

Basavarajeswari Group of Institutions
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, March/April 2023
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.	A 20kVA, 2500/250V, 50Hz, 1-phase transformer has the following test results: O.C. Test: 250V, 1.4A, 105W (LV side) S.C Test: 104V, 8A, 32W (HV side). Determine i) Efficiency at full load, 0.8 p. f and half full load at 0.9 p.f. ii) % of regulation at full load for both lagging and leading p.f. iii) Equivalent circuit parameters.	08	(3 :1: 1.3.1)
b.	Analyse the operation of 1-Ø transformer ON LOAD with vector diagrams for R, RL and RC loads.	06	(2 :1: 1.3.1)
c.	Discuss the advantages of single 3-Ø transformer over bank of three 1-Ø transformers.	06	(2 :2: 1.3.1)
(OR)			
2. a.	Two electric arc furnaces are supplied with 1-Ø current at 80 V from 3-Ø, 11000 V system by means of two 1-Ø Scott connected transformers with similar secondary windings, when the load on one of the furnaces is 500 kW and on the other 800 kW, what current will flow in each of the 3-lines at 0.8 p.f. lag.	08	(3 :2: 1.3.1)
b.	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)
c.	What is an auto-transformer? Derive an expression for saving of copper in an auto-transformer compared to 2-winding transformer. Also list its applications.	06	(2 :1: 1.3.1)
<u>MODULE – 2</u>			
3. a.	Explain the Sumpner's test with circuit diagram. Also show how the efficiency and regulations are determined.	06	(2 :1: 1.3.1)
b.	Discuss the necessity and conditions for parallel operation of the transformers.	06	(2 :5: 1.3.1)
c.	Two transformers A and B are connected in parallel to a load of $(2+j1.5) \Omega$. Their impedances on secondary side are $Z_A = (0.15+j0.5) \Omega$ and $Z_B = (0.1+j0.6) \Omega$. Their no-load terminal voltages are $E_A = 207 \text{ V}$ and $E_B = 205 \text{ V}$. Find the current supplied by each transformer and power factor of each transformer.	08	(3 :5: 1.3.1)

(OR)

4. a. Derive an expression for saving of copper in an auto-transformer compared to 2-winding transformer. **06** (2 :1: 1.3.1)
b. Derive the expressions for load shared by the two transformers in parallel when no load voltages are unequal. **06** (2 :5: 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)

MODULE – 3

5. a. What is cooling of transformers? List the different methods of cooling and explain any two methods. **06** (2 :3: 1.3.1)
b. What is commutation in DC generator? Explain the process of commutation with neat diagrams. **06** (2 :3: 1.3.1)
c. A 4-pole lap connected armature running at 1400 rpm delivering a current of 100 A and has 64 commutator segments. The brush width is 1.4 segments and inductance of each coil is 0.05 mH. Calculate the value of reactance voltage assuming linear, sinusoidal and ideal commutations. **08** (3 :3: 1.3.1)

(OR)

6. a. Define distribution factor. Derive an expression for distribution factor. **06** (2 :3: 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. A 3- ϕ , 8 pole star connected alternator has the armature coils short chording by one slot. The coil span is 165° e. 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. 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 2300 V, 50 Hz, 3- ϕ star connected alternator has an effective R_a of 0.2 Ω . A field current of 35 A produces a current of 150 A on short circuit and 780 V on open circuit. Calculate the voltage regulation at 0.8 pf lagging. Full load current is 25 A. **10** (3 :4: 1.3.1)

(OR)

8. a. Define Short Circuit Ratio (SCR). Discuss the synchronous impedance method of voltage regulation of an alternator. **10** (2 :4: 1.3.1)
b. The following data were obtained for the OCC of a 10MVA, 13kV, 3-phase, 50Hz star connected synchronous generator: **10** (3 :4: 1.3.1)

If (A)	50	75	100	125	150	162.5	200	250	300
Vo.c (kV) line	6.2	8.7	10.5	11.8	12.8	13.2	14.2	15.2	15.9

An excitation of 100 A causes the full load current to flow during the short circuit test. The excitation required to give rated current at Z.P.F and rated voltage is 290 A. Determine the regulation when the machine supplies full load at 0.8 p. f lag. by using Z.P.F method. Neglect R_a .

MODULE – 5

9. 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. What are the conditions for synchronization of alternator? With neat diagram explain any one method of synchronization. 10 (2 :5: 1.3.1)

(OR)

10. a. Discuss the concept of two reaction theory in a salient pole alternator. 10 (2 :3: 1.3.1)
- b. Define hunting in synchronous generator. Discuss the causes of hunting and its suppression using damper windings. 10 (2 :5: 1.3.1)

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