Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN										Course Code	2	2	E	E	3	4

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

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.	Show that the open delta connection of 3-phase transformers having kVA rating of 57.7% of that of delta-delta connection. Also state the advantages of open delta connection.	**06**	(2 :1: 1.3.1)
	c.	A 5kVA,500/250V,50Hz,1-phase transformer has the following test results: O.C. Test: 500V,1A, 50W (L.V. side open) S.C Test: 25V, 10A, 60W (L.V. side shorted). Determine (i) Efficiency at full load, 0.8 p.f and half full load at 0.9 p.f. (ii) Percentage of regulation at full load 0.8 p.f. lagging. (iii) Equivalent circuit parameters.	**08**	(3 :1: 1.3.1)
		OR		
2.	**a.**	In a Scott connection show that voltage across the primary winding of a teaser transformer is 0.866 times the line voltage with phasor diagram including the location of neutral point.	**06**	(2 :2: 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.	Find all –day efficiency of 375 kVA distribution transformer whose copper loss and iron loss are 3.5 kW and 2.5 kW respectively. During a day it is loaded as follows:	**08**	(3 :1: 1.3.1)

Load (kW)	300	200	100	No. load
Power factor	0.8	0.7	0.9	--
No. of Hours	6	10	4	4

		MODULE – 2		
3.	**a.**	Explain the Sumpner's test with circuit diagram. Also discuss how the efficiency and regulation are determined.	**06**	(2 :1: 1.3.1)
	b.	Derive an expression for saving of copper in an auto-transformer compared to 2-winding transformer.	**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 no load terminal voltages are E_A=6600 V and E_B=6400 V. Find the current supplied by each transformer.	**08**	(3 :5: 1.3.1)
		OR		
4.	**a.**	Explain how eddy current and hysteresis losses are separated by graphical method**.**	**06**	(2 :1: 1.3.1)

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

	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	Two 1-Ø transformers share a load of 400 kVA at 0.8 p.f lagging, the equivalent impedances referred to secondary are (1+j2.5) **Ω** and (1.5+j3) **Ω**. Find the load shared by each transformer.	**08**	(3 :5: 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 :2: 1.3.1)
	b.	Describe the tertiary winding transformer with respect to voltage stabilization, equivalent circuit and advantages.	**06**	(2 :2: 1.3.1)
	c	A 4 pole lap connected armature running at 1500 rpm delivering a current of 150 A and has 64 commutator segments. The brush width is 1.2 segments and inductance of each coil is 0.05 mH. Calculate the value of reactance voltage assuming linear and sinusoidal commutations.	**08**	(3 :3: 1.3.1)

OR

6.	**a.**	Derive an EMF equation of a synchronous generator.	**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 3-Ø, 4 pole, 50 Hz, star connected alternator has 48 slots and 4 conductors per slot. The flux per pole is 0.12 Wb, the coil span is 150^o electrical. Find phase and line emf.	**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 R_a of 0.2 **Ω**/ph. A field current of 40A produces a current of 200 A on short circuit and 1040 V (line) on open circuit. Calculate the voltage regulation at 0.8 pf lagging and leading. Full load current is 19.24 A.	**10**	(3 :4: 1.3.1)

OR

8.	**a.**	Define Short Circuit Ratio (SCR). Show that per unit value of synchronous reactance is inversely proportional to SCR. What are the significance of SCR.?	**10**	(2 :4: 1.3.1)
	b.	The following data were obtained for the OCC of a 10 kVA, 440 V, 3-phase,50 Hz star connected synchronous generator:	**10**	(3 :4: 1.3.1)

I_f (A)	1.5	3	5	8	11	15
$V_{o.c}$ (V) line	150	300	440	550	600	635

An excitation of 4 A causes the full load current to flow during the short circuit test. An excitation of 14 A is required to give 500 V of terminal voltage at Z.P.F .Determine the regulation when the machine supplies full load at 0.8 p.f lag.by using Potier triangle 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.**	Define hunting in a synchronous generator. Discuss the causes, effects and prevention of hunting.	**10**	(2 :3: 1.3.1)
	b.	Discuss the concept of two reaction theory in a salient pole alternator.	**10**	(2 :3: 1.3.1)

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