 8% respectively. Calculate the kVA loading and the power factor at which each transformer operates. (3 marks)

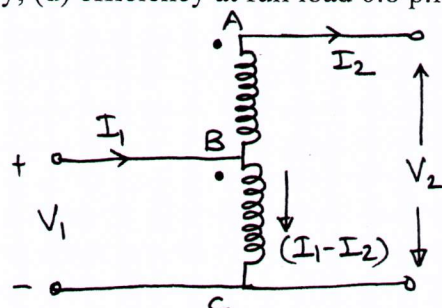
Q4. The following test results were obtained on a 20 kVA, 50 Hz, 2000/200 V distribution transformer:

OC Test on LV side: 200 V, 4 A, 120 W and

SC Test on HV side: 60 V, 10 A, 300 W.

Draw the phasor diagram of the transformer at full load 0.8 p.f. leading. Mark all the phasor with proper magnitude and angles.

If the above transformer is connected as step-up auto-transformer as shown below where  $V_{AB} = 200$  V and  $V_{BC} = 2000$  V calculate: (a) HV & LV side voltage ratings of auto-transformer; (b) its KVA rating; (c) KVA transferred inductively and conductively; (d) efficiency at full load 0.8 p.f.



Q5. A 110 kVA, 2200/110 V, 60 Hz transformer has following circuit constants:  $R_1=0.22$  ohms,  $R_2=0.005$  ohms,  $X_1=2$  ohms,  $X_2=0.005$  ohms,  $R_c=5500$  ohms,  $X_m=1100$  ohms. During 24 hours, the transformer has following load cycles: 4 hours on no load, 8 hours on quarter load at a power factor of 0.8 lagging, 8 hours on half load at unity power factor and 4 hours on full load at unity power factor. Assuming core losses to be 1.346 kW find the all day efficiency of the transformer.

- Q6. (a) Explain the phenomenon of torque production in a dc motor through concept of interaction of magnetic fields. Also show that no electromagnetic torque is produced if stator has two poles and rotor has four poles. (2 marks)
- (b) A 400/100 V, 10 kVA, 2-winding transformer is to be employed as an auto transformer to supply a 400 V circuit from a 500 V source. When tested as a 2-winding transformer at rated load, 0.85 p.f. lagging, its efficiency is 0.97. (a) Determine its kVA rating as the auto transformer. (b) Find its efficiency as an auto transformer. (3 marks)

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