

**BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT**

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN 

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Course Code 

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Third Semester B.E. Degree Examinations, September 2024

**ELECTRICAL MACHINES-I**

Duration: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions choosing ONE full Question from each Module.  
2. Missing data, if any, may be suitably assumed

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>												
<b>Module-1</b>															
1.	a. Derive an expression for voltage regulation of a transformer considering lagging power factor.	<b>06</b>	(2:1:1.3.1)												
	b. Develop exact and approximate equivalent circuits of a transformer referred to primary side.	<b>06</b>	(2:1:1.3.1)												
	c. A 15 KVA, 2300/230 V, 50 Hz, single phase transformer gave the following test data.	<b>08</b>	(3:1:1.3.1)												
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">OC TEST</td> <td style="width: 25%;">2300 V</td> <td style="width: 25%;">0.21 A</td> <td style="width: 25%;">50 W</td> </tr> <tr> <td>SC TEST</td> <td>47 V</td> <td>6 A</td> <td>160 W</td> </tr> </table>	OC TEST	2300 V	0.21 A	50 W	SC TEST	47 V	6 A	160 W						
OC TEST	2300 V	0.21 A	50 W												
SC TEST	47 V	6 A	160 W												
	Find the equivalent circuit parameters referred to high voltage side and draw the equivalent circuit.														
<b>OR</b>															
2.	a. State the advantages of three phase unit transformer over three single phase transformer bank of the same KVA ratings.	<b>06</b>	(2:2:1.3.1)												
	b. With the help of connection and phasor diagram, explain how two-phase supply can be obtained from three-phase supply using Scott connection.	<b>06</b>	(2:2:1.3.1)												
	c. Find the all-day efficiency of single phase transformer having maximum efficiency of 98 % at 15 kVA at UPF and loaded as follows.	<b>08</b>	(3:1:1.3.1)												
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">Number of hours</td> <td style="width: 25%;">12</td> <td style="width: 25%;">6</td> <td style="width: 25%;">6</td> </tr> <tr> <td>Loading in kW</td> <td>2</td> <td>2</td> <td>0</td> </tr> <tr> <td>Power factor</td> <td>0.5</td> <td>0.8</td> <td>-</td> </tr> </table>	Number of hours	12	6	6	Loading in kW	2	2	0	Power factor	0.5	0.8	-		
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Loading in kW	2	2	0												
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<b>Module-2</b>															
3.	a. Explain the back to back test on two 1- $\emptyset$ transformers.	<b>08</b>	(2:1:1.3.1)												
	b. Discuss the need and conditions for parallel operation of transformers.	<b>06</b>	(2:5:1.3.1)												
	c. Two transformers connected in open delta supply a 400 kVA balanced load operating at 0.866 p.f. lagging. The load voltage is 440 V. Find the (i) kVA supplied by each transformer. (ii) kW supplied by each transformer.	<b>06</b>	(3:2:1.3.1)												
<b>OR</b>															
4.	a. Derive an expression for saving of copper in an auto-transformer compared to 2-winding transformer.	<b>06</b>	(2:1:1.3.1)												
	b. Derive the expressions for load shared by the two transformers in parallel when no load voltages are unequal.	<b>06</b>	(2:5:1.3.1)												
	c. Two single phase transformers with equal turns have impedances of $(0.5+j3) \Omega$ and $(0.6+j10) \Omega$ with respect to the secondary. If they operate in parallel, determine how they share load of 100 kW at 0.8 p.f lagging.	<b>08</b>	(3:5:1.3.1)												

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

### Module-3

5. a. What is commutation in a DC Generator? Discuss the process of commutation with neat sketches. **06** (2:3:1.3.1)
- b. List the different methods of cooling of a transformer. Explain any two methods with neat sketches. **06** (2:2:1.3.1)
- c. An 8 pole wave wound d.c. generator has 480 armature conductors. The armature current is 200 A. Find the armature reaction demagnetizing and cross magnetizing ampere turns per pole if the brushes are shifted  $6^\circ$  electrical from G.N.A. **08** (3:3:1.3.1)

#### OR

6. a. Derive an equation for induced emf of a synchronous generator. **06** (2:3:1.3.1)
- b. Explain three winding transformer with its merits and demerits. **06** (2:2:1.3.1)
- c. A 3- $\phi$ , 8 pole, star connected alternator has the armature coils short chorded by one slot. The coil span is  $165^\circ$  ele. The alternator is driven at a speed of 750 rpm. If there are 12 conductors per slot and flux per pole is 50 mWb. Calculate the values of induced emf. **08** (3:3:1.3.1)

### Module-4

7. a. Define voltage regulation. Explain ZPF method to determine the voltage regulation of an alternator. **10** (2:4:1.3.1)
- b. The open circuit and short circuit test results for 3-phase, star connected, 1000 KVA, 1905 V, 50 Hz alternator are **10** (3:4:1.3.1)

Open circuit line voltage (Volts)	760	1500	1700	1905	2300	2600
Short circuit current (Ampere)	--	220	--	335	--	--
Field current (Ampere)	10	20	25	30	40	50

The armature resistance per phase is  $0.2 \Omega$ . Draw the open circuit and short circuit characteristics and find the regulation on full load 0.8 lagging p.f by ampere turn method.

#### OR

8. a. Define Short Circuit Ratio (SCR). Show that per unit synchronous reactance is inversely proportional to the SCR. State its significances. **10** (2:4:1.3.1)
- b. A 11 kV, 1000 KVA, 3-phase, star connected alternator has a resistance of  $2 \Omega$  per phase. The open circuit and full load zero power factor characteristics are given below. Find the voltage regulation for full load current at 0.8 p.f lagging by using Potier's triangle method. **10** (3:4:1.3.1)

Current(A)	40	50	110	140	180
O.C line voltage(V)	5800	7500	12500	13750	15000
Zero p.f line volts(V)	0	1500	8500	10500	12500

### Module-5

9. a. Define hunting in synchronous generator. Discuss the causes of hunting and its suppression using damper windings. **10** (2:5:1.3.1)
- b. With neat circuit diagram, explain the slip test to determine  $X_d$  and  $X_q$ . **10** (2:3:1.3.1)
- OR**
- 10 a. What are the conditions for synchronization of an alternator? Explain the synchronization of alternator by synchroscope method. **10** (2:5:1.3.1)
- b. Explain the concept of two reaction theory in a salient pole alternator. **10** (2:3:1.3.1)

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