

Bachelor of Electrical Engineering 2<sup>nd</sup> Year 1<sup>st</sup> Semester Examination, 2023

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 - I	Marks
	<b>Answer question no. 6 and any two from the rest.</b>	
1.	Justify the following (any six) :	<b>6x3</b>
	i) In a DC machine armature mmf waveform is a time varying triangular waveform.	
	ii) Swinburne test cannot be performed for DC series generator.	
	iii) Lap connected DC machine requires the equalizer connections whereas wave connected DC machine doesn't require it.	
	iv) The role of commutator remains the same irrespective of operation of a DC machine (as a motor or generator).	
	v) Shunt DC generator is preferred for welding application.	
	vi) Inductive kick method is used to check the proper position of the brushes	
	vii) DC series motor should not be operated under low load condition.	
	viii) A DC motor itself solely cannot decide the speed of operation	
2.	i) Show that resistance commutation is not a linear commutation.	<b>5+4+3+4</b>
	ii) What is interface film? How commutation process continues in spite of this interface film.	
	iii) Interpoles help in linear commutation- explain	

[ Turn over

Question No.		Marks
iii)	In a 4-pole DC machine each coil having 4 turns contributes 10 volts. Find the maximum possible voltage rating of the machine if it has 320 conductors.	
3.	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. It's field resistance is 100 $\Omega$ and armature resistance is 0.1 $\Omega$ . Compute the value of the additional resistance required to be connected in the armature circuit to reduce the speed by 200 rpm in case of a fan load where the load torque is proportional to the square of the speed.	
4.	i) What are the adverse effects of armature reaction in a DC machine? Show that brush shift is not a good solution for these.	8 + 8
	ii) A 4 pole series motor has 944 wave connected armature conductors. At a certain load the flux per pole is 34.6 mWb and the total mechanical torque developed is 209 Nm. Calculate the line current taken by the motor and the speed at which it will run with an applied voltage of 500V. The total motor resistance is 3 $\Omega$ .	
5.	Write short notes on the following :	8x2
	i) No-load characteristics of different types of DC generators	
	ii) Hopkinson's method of testing of DC machine	

**PART – II**

Answer all questions.

6. Justify the statements, with proper correction, if necessary (any four) 4x2½
- a) Shell type construction is preferred for low voltage high current transformers.
  - b) Mitered joint is used for large transformer to decrease cost.
  - c) Buchholz's relay can protect a transformer from any type of winding fault.
  - d) Explosion vent is provided at the top lead of transformer to protect from lightning.
  - e) Conservators are provided on the top of all transformer tanks.
  - f) CRGOS increase efficiency of a transformer.
7. a) From the basic principal develop equivalent circuit of a single phase transformer. 10  
or  
b) Draw and explain the phasor diagram of a single phase transformer under (i) no-load condition and (ii) when supplying full load current at lagging p.f.
8. a) Derive an expression for maximum efficiency of a transformer. 10  
or  
b) Derive an expression for voltage regulation of a transformer.
9. a) State and explain the conditions of parallel operation of single phase transformers 10  
or  
b) What are the advantage and disadvantage of an auto transformer?
10. a) A 10 kVA, single phase transformer has a core loss of 70 W and full load copper loss of 200 W. The daily variation of the load on the transformer is as follows: 10
- 7 A.M. to 1 P.M. : 6 kW at 0.7 p.f.  
1 P.M. to 6 P.M. : 4 kW at 0.85 p.f.  
6 P.M. to 1 A.M. : 10 kW at 0.9 p.f.  
1 A.M. to 7 A.M. : no-load
- Determine the all-day efficiency of the transformer.  
or
- b) A 5 kVA, 230V / 115V, 50 Hz, single phase transformer gave the following test results:
- Open circuit test: 115 V, 1.2 A, 50 W  
Short circuit test : 10.2 V, 21 A, 80 W
- Find the equivalent circuit parameters referred to H.V. side and calculate voltage regulation of the transformer at full load, 0.8 p.f. (lagging).