Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2022

EE3CO36 Electrical Machines -I

Programme: B.Tech. Branch/Specialisation: EE

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. Permeability in a magnetic circuit corresponds to .....in an electric circuit- **1**

(a) Resistance (b) Resistivity
(c) Conductivity (d) Conductance

ii. Those magnetic materials are best suited for making armature and transformer cores that have.....permeability and .....hysteresis loss- **1**

(a) High, high (b) Low, high (c) High, low (d) Low, low

iii. Transformer ratings are given in _____. **1**

(a) kVA (b) HP (c) kVAR (d) kW

iv. What is the thickness of laminations used in a transformer? **1**

(a) 14 mm to 15 mm (b) 25 mm to 40 mm
(c) 0.1 mm to 0.5 mm (d) 4 mm to 5 mm

v. Three units of single-phase transformers and one single three-phase transformer rating _____. **1**

(a) Will be same for one rating (b) Can never be made same
(c) May be same (d) None of these

vi. A 400 V, 10 KVA transformer at 50 Hz, is operated at the frequency of 40 Hz, then the humming _____. **1**

(a) Increases (b) Decreases
(c) Remains same (d) Increases to very high

vii. An 8-pole, 3-phase, 50 Hz induction motor is operating at a speed of 720 rpm. The frequency of the rotor current of the motor in Hz is ____. **1**

(a) 2 (b) 4 (c) 3 (d) 1

P.T.O.

viii. The shaft of an induction motor is made of- **1**
(a) Stainless steel (b) Carbon steel
(c) Cast iron (d) Aluminium

ix. What type of coils are used for winding the single-phase induction motor generally? **1**
(a) Rectangular coils (b) Square coils
(c) Cruciform coils (d) Circular coils

x. Which type of capacitor is used in single-phase induction motor? **1**
(a) Electrolytic capacitor (b) Mica capacitor
(c) Paper capacitor (d) Any of these

Q.2 i. State law of electromagnetic induction. Formulate the concept of statically and dynamically induced emf. **4**

ii. Differentiate singly excited and doubly excited systems in detail. **6**

OR iii. A steel ring has a mean diameter of 20 cm, a cross-section of 25 square cm, and a radial air gap of 0.8 mm cut across it. When excited by a current of 1A through a coil of 1000 turns wound on the ring core, it produces an air gap flux of 1 m Wb. Neglecting leakage and fringing, calculate (a) the relative permeability of steel and (b) the total reluctance of the magnetic circuit. **6**

Q.3 i. Define transformation ratio. **2**

ii. How do two transformers work in parallel? Explain the parallel operation of two single-phase transformers using a suitable circuit diagram. **8**

OR iii. A 15kVA, 2200/220 V, 50 Hz transformer gave the following test results: **8**

OC (LV Side)	220V	2.72A	185W
SC (HV Side)	112V	6.3 A	197 W

Compute the followings-
(a) Core loss
(b) Full load copper loss
(c) Efficiency at full load 0.85 lagging pf
(d) Voltage regulation at full load 0.8 lagging pf

Q.4 i. Explain the working principle of the Autotransformer with its circuit diagram. **4**

ii. Write a short note on the followings- **6**
(a) Conservator (b) Breather

OR iii. A three-phase transformer bank consisting of three single-phase transformers used to step down the voltage of a three-phase, 6600V transmission line. If the primary line current is 10 A and turns ratio is 12, Calculate the secondary line voltage, line current, and output kVA for the following connections- **6**
(a) Y/Δ (b) Δ/Y
Neglect Losses.

Q.5 i. Write any four differences between squirrel cage and wound rotor of induction motor. **4**

ii. Draw the Torque-Slip characteristics of Induction machine and also explain various modes of operations. **6**

OR iii. A 400 V, 3-phase, 6 poles, 50 Hz, induction motor gave the following test results: **6**

No-Load	400V	8V	0.16 pf
Blocked rotor	200V	39A	0.36 pf

Determine the mechanical output, torque and slip when the motor draws a current of 30 A from the mains. Assume the stator and rotor copper losses to be equal. Use circle diagram method.

Q.6 Write a short note on any two of the following:

i. Cogging & Crawling **5**

ii. Double revolving field theory **5**

iii. Capacitor start induction motor **5**

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Marking Scheme
EE3CO36 Electrical Machines -I

Q.1	i.	(c) Conductivity	1 Mark	**1**
	ii.	(c) High, low	1 Mark	**1**
	iii.	(a) kVA	1 Mark	**1**
	iv.	(c) 0.1 mm to 0.5 mm	1 Mark	**1**
	v.	(a) Will be same for one rating	1 Mark	**1**
	vi.	(a) Increases	1 Mark	**1**
	vii.	(a) 2	1 Mark	**1**
	viii.	(b) Carbon steel	1 Mark	**1**
	ix.	(d) Circular coils	1 Mark	**1**
	x.	(a) Electrolytic capacitor	1 Mark	**1**
Q.2	i.	Law of electromagnetic induction	2 Marks	**4**
		Formulate the concept of statically and dynamically induced emf	2 Marks	
	ii.	Difference (3 difference)	2 Marks each (2 Marks*3)	**6**
OR	iii.	(a) The relative permeability of steel $\mu_r = 199.34$	3 Marks	**6**
		(b) The total reluctance of the magnetic circuit: sg + ss = 254647.9 + 2294379.03 = 2549026.93 AT/m	3 Marks	
Q.3	i.	Define transformation ratio	2 Marks	**2**
	ii.	Two transformers work in parallel	3 Marks	**8**
		Explain the parallel operation of two single-phase transformers using a suitable circuit diagram	5 Marks	
OR	iii.	(a) Core loss	1 Mark	**8**
		(b) Full load copper loss	2 Marks	
		(c) Efficiency at full load 0.85 lagging pf	2 Marks	
		(d) Voltage regulation at full load 0.8 lagging pf	3 Marks	
Q.4	i.	Working principle of the Autotransformer	2 Marks	**4**
		Circuit diagram	2 Marks	
	ii.	(a) Conservator	3 Marks	**6**
		(b) Breather	3 Marks	
OR	iii.	(a) Y/Δ		**6**
		Secondary line voltage: 317.55 V	1 Mark	
		Line current: 207.84 A	1 Mark	
		Output kVA:114.3	1 Mark	
		(b) Δ/Y		
		Secondary line voltage: 925.6 V	1 Mark	
		Line current: 69.28 A	1 Mark	
		Output kVA:114.3	1 Mark	
Q.5	i.	Four differences	1 Mark each (1 Mark*4)	**4**
	ii.	Torque-Slip characteristics of Induction machine	3 Marks	**6**
		Modes of operations	3 Marks	
OR	iii.	Mechanical output: 7.45 kW	2 Marks	**6**
		Torque: 89.33 Nm	2 Marks	
		Slip 0.26	2 Marks	
Q.6				
	i.	Cogging	2.5 Marks	**5**
		Crawling	2.5 Marks	
	ii.	Theory	2.5 Marks	**5**
		Diagram	2.5 Marks	
	iii.	Theory	2.5 Marks	**5**
		Diagram	2.5 Marks	

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