

CBCS SCHEME

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21EE34

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024 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. With the help of a phasor diagram explain the operation of single phase practical transformer on RL load of lagging power factor. (07 Marks)
- b. The following test results were obtained from OC and SC test on 8KVA 400/200 volts, 50Hz, single phase transformer.

| Test | Voltage applied in volts | Current in amps | Power drawn in watts |
|---------|--------------------------|-----------------|----------------------|
| OC Test | 120 | 4 | 75 |
| SC Test | 9.5 | 20 | 110 |

- Calculate: i) Equivalent circuit parameters ii) Voltage regulation and efficiency at full load 0.8pf lagging. (08 Marks)
- c. Define voltage regulation of transformer explain its significance. (05 Marks)

OR

- 2 a. A 15kVA, 2000/200 volts, single phase, 50Hz transformer has an iron loss of 250 watts and full load copper loss of 350 watts. During a day it is loaded as follows:

| Number of hours | Load | Power factor |
|-----------------|------------------|--------------|
| 9 | 1/4 of full load | 0.6 lagging |
| 7 | Full load | 0.8 lagging |
| 6 | 3/4 of full load | 1.0 (upf) |
| 2 | No load | - |

- Calculate all day efficiency. (08 Marks)
- b. With the help of a connection diagram phasor diagram, explain how SCOTT connections are used to obtain 2 phase from 3 phase supply. (07 Marks)
- c. Enumerate the advantages of single 3 phase transformer over bank of 3 single phase transformers. (05 Marks)

Module-2

- 3 a. With a neat circuit diagram, explain how sumpners test conducted on 2 identical transformers, also show efficiency and regulation are calculated from sumpners test data. (08 Marks)
- b. What is the necessity of parallel operation of transformers? List the conditions to be satisfied for parallel operation. (06 Marks)
- c. Derive expression for load sharing between 2 transformers having an equal voltage ratio. (06 Marks)

OR

- 4 a. Derive expression for saving of copper in auto transformer compared to 2 winding transformers. (07 Marks)
- b. With a neat diagram, explain the operation of on load tap changer. (07 Marks)
- c. Explain how the eddy current and hysteresis losses are separated in a single phase transformers. (06 Marks)

Module-3

- 5 a. What is 3 winding transformer? Why tertiary winding is used? (07 Marks)
- b. List the methods of cooling of transformers explain any one method in detail with a neat sketch. (07 Marks)

- c. Derive EMF equation of DC generator. (06 Marks)

OR

- 6 a. What is armature reaction? With neat figures, explain armature reaction in DC machine under normal working conditions. (07 Marks)
- b. What is commutation? With a neat diagram, explain the process of commutation. (07 Marks)
- c. Define pitch factor and distribution factor. (06 Marks)

Module-4

- 7 a. Enumerate the various methods to determine voltage regulation of alternator. Explain the method of determining voltage regulation of synchronous generator by Zpf method with all the necessary circuit diagrams necessary in the test. (10 Marks)
- b. A 3 ϕ Y-connected, 5KVA, 400V, 50Hz 4 pole alternator has the following test data at rated speed:

i)

| | | | | | | | | | | | | |
|---------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Excitation current (I_f) in amps. | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4 | 4.5 | 5.0 | 6.0 | 8.0 |
| V_{oc}/ph in volts | 75 | 140 | 173 | 202 | 224 | 240 | 250 | 257 | 260 | 263 | 266 | 271 |

ii)

| | | | |
|----------------------------|-----|-----|------|
| Exciting (I_f) current | 1.0 | 2.0 | 3.0 |
| I_{sc-sc} current | 3.6 | 7.2 | 10.8 |

iii) $R_a/ph = 2.0\Omega$

- Draw the occ and scc, determination voltage regulation at 0.8pf lagging. (10 Marks)

OR

- 8 a. With a neat circuit diagram, explain the method of determining voltage regulation by MMF method. (10 Marks)
- b. 10KVA, 440V, 50Hz, 3 ϕ , Y – connected alternator has the following OCC as given below

| | | | | | | |
|------------------------|-----|-----|-----|-----|-----|-----|
| I_f in amps | 1.5 | 3 | 5 | 8 | 11 | 15 |
| $V_{oc}/line$ in volts | 150 | 300 | 440 | 550 | 600 | 635 |

With full load Zpf, the applied excitation required is 14A to produce 500V of terminal voltage, on short circuit 4A excitation is required to give full load current. Determine the voltage regulation for full load 0.8pf lagging. (10 Marks)

Module-5

- 9 a. With a phasor diagram and necessary diagram, explain the concept of two reaction theory in a salient pole synchronous machine. (10 Marks)
- b. With a neat circuit diagram, explain the slip test on salient pole synchronous machine and indicate how X_ϕ and X_Q can be determined from the test. (10 Marks)

OR

- 10 a. Write a short note on capability curves of synchronous generator. (06 Marks)
- b. What is hunting in synchronous machines? Explain the role of damper winding. (08 Marks)
- c. Write the power angle equation of a salient pole machine and draw the power angle curve. (06 Marks)

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