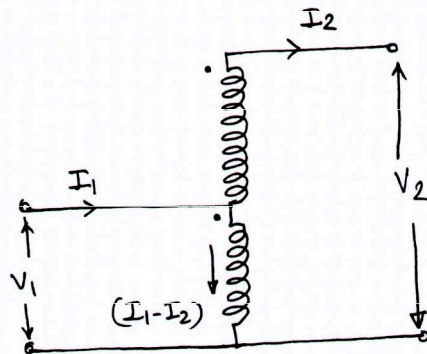


NATIONAL INSTITUTE OF TECHNOLOGY, DELHI**Name of Examination: B.Tech****Branch: Electrical & Electronics****Semester: IV****Title of Course: Electrical Machines-I****Course Code: EEB251****Time: 2 Hrs****Maximum Marks: 25****Note: Attempt any five questions. All questions carry equal marks.**

- Q1. A 10 kVA, 5000/440 V, 25 Hz single phase transformer has copper, eddy current and hysteresis loss of 1.5, 0.5 and 0.6 percent of full load. What will be the percentage losses if the transformer is used on 10 kV, 50 Hz system keeping full load current constant? Assume unity power factor operation. Compare full load efficiencies for the two cases.
- Q2. A 15 KVA, 2300/230 V, 50 Hz single phase transformer when tested gave following results:
Short Circuit Test: 47 V, 6 A, 160 W
Open Circuit Test: 2300 V, 0.21 A, 50 W
 (a) Draw equivalent circuit referred to HV side, (b) find per-unit equivalent impedance, (c) find full load voltage regulation at rated load and 0.8 p.f. lagging and 0.8 pf leading when load voltage is held constant at 220 V (d) efficiency at rated load and 0.8 p.f. lagging and half rated load at unity p.f. (e) Maximum efficiency and the power at which it occurs.
- Q3. 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.
- 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 pf 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 pf.



- 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 5 kVA, 220/110 single phase transformer has the maximum efficiency of 96.97% at lagging power factor. Its core loss is 50 watts and full load regulation at 0.8 pf lag is 5%. Find the efficiency and regulation at $3/4^{\text{th}}$ full load at 0.9 power factor lagging. At what power factor at full load the regulation will be (i) maximum, (ii) minimum and (iii) zero?
