CBCS SCHEME

USN

15EE33

# Third Semester B.E. Degree Examination, Jan./Feb. 2021
## Transformers and Generators

Time: 3 hrs. Max. Marks: 80

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



### Module-1

1 a. Explain the working of an ideal transformer with help of relevant diagrams when supplying a load. **(06 Marks)**

b. Write a note on phase-shift between primary and secondary voltages in a 3 phase transformers and its representation. **(05 Marks)**

c. A single phase 1000/200 V transformer has primary and secondary resistances 0.25 Ω and 0.018 Ω respectively. If iron loss of the transformer is 240 W, calculate the secondary current at which maximum efficiency occurs. Also calculate the maximum efficiency at 0.8 p.f. lag. **(05 Marks)**

**OR**

2 a. Explain with aid of figures how 3 phase voltage can be converted into 2 phase voltage in Scott connection. **(08 Marks)**

b. With relevant circuit diagrams, explain the OC and SC tests conducted on a single phase transformer. Give the expressions to calculate the transformer parameters from the data obtained by the tests. **(04 Marks)**

c. A 3 phase step-down transformer is connected to 6600 V on the primary side. The ratio of turns per phase is 10 and the line current drawn from the mains is 25A. Find the secondary line voltage, line current and output if the transformer is (i) Star-Star (ii) Star-Delta. **(04 Marks)**

### Module-2

3 a. Mention the advantages and applications of autotransformer. **(04 Marks)**

b. Derive an expressions for kVA shared between two transformers connected in parallel supplying a common load with equal voltages ratio. **(06 Marks)**

c. A 10 kVA, 1000/100 V two winding transformer is to be used as an autotransformer with a constant source voltage of 1000 V. At full load of upf, calculate the power output , power transformed and power conducted. If the efficiency of the two winding transformer at 0.7 p.f. and full load is 97%, find the efficiency of the autotransformer. **(06 Marks)**

**OR**

4 a. What are the purposes for which tappings are provided in the transformers? Explain with a neat schematic diagram an off-load tap changer. **(07 Marks)**

b. Write a note on tertiary winding in 3 phase transformer. **(03 Marks)**

c. Two transformers A and B are connected in parallel and supply a common load have open circuit emf of 6000 V and 5800 V respectively. Equivalent impedances in terms of secondary of A and B are $(0.4 + j4)\Omega$ and $(0.2 + j2)\Omega$. The load impedance is $(20 + j4)\Omega$, find the current supplied by each transformer. **(06 Marks)**

## Module-3

5 a. Explain the phenomena of current in-rush in transformers. **(06 Marks)**

b. Explain the voltage building-up process in a self excited generator. **(04 Marks)**

c. A 3-phase, 18 pole alternator has a resultant flux of 0.093 Wb/pole. The flux is uniformly distributed over the pole. The stator has 4 slots per pole per phase and 8 conductors per slot are connected in double layer. The coil span is 150° electrical. Calculate the phase and line voltage if the speed is 400 rpm. **(06 Marks)**

**OR**

6 a. What is the necessity of polarity test? With a neat figure, explain how polarity test is conducted on a single phase transformer. **(04 Marks)**

b. With neat figures, explain the load characteristics of shunt and cumulative compound generators. **(06 Marks)**

c. Derive expressions for winding factors of a synchronous generator. **(06 Marks)**

## Module-4

7 a. What is voltage regulation of an alternator? From the phasor diagrams of a cylindrical rotor machine, obtain expressions for excitation voltage $E_f$ for different p.fs. **(06 Marks)**

b. Explain the parallel operation of alternators and derive expressions for load sharing between them. **(06 Marks)**

c. Explain briefly about generator excitation for constant voltage. **(04 Marks)**

**OR**

8 a. A 2000 kVA, star connected, 2500 V, 3 phase salient pole synchronous generator has $X_d = 2\Omega$ per phase and $X_q$ 1.2 $\Omega$ per phase. Neglecting armature resistance, determine the excitation voltage at rated kVA operation and at 0.8 p.f. lagging. **(05 Marks)**

b. Deriving relevant expression, obtain the power angle characteristic of a salient pole synchronous generator. **(05 Marks)**

c. Briefly explain the slip test conducted on a salient pole synchronous generator to find $X_d$ and $X_q$. **(06 Marks)**

## Module-5

9 a. With a circuit diagram, explain how the O.C. and S.C tests are conducted on a synchronous generator and show how voltage regulation is calculated by e.m.f. method. **(08 Marks)**

b. A 3 phase, 1500 kVA, star connected, 50 Hz, 2300 V alternator has a resistance between each pair of terminals when measured by direct current is 0.16 $\Omega$. Assume that the effective resistance is 1.5 times the ohmic resistance. A field current of 70 A produces a short circuit current equal to full load current of 376 A in each line. The same filed current produces an emf of 700 V on open circuit. Determine the synchronous reactance of the machine and regulation at (i) Full load 0.8 p.f. lag (ii) Half load 0.8 p.f. lag. **(08 Marks)**

**OR**

10 a. A 3 phase, star connected 1000 kVA, 2000 V, 50 Hz, synchronous generator gave the following tests results. The effective armature resistance per phase is 0.25 $\Omega$. Find the full load regulation at 0.8 p.f. lagging by mmf method.

| Field current A | 10 | 20 | 25 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|
| O.C voltage/phase V | 412 | 866 | 1016 | 1155 | 1357 | 1501 |
| S.C. current A | - | 200 | 250 | 300 | - | - |

**(10 Marks)**

b. With suitable graphs, explain capability curves for an alternator. **(06 Marks)**

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