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

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2019

EE3EL02 / EX3EL02 Electrical Machine Design

Programme: B.Tech. Branch/Specialisation: EE/EX

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. Electrical machines having power outputs ranging from a few kW up to approximately 250 kW may be classified as_____? **1**

(a) Small size machines (b) Medium size machines

(c) Large size machines (d) Any of these

ii. The time taken by the machine to attain 0.632 of its final steady temperature rise is called_____? **1**

(a) Heating time constant (b) Cooling time constant

(c) Either (a) or (b) (d) None of these

iii. What would happen if a power transformer designed for operation on 50 Hz (frequency) were connected to a 500 Hz (frequency) source of the same voltage? **1**

(a) Current will be too much high

(b) Transformer may start to smoke and burn

(c) Eddy Current and Hysteresis loss will be excessive

(d) No effect

iv. For a single phase, 230/2300 Volts, 50Hz core type transformer of cross section 25 cm, if the maximum flux density is 1.12 wb/m2, the number of primary and secondary turns is _____. **1**

(a) 8, 148 (b) 16, 160 (c) 23, 230 (d) 14, 140

v. The effect of increasing the length of the air gap in an induction motor will increase **1**

(a) Power factor (b) Speed

(c) Magnetising current (d) Air-gap flux

P.T.O.

vi. Which type of slots are used in the rotor of an induction motor? **1**
(a) Open slots (b) Semi closed slots
(c) Closed slots (d) None of these

vii. What are the number of the brushes in the lap winding? **1**
(a) Double the number of poles
(b) Same as the number of poles
(c) Half the number of poles
(d) Two

viii. Coil span for 4-pole, 12-slot armature winding is_____ **1**
(a) 24 (b) 48 (c) 8 (d) 3

ix. A synchronous machine with low value of short-circuit ratio has **1**
(a) Good speed regulation (b) Good voltage regulation
(c) Higher stability limit (d) Lower stability limit.

x. The damping winding in a synchronous motor is generally used **1**
(a) To provide starting torque only
(b) To reduce noise level
(c) To reduce eddy currents
(d) To prevent hunting and provide the starting torque.

Q.2 i. Define the term window space factor. **2**
ii. Define the terms specific electric loading and magnetic loading. Explain its significance in design of electrical machines. **3**
iii. What are the main factors affecting the design of electrical machines? **5**
OR iv. Explain why the temperature rise in electrical machines vary according to **5**
(a) The type of insulation (b) Rating

Q.3 i. What is the importance of no load current and temperature rise in three phase transformers? **2**
ii. Explain the procedure for design of winding of power transformer. **8**
OR iii. Calculate the main dimensions for a 250 kVA, 6600/400V,50 Hz, 3 phase, mesh /star, core type oil immersed, self-cooled, out-door type power transformer. Assume suitable values for various design constants and specific loading. **8**

Q.4 i. Low speed induction motors have inherently a poor power factor. Discuss why? **3**
ii. Deduce for a three-phase induction motor an expression showing the relationship between output, it's main dimensions, speed, the specific electric and magnetic loading, efficiency and power factor. **7**
OR iii. Discuss the various factors which are taken into account while designing of rotor for a three-phase slip ring induction motor. **7**

Q.5 i. Why interpoles are required in DC machines? **4**
ii. Discuss the factor on which govern the choice of number of poles in DC machine. **6**
OR iii. Describe the design of armature for a DC machine. How the MMF distribution in DC machines can be calculated? **6**

Q.6 Attempt any two:
i. Explain the term 'short circuit ratio' as applied in Synchronous machines. How does its value affect the design of alternator? **5**
ii. What are the direct and quadrature axis reactances and how they can be determined? **5**
iii. Derive an expression for the output coefficient of a three-phase alternator in terms of specific magnetic and electric loading. **5**

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Marking Scheme

EE3EL02 / EX3EL02 Electrical Machine Design

Q.1	i.	Electrical machines having power outputs ranging from a few kW up to approximately 250 kW may be classified as_____? (b) Medium size machines		**1**
	ii.	The time taken by the machine to attain 0.632 of its final steady temperature rise is called_____? (a) Heating time constant		**1**
	iii.	What would happen if a power transformer designed for operation on 50 Hz (frequency) were connected to a 500 Hz (frequency) source of the same voltage? (c) Eddy Current and Hysteresis loss will be excessive		**1**
	iv.	For a single phase, 230/2300 Volts, 50Hz core type transformer of cross section 25 cm, if the maximum flux density is 1.12 wb/m2, the number of primary and secondary turns is _____. (c) 23, 230		**1**
	v.	The effect of increasing the length of the air gap in an induction motor will increase (c) Magnetising current		**1**
	vi.	Which type of slots are used in the rotor of an induction motor? (b) Semi closed slots		**1**
	vii.	What are the number of the brushes in the lap winding? (b) Same as the number of poles		**1**
	viii.	Coil span for 4-pole, 12-slot armature winding is_____ (d) 3		**1**
	ix.	A synchronous machine with low value of short-circuit ratio has (d) Lower stability limit.		**1**
	x.	The damping winding in a synchronous motor is generally used (d) To prevent hunting and provide the starting torque.		**1**
Q.2	i.	Definition of window space factor.		**2**
	ii.	Specific electric loading	1 mark	**3**
		Specific magnetic loading	1 mark	
		Significance in design of electrical machines	1 mark	
	iii.	Factors affecting the design of electrical machines		**5**
		1 mark for each factor	(1 mark *5)	
OR	iv.	(a) The type of insulation	2.5 marks	**5**
		(b) Rating	2.5 marks	
Q.3	i.	Importance of no load current and temperature rise in three phase transformers 1 mark for each	(1 mark *2)	**2**
	ii.	Procedure for design of winding of power transformer.		**8**
		Core	4 marks	
		Winding	4 marks	
OR	iii.	Calculate the main dimensions		**8**
		Core	4 marks	
		Winding	4 marks	
Q.4	i.	Low speed induction motors have inherently a poor power factor.		**3**
		Explanation in two pints 1.5 marks for each	(2.5 marks *2)	
	ii.	Core	3 marks	**7**
		Output	4 marks	
OR	iii.	Factors which are taken into account while designing of rotor for a three-phase slip ring induction motor.		**7**
		Rotor slots	3 marks	
		Rotor winding	4 marks	
Q.5	i.	Interpoles are required in DC machines		**4**
	ii.	Factor on which govern the choice of number of poles in DC machine.		**6**
		1 mark for each factor	(1 mark * 6)	
OR	iii.	Design of DC machine armature	3 marks	**6**
		MMF distribution in DC machines	3 marks	
Q.6		Attempt any two:		
	i.	Short circuit ratio	3 marks	**5**
		Its value affect the design of alternator	2 marks	
	ii.	Direct and quadrature axis reactances		**5**
		X_d	2.5 marks	
		Y_d	2.5 marks	
	iii.	Derivation for the output coefficient of a three-phase alternator in terms of specific magnetic and electric loading.		**5**
		Stepwise marking		

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