Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN											Course Code	2	1	E	E	3	4

Third Semester B.E. Degree Examinations, April/May 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

Q. No		Question	Marks	(RBTL:CO:PI)
		MODULE – 1		
1.	**a.**	Analyse the operation of 1-Ø transformer ON LOAD with vector diagrams for R, RL and RC loads.	**06**	(2 :1 : 1.3.1)
	b.	Discuss the advantages of 3-Ø single unit transformer over bank of three 1-Ø transformers.	**06**	(2 :2 : 1.3.1)
	c.	An 8kVA, 400/120V, 50Hz,1-phase transformer has the following test results: O.C. Test: 120V, 4A, 75W (LV side) S.C Test: 9.5V, 20A, 110W (H V side). Determine (i) Efficiency at half full load, 0.8 p.f. (ii) % of regulation at full load 0.8 pf lagging. (iii) Equivalent circuit parameters.	**08**	(3 :1 : 1.3.1)
		OR		
2.	**a.**	Develop an exact equivalent circuit diagram of a 1-Ø transformer referred to both primary and secondary.	**06**	(2 :1 : 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	Two electric furnaces are supplied with 1-Ø circuit at 110V from a 3-phase, 6600V supply by means of two 1-Ø 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-Ø lines at 0.71 p.f lagging? Draw vector diagram.	**08**	(3 :2 : 1.3.1)
		MODULE – 2		
3.	**a.**	What is an auto-transformer? Derive the expression for saving of copper in an auto-transformer.	**06**	(2 :1 : 1.3.1)
	b.	Analyse the performance of transformer by conducting Sumpner's test with relevant circuit diagram.	**06**	(2 :1 : 1.3.1)
	c.	Two transformers A and B are connected in parallel to a load of (8+j6) Ω.Their impedances on secondary side are Z_A= (0.3+j3) Ω and Z_B= (0.2+j1) Ω.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)
		OR		
4.	**a.**	With the help of neat sketches, explain the working of ON-load and OFF-load tap changer.	**06**	(2 :2 : 1.3.1)
	b.	Derive the expressions for load shared by the two transformers in parallel when no load voltages are equal.	**06**	(2 :5 : 1.3.1)

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

	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 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.	A 6 pole, 148A, DC shunt generator has 480 conductors and is wave wound. Its field current is 2A. Find demagnetizing and cross magnetising Ampere turns /pole at full load when (i) The brushes are at GNA (ii) The brushes are shifted from GNA by 5° Electrical (iii) Brushes are shifted from GNA By 5° Mechanical.	08	(3 :3 : 1.3.1)

OR

6.	a.	Define pitch and distribution factors. Derive an EMF equation of a synchronous generator.	06	(2 :2 : 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 3-Ø, 16 pole, star connected alternator has 144 slots and 10 conductors per slot. The flux per pole is 30 mWb. The speed is 375 rpm. Find frequency, phase and line emfs if the winding is short chorded by 2 slots.	08	(3 :3 : 1.3.1)

MODULE – 4

7.	a.	Discuss Ampere-Turn (AT) 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-Ø, star connected alternator has an effective armature resistance of 0.2 Ω 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.	Describe the ZPF method of voltage regulation of an alternator.	10	(2 :4 : 1.3.1)
	b.	The following test results are obtained on a 6600 V, 3-Ø, 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. Neglect armature resistance.

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.	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.	Discuss the concept of two reaction theory in a salient pole alternator.	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)

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