Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2023

Subject Code:3140913 Date:19-01-2024

Subject Name: Electrical Machine- I

Time: 10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Briefly describe the operating principle of a transformer. Draw schematic diagram of a single phase transformer.	**03**
	(b)	Explain the term 'voltage regulation of a transformer'. Write down the equation of voltage regulation of a single phase transformer.	**04**
	(c)	Explain the terms (1) Pole pitch (2) Full pitch coil (3) Front pitch (4) Back pitch in relation to armature winding of a DC machine	**07**
Q.2	**(a)**	Derive the EMF equation of a transformer from first principles.	**03**
	(b)	Draw necessary diagrams and explain the (1) Pole with field windings (2) Armature core, for a DC machine.	**04**
	(c)	An 8-pole DC generator has 500 armature conductors and has a useful flux per pole of 0.025 Wb. What will be the emf generated if it is lap connected and runs at a speed of 1000 rpm? What must be the speed at which it must be driven to produce the same emf if it is wave wound?	**07**
		OR	
	(c)	A 440/110 Volt transformer has a HV resistance of 0.04 Ohm and LV resistance of 0.02 Ohm. Its iron loss at rated output is 150 Watt. Determine the secondary current at which maximum efficiency will occur. Also find out the value of maximum efficiency with unity power factor load.	**07**
Q.3	**(a)**	Draw the field lines for the magnetic fields produced by a bar magnet and a current carrying coil respectively.	**03**
	(b)	Take a suitable example and explain the terms (1) MMF (2) Reluctance (3) Inductance (4) Flux	**04**
	(c)	Derive the equation of force as a partial derivative of stored energy with respect to position of a moving element.	**07**
		OR	
Q.3	**(a)**	Draw the magnetic field lines created due to field winding currents in case of a DC machine.	**03**
	(b)	Explain B-H curve and its significance for a magnetic material.	**04**
	(c)	Derive the equation of torque as a partial derivative of stored energy with respect to angular position of a rotating element.	**07**
Q.4	**(a)**	Derive the EMF equation for a DC generator.	**03**
	(b)	Briefly explain the Swinburn's test for a DC shunt machine	**04**
	(c)	Draw the vector diagrams and winding connections for the following transformer connections. (1) Yd1 (2) Dz0	**07**
		OR	
Q.4	**(a)**	Describe various losses in a DC machine and derive the equation of efficiency of DC machine as a motor and as a generator.	**03**

	(b)	Draw the vector diagram and winding connections for Open Delta connection.	**04**
	(c)	Draw the vector diagrams and winding connections for the following transformer connections. (1) Dy11 (2) Yz1	**07**
Q.5	**(a)**	Derive the torque equation of a DC motor from first principles.	**03**
	(b)	What is the necessity of starter in a DC motor? Explain the working of 3-point starter.	**04**
	(c)	Mention the techniques used for cooling of transformers. Explain any two methods in detail.	**07**

OR

Q.5	**(a)**	Briefly explain the short circuit test for a single-phase transformer.	**03**
	(b)	What is armature reaction? Discuss any one method to counterbalance armature reaction.	**04**
	(c)	Draw the circuit diagram and explain the Field test for DC series machines in detail.	**07**

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