

Power Apparatus and System Design (EE49004), Spring 2021-22

Assignment: PASD_DD_N_As- 3

- **Date of announcement:** 24th March, 2022 **Date of submission:** 7th April, 2022
- **Mode of submission:** prepare a single pdf for the solution and submit it to MSteam
- **Name convention for the pdf:** [RollNo_PASD_as.pdf](#), (if required you may submit other documents in different format but use similar name convention)
- **Total Mark = 50**
- Mention your details clearly on each of the document to be submitted (name, roll number, etc)

Assignment statement

Question 1. List at least ten differences between power and distribution transformers based on their ratings, design criteria, efficiency, uses, etc.

Question 2.

- Define energy efficiency and all-day efficiency of the transformer.
- The daily variation of load on a 100 kVA distribution transformer is as follows:

i)	6:00 A.M to 9:30 A.M	65 kW, 45 kVAr + your home P(kW) and Q(kVAr)
ii)	9:30 A.M to 1:00 P.M	80 kW, 50 kVAr + your home P(kW) and Q(kVAr)
iii)	1:00 P.M to 4:00 P.M	50 kW, 40 kVAr + your home P(kW) and Q(kVAr)
iv)	4:00 P.M to 10:45 P.M	36 kW at 0.85 pf + your home P(kW) and Q(kVAr)
v)	10:45 P.M to 2:00 A.M	25 kW at 0.90 pf + your home P(kW) and Q(kVAr)
vi)	2:00 A.M to 6 A.M	No load

This transformer has no-load core loss of 400 watts and a full load ohmic loss of 1350 watts. Determine all day efficiency of this transformer.

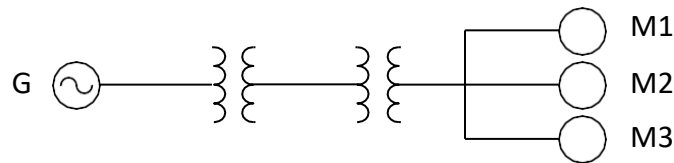
Question 3. Data available for four numbers of two winding transformer, 2000V/200V is given in the following table.

Transformer	Rating	Z_{eq} (Referred to primary side)
A	100kVA	2.60ohm
B	200kVA	1.30ohm
C	300kVA	1.05ohm
D	400kVA	0.821ohm

(All have same voltage ratings on primary and secondary winding)

- How will they share a load of 1000 kVA if connected in parallel? Also find out whether any of the transformer will get overloaded or not.
- If no transformer is to be overloaded, calculate the maximum kVA which can be served by the parallel operation of A, B, C and D transformer. Find out which transformer(s) is/are going to be under loaded?
- Out of the aforesaid four transformers, which pair of transformers would not operate at their rated kVA capacity in parallel.

Question 4. A 100 MVA, 33 kV, 3 phase generator has a sub-transient reactance of 15%. The generator is connected to the motors through transmission line and transformers as shown in figure given below. The motors have rated input of 30 MVA, 20 MVA and 50 MVA at 30 kV with 20% sub-transient reactance. The three phase transformers are rated at 100 MVA, 33kV (delta)/110kV (star) with leakage reactance of 11%. The line has reactance of 50 ohm. Selecting the generator rating as base quantity, obtain p.u. reactance diagram of system, and find the following (Take unity power factor for calculations):



- If the transformer of rating 100 MVA, 33kV (delta)/110KV (star) is used as a power transformer with maximum efficiency of 97% at full load, find the losses at full load.
- What will be the efficiency of same transformer at 70% of full load?
- If another transformer with same rating and same maximum efficiency as mentioned in (a) at 70% of full load, find the losses and efficiency at full load.
- Write your observation based on outcome from (b) and (c), and relate it with power and distribution transformer.

Note:—

- Clearly mention each step while writing your answers.
- Reference for Q4 - Modern power system analysis by Nagrath and Kothari (chapter : 4 Representation of power system components)
- Reference for Q2, Q3, Q4 - Electrical Machine by P.S. Bimbhra (Chapter on Transformers)

***** End of Assignment *****