USN | | | | | | | | | | **18EE33**

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
Transformers and Generators

Time: 3 hrs.   Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1   a. Draw and explain the full load phasor diagrams of single phase transformer for lagging, leading and unity power factor loads. **(10 Marks)**

   b. A 4 KVA, 200/400 V, single phase transformer has the following OC/SC test results.
      OC test : 200 V, 0.7 A, 65 W   SC Test : 15 V, 10 A, 75 W(LV side).
      Calculate the full load efficiency at UPF and regulation at 0.8 pf lagging. **(06 Marks)**

   c. What is all day efficiency of transformer? How to calculate it? **(04 Marks)**

OR

2   a. Show that open delta connection has a KVA rating of 58% of the rating of the normal delta delta connection. Also list the limitations of open delta connection. **(08 Marks)**

   b. Two electric furnaces are supplied with single phase current at 80 V from a 3 ϕ, 11000 V systems by means of two single phase Scott connected transformers with similar secondary windings. When the load on one furnace is 500 kW (teaser secondary) and on other 800 kW (main secondary) what will flow in each on the 3 lines at UPF and 0.8 pf lagging. **(08 Marks)**

   c. State the advantages of single 3-phase unit transformer over bank of single phase transformers. **(04 Marks)**

Module-2

3   a. With a neat circuit diagram, explain in detail Sumpner's test for determining the efficiency and voltage regulation of transformer. **(08 Marks)**

   b. Derive an expression for the currents and load shared by two transformers connected in parallel supplying a common load when no load of these are equal. **(06 Marks)**

   c. Two 1 ϕ transformers rated at 250 KVA each are operated in parallel on both sides. Impedances of transformers are $(1 + j6)\Omega$ and $(1.2 + j4.8)\Omega$ respectively. Find the load shared by each when the total load is 500 KVA at 0.8 pf lagging. **(06 Marks)**

OR

4   a. What is an auto transformer? Derive an expression for the saving of copper in an auto transformer as compared to an equivalent two winding transformer. What are the advantages and limitations? **(10 Marks)**

   b. With the help of sketches, explain the working of on load tap changer. **(06 Marks)**

   c. What are the conditions to be satisfied for parallel operation of two transformers? **(04 Marks)**

Module-3

5 a. What is three winding transformer? Explain how the stabilization is achieved due to the tertiary winding. (07 Marks)

b. What is commutation? Explain practical commutation with neat diagram of DC machine. (08 Marks)

c. Derive emf equation of alternators. (05 Marks)

OR

6 a. What is armature reaction? With neat figures explain armature reaction in DC machine under normal working conditions. (08 Marks)

b. Explain the methods used to reduce harmonics in 3 ϕ alternators. (06 Marks)

c. A 4 pole, 3 ϕ, 50 Hz star connected alternator has 60 slots with 4 conductors/slot. The coils are short pitched by 3 slots. If the phase speed is 60°, find the phase voltage induced for a flux/pole 0.943Wb sinusoidally distributed in space. All the turns/phase are in series. (06 Marks)

Module-4

7 a. Discuss the effect of change of excitation at constant load. (06 Marks)

b. Name the various methods for determining the voltage regulation for 3 ϕ alternator. Explain EMF method in detail. (08 Marks)

c. What is short circuit ratio? Explain the significance of SCR. (06 Marks)

OR

8 a. With a neat sketch, explain OCC and SCC characteristics of an alternator. (06 Marks)

b. Differentiate between synchronous reactance, adjusted synchronous reactance and Potier reactance. (06 Marks)

c. The following test results are obtained on a 6600 V alternator :

Open circuit voltage	3100	5000	6600	7500	8300
Field current (Amps)	16	25	37.5	50	70

A field current of 20 A is found necessary to circulate full load current on short circuit of the armature. Using ampere-turn method, find the full load regulation at 0.8 pf lagging. Neglect resistance and leakage reactance. (08 Marks)

Module-5

9 a. With a neat circuit diagram, explain slip test to determine direct axis reactance and quadrature axis reactance of an salient pole synchronous generator. (08 Marks)

b. Derive the expression for synchronizing power. (06 Marks)

c. A 3ϕ star connected synchronous generator supplies current of 10 A having phase angle of 20 degree lagging at 400 V. Find the load angle and components of armature current I_d and I_q. If $X_d = 10\Omega$ and $X_q = 6.5 \Omega$. Armature resistance to be negligible. Also find voltage regulation. (06 Marks)

OR

10 a. Write a note on capability curve of synchronous generator.   **(06 Marks)**

   b. What is hunting in synchronous machines? Explain the role of damper winding.   **(06 Marks)**

   c. Two identical 2000 KVA alternators operate in parallel. The governor of first machine is such that the frequency drops uniformly from 50 Hz on no load to 48 Hz on full load. The corresponding uniform speed drop of the second machine is 50 Hz to 47.5 Hz.

      i) How will the two machines share a load of 3000 kW?

      ii) What is the maximum load at UPF that can be delivered without overloading either machine?   **(08 Marks)**

* * * * *