

Ref. No. : Ex/EE/5/T/212/2024

**BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) 2ND YEAR 1ST SEMESTER
EXAMINATION – 2024**

SUBJECT: ELECTRICAL MACHINES-I

Time: Three hours

Full Marks: 100

Use a separate Answer-Script for each part

Part-I (50 Marks)

Question No.	Answer any three questions(2 marks for neat and well-organized answers)	Marks
1.	a) What is an auto transformer? What are its merits and demerits over two-winding transformer?	8
	b) Derive an expression for saving in conductor material in an autotransformer over a two winding transformer of equal rating.	8
2.	a) Discuss the necessary conditions for successful parallel operation of single phase transformers.	8
	b) A 50 kVA, 2300/230 V, 50 Hz single phase transformer takes 360 W at a power factor of 0.4 with 2300 V applied to the high voltage winding and the low voltage winding open circuited. If the transformer has 230 V impressed on the low voltage side with no load on the high voltage side, what will be the current in the low voltage winding? Neglect saturation.	8
3.	a) Develop the equivalent circuit of a single phase transformer. Clearly state the assumptions if any.	8
	b) The two windings of a 48-kVA, 2400/240V, 50 Hz transformer have resistances of 0.6Ω and 0.025Ω for the high- and low-voltage windings, respectively. This transformer requires that 238 V be impressed on the high voltage coil in order for the rated current to be circulated in the short-circuited low-voltage winding. (i) Calculate the equivalent leakage reactance referred to the high-voltage side. (ii) How much power is needed to circulate the rated current on a short circuit? (iii) Compute the efficiency at full load when the power factor is 0.8 lagging. Assume that the core loss equals the copper loss.	8

[Turn over

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Part-I (50 Marks)

4. a) Derive an expression for computing the per unit voltage regulation of a transformer both for leading and lagging power factor load. **8**
- b) Find the all-day efficiency of a 500 kVA distribution transformer whose copper and iron losses at full load are 4.5 kW and 3 kW respectively. During a day of 24 hours , it is loaded as under: **8**

<i>No. Of hours</i>	6	6	8	4
<i>Load in kW</i>	450	300	150	0
<i>Power Factor</i>	0.9	0.75	1	-

5. **Write short notes on any two of the following:** **8×2**
- a) Breather of a transformer
- b) Conservator of a transformer
- c) Bushing of a transformer

Bachelor of Engineering(Electrical Engineering) 2nd Year 1st Semester
Examination, 2024

SUBJECT: ELECTRICAL MACHINES - I

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Time: Three Hours

Full Marks: 100 (50 each part)

Use a separate Answer-Script for each part.

Question No.	PART - II	Marks
	Answer three questions. Two marks are reserved for neat and well organized answer.	
6.	Justify the following (any four) :	16
i)	In a DC machine normally full pitch coil is used.	
ii)	Lap connected DC machine requires the equalizer connections whereas wave connected DC machine doesn't require it.	
iii)	The role of commutator remains the same irrespective of operation of a DC machine (as a motor or generator).	
iv)	Shunt DC generator is preferred for welding application. .	
v)	DC series motor should not be operated under low load condition.	
vi)	A DC motor can be used as a generator.	
vii)	Interpole helps in linear commutation- explain	
7. i)	Explain in brief the different methods of speed control of D.C motors.	10
ii)	Plot the torque-current characteristic of D.C. shunt motor.	6

Question No.		Marks
8. i)	Derive the expression of electro-magnetic torque in a DC machine.	5+3+8
ii)	Why DC series motor is suitable for traction applications?	
iii)	A 220V DC shunt motor takes 22A at rated voltage and runs at 1000 rpm. The field resistance is 100 ohms and armature resistance is 0.1 ohm. Calculate the back E.m.f of the motor.	
9. i)	What is armature reaction in D.C. machine and what are the adverse effects of it ?	8 + 8
ii)	A 4 pole series motor has 940 wave connected armature conductors. At a certain load the flux per pole is 34.5 mWb and the total mechanical torque developed is 220 Nm. Calculate the line current taken by the motor and the speed at which it will run with an applied voltage of 400V. The total motor armature resistance is 1.3 Ω .	
10.	Write short notes on any two the followings :	8x2
i)	Commutation process in D.C. machine.	
ii)	Lap and Wave connection in D.C. machine.	
iii)	D.C. compound generator.	