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, September / October 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.** What is predetermination of efficiency of transformer? State its advantages. **04** (2 :1 : 1.3.1)

b. Explain how open circuit and short circuit tests are used to obtain equivalent circuit parameters of a single phase transformer. **08** (2 :1 : 1.3.1)

c. A 3-phase, 2300/230 V, 500 kVA, 50 Hz distribution transformer has core loss of 1600 W at rated voltage and copper loss of 7.5 kW at full-load. During the day it is loaded as follows : **08** (3 :1 : 1.3.1)

% load	0	20	50	80	100	125
Power factor	-	0.7 lag	0.8 lag	0.9 lag	1	0.85
Hours	2	4	4	5	7	2

Determine the all-day efficiency of the transformer.

OR

2. **a.** Explain briefly the grouping in three phase transformers. **04** (2 :2 : 1.3.1)

b. With the help of neat circuit diagram and phasor diagram explain Scott connection. **08** (2 :2 : 1.3.1)

c A 400 kVA load at 0.7 pf lagging is supplied by three, single phase transformers connected in Δ-Δ. Each of the Δ-Δ transformer is rated at 200 kVA, 2300/230 V. If one defective transformer is removed from the service, calculate for the V-V connection (i)the kVA load carried by each transformer (ii) percentage of rated load carried by each transformer (iii)total kVA rating of the transformers in V-V bank(iv) ratio of V-V bank to Δ-Δ bank transformer kVA ratings. **08** (3 :2 : 1.3.1)

MODULE – 2

3. **a.** State the conditions necessary for parallel operation of three phase transformers. **04** (2 :5 : 1.3.1)

b. Two three-phase transformers which have the same turns ratio are connected in parallel and supply a total load of 800 kW at 0.8 power factor lagging . Their ratings are as follows. **08** (3 :5 : 1.3.1)

Transformer	Ratings	Per unit resistance	Per unit reactance
A	400 kVA	0.02	0.04
B	600 kVA	0.01	0.05

Determine the power output and power factor of each transformer.

c. Explain the procedure to separate hysteresis and eddy current losses occurring in the core transformer. **08** (2 :1 : 1.3.1)

OR

4.	**a.**	Compare no load and on load tap of the changing transformers.	**06**	(2 :2 : 1.3.1)
	b.	Show that an autotransformer is copper economical comparing to two winding transformer of same rating.	**06**	(2 :1 : 1.3.1)
	c.	Two similar single phase, 250 kVA transformers gave the following results when tested by back-back method: Mains wattmeter, W_1= 5.0 kW Primary series circuit wattmeter, W_2= 7.5 kW (at full load) Find out the individual transformer efficiency at 75% full load and 0.8 p.f. leading.	**08**	(3 :1 : 1.3.1)

MODULE – 3

5.	**a.**	Explain different methods of cooling the transformers using oil as cooling medium.	**06**	(2 :2 : 1.3.1)
	b.	A 3-phase, 3-winding delta/delta/star, 33000/11000/400-V, 200 kVA transformer has a secondary load of 150 kVA at 0.8 p.f. lagging, and a tertiary load of 50 kVA at 0.9 p.f. lagging. The magnetizing current is 4% of rated load, the iron loss being 1 kW. Calculate the value of primary current when the other two windings are delivering the above loads.	**08**	(3 :2 : 1.3.1)
	c.	What is commutation? Explain the associated problems in a d.c. generator.	**06**	(2 :3 : 1.3.1)

OR

6.	**a.**	What are harmonics? Give reason for their presence in phase voltage of alternators. Why are even order harmonics absent in the phase voltage of alternators?	**04**	(2 :3 : 1.3.1)
	b.	Define pitch factor, distribution factor and derive an expression for distribution factor.	**08**	(2 :3 : 1.3.1)
	c.	**A** 3-Ø, 16-pole, star connected alternator has 144 slots and 10 conductors per slot. The flux pole is 30 mWb. The speed is 375 rpm. Find frequency, phase and emfs (line), if the winding is short chorded by 2 slots.	**08**	(3 :3 : 1.3.1)

MODULE – 4

7.	**a.**	State the reasons for drop in terminal voltage of alternator from no-load to loaded condition of operation.	**04**	(2 :4 : 1.3.1)
	b.	Explain the procedure of obtaining synchronous reactance of an alternator.	**08**	(3 :4 : 1.3.1)
	c.	Draw the open-circuit and short circuit characteristics using the data given below for a 150 MW, 13 kV, 0.85 p.f., 50 Hz synchronous generator. Open-circuit characteristic:	**08**	(3 :4 : 1.3.1)

I_f(A)	**200**	**450**	**600**	**850**	**1200**
V_{oc}(line)(kV)	**4**	**8.7**	**10.8**	**13.3**	**15.4**

Short-circuit characteristic:
I_f = 750 A, I_{sc}= 8000 A.
(i)Determine the unsaturated synchronous reactance of the machine.
(ii) Determine the voltage regulation at 0.8 (lag) p.f.

OR

8.	**a.**	State the assumptions made in determining synchronous impedance.	**04**	(2 :4 : 1.3.1)
	b.	Explain the procedure to determine the regulation of an alternator by ASA method.	**08**	(2 :4 : 1.3.1)

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

c. The following data were obtained for the OCC of a 10 MVA, 13 kV, 3-phase, 50 Hz, star –connected synchronous generator: **08** (3 :4 : 1.3.1)

Open-circuit characteristic:

I_f(A)	50	75	100	125	150	162.5	200	250	300
V_{oc}(line) (kV)	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 zero power factor and rated voltage is 290 A. Calculate the voltage regulation of this machine at full-load and 0.8 p.f. lagging by using mmf method.

MODULE – 5

9. a. State the conditions necessary for synchronizing an alternator with infinite bus. **04** (2 :5 : 1.3.1)

b. Explain two bright and one dark lamp method used for synchronizing an alternator with infinite bus. **08** (2 :5 : 1.3.1)

c. Derive an expression for synchronizing power. **08** (2 :3 : 1.3.1)

OR

10. a. What is hunting in a synchronous generator? Explain. **06** (2 :3 : 1.3.1)

b. What is slip test? Explain how it is used for determining quadrature- axis and direct- axis reactance. **08** (2 :3 : 1.1.1)

c. Discuss the concept of two reaction theory in a salient pole synchronous generator. **06** (2 :4 : 1.3.1)

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