

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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Course Code

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Third Semester B.E. Degree Examinations, January 2025

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>
<u>MODULE – 1</u>			
1.	a. Analyse the operation of 1- \emptyset transformer ON LOAD with phasor diagrams for resistive, inductive and capacitive loads.	06	(2 :1: 1.3.1)
	b. Analyse the Scott connection with phasor diagram including the location of neutral point.	06	(2 :2: 1.3.1)
	c. A 20 kVA, 2200/220 V, 50 Hz, 1- \emptyset transformer has the following test results: O.C. Test: 220 V, 4.2 A, 148 W (H.V. side) S.C Test: 86 V, 10.5 A, 360 W (L. V. side). Determine (i) Efficiency at full load and half full load, 0.8 p.f lagging. (ii) % of regulation at full load, 0.8 p.f lagging. (iii) Equivalent circuit parameters referred to primary side.	08	(3 :1: 1.3.1)
(OR)			
2.	a. Show that the open delta connection of 3-phase transformers has kVA rating of 57.7 % of that of Δ - Δ connection. Also state the advantages of V-V connection.	06	(2 :2: 1.3.1)
	b. Develop an exact equivalent circuit diagram of a 1- \emptyset transformer referred to both primary and secondary.	06	(2 :1: 1.3.1)
	c. Two electric furnaces are supplied with 1- \emptyset circuit at 110 V from a 3-phase, 6600 V supply by means of two 1- \emptyset Scott connected transformers with similar windings. When the load on the main transformer is 500 kW and on the teaser is 800 kW. Determine the current in each of 3- \emptyset lines at 0.71 p.f lagging? Draw vector diagram.	08	(3 :2: 1.3.1)
<u>MODULE – 2</u>			
3.	a. What is an auto-transformer? Derive an expression for saving of copper in an auto-transformer compared to 2-winding transformer.	06	(2 :1: 1.3.1)
	b. Analyse the performance of transformer by conducting back-to-back test with circuit diagram.	06	(2 :1: 1.3.1)
	c. In a 400 V, 50 Hz transformer, the total iron loss is 2500 W. When supply voltage and frequency is reduced to 200 V, 25 Hz respectively the corresponding loss is 850 W. Calculate the eddy current loss and hysteresis loss at normal voltage and frequency.	08	(3 :1: 1.3.1)

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

(OR)

4. a. Discuss the necessity and conditions for parallel operation of the transformers. **06** (2 :5: 1.3.1)
- b. Why tap changing of a transformer is preferred on H V side? Describe On Load Tap Changing (OLTC) of a transformer with neat sketch. **06** (2 :2: 1.3.1)
- c. Two transformers A and B are connected in parallel to a load of $(8+j6) \Omega$. Their impedances on secondary side are $Z_A=(0.3+j3)\Omega$ and $Z_B=(0.2+j1)\Omega$. Their open circuit emfs are $E_A=6600$ V and $E_B=6400$ V. Find the current supplied by each transformer and power factor of each transformer. **08** (3 :5: 1.3.1)

MODULE – 3

5. a. What is the importance of transformer cooling? List the different methods of cooling and explain any two methods with neat sketches. **06** (2 :2: 1.3.1)
- b. What is armature reaction? Discuss the armature reaction in a DC generator with neat sketches. **06** (2 :3: 1.3.1)
- c. Calculate the reactance voltage for a machine having following parameters: **08** (3 :3: 1.3.1)
- No. of commutator segments=55 ; Revolutions per minute=900
Brush width in terms of commutator segments=1.74;
Self-inductance=153 μ H ; Current in each conductor=27 A.

(OR)

6. a. What is commutation in DC generator? Explain the process of commutation with neat diagrams. **06** (2 :3: 1.3.1)
- b. Define pitch factor. Derive an expression for distribution factor with phasor diagram. **06** (2 :3: 1.3.1)
- c. A 3- ϕ , 8 pole star connected alternator has the armature coils short chored by one slot. The coil span is 165° 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 line and phase emfs. **08** (3 :3: 1.3.1)

MODULE – 4

7. a. Discuss MMF method to determine the voltage regulation of an alternator. What are the limitations of this method? **10** (2 :4: 1.3.1)
- b. A 100 kVA, 3000 V, 50 Hz, 3- ϕ , star connected alternator has an effective armature resistance of 0.2Ω per phase. A field current of 40 A produces a current of 200 A on short circuit and 1040 V (line) on open circuit. Calculate the voltage regulation at 0.8 p.f lagging and leading. Draw phasor diagrams. **10** (3 :4: 1.3.1)

(OR)

8. a. Define Short Circuit Ratio (SCR) w.r.t alternator. Derive the relation between SCR and per unit value of synchronous reactance. List the significance of it. **10** (2 :4: 1.3.1)
- b. The following test results are obtained on a 6600 V, 3- ϕ , 50 Hz star connected synchronous generator: **10** (3 :4: 1.3.1)

Field Current (A)	16	25	37.5	50	70
O.C Voltage (V)	3100	4900	6600	7500	8300

A field current of 20 A is necessary to circulate full load current. Determine the voltage regulation by MMF method at full load 0.8 pf lagging and leading. Neglect armature resistance.

MODULE – 5

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| 9. | a. | What are the conditions for synchronization of alternator? With neat diagram explain synchronization by synchroscope method. | 10 | (2 :5: 1.3.1) |
| | b. | Define hunting in synchronous generator. Discuss the causes of hunting and its suppression using damper windings. | 10 | (2 :3: 1.3.1) |
| (OR) | | | | |
| 10. | a. | With neat circuit diagram, explain the slip test and indicate how X_d and X_q can be determined from the test. | 10 | (2 :3: 1.3.1) |
| | b. | Discuss the concept of two reaction theory in a salient pole alternator. | 10 | (2 :5: 1.3.1) |

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