

Enrollment No.....



Faculty of Engineering  
End Sem (Even) Examination May-2019  
EE2EL06 Electrical Machine Design

Programme: Diploma

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. Which of the following is the major considerations to evolve a good design? 1  
 (a) Cost  
 (b) Durability  
 (c) Compliance with performance criteria as laid down in specifications  
 (d) All of these
- ii. The design of mechanical part is particularly important in case of ..... speed machine. 1  
 (a) Low (b) Medium (c) High (d) Any of these
- iii. The value of exciting or magnetizing current depends upon which of the following factors? 1  
 (a) Total m.m.f required  
 (b) The number of turns in the exciting winding  
 (c) The way in which the winding is distributed  
 (d) All of these
- iv. \_\_\_\_\_ are used for construction of core of electromagnets. 1  
 (a) Soft magnetic material (b) Hard magnetic material  
 (c) Either (a) or (b) (d) None of these
- v. Power Transformer have rating 1  
 (a) Equal to 50 kVA (b) Equal to 100 kVA  
 (c) Above 200 kVA (d) Any of these
- vi. Yokes with rectangular Cross- section are used for 1  
 (a) Small capacity transformer  
 (b) Medium capacity transformer  
 (c) Large capacity transformer  
 (d) Any of these

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- vii. Inter poles in DC machines are provided to reduce **1**  
 (a) Sparking (b) Armature reaction  
 (c) Iron loss (d) Efficiency.
- viii. DC motor yoke is generally made of **1**  
 (a) Wood (b) Copper (c) Aluminium (d) Steel.
- ix. In case of induction motor, with increase in supply voltage, which of the following increases? **1**  
 (a) Power factor (b) Slip  
 (c) Torque (d) All of these
- x. In the design of induction motors, normally the number of slots per pole per phase is taken as **1**  
 (a) Two (b) Three  
 (c) Three or more (d) Three or less.
- Q.2 Attempt any two:
- i. What are the limitations in the design of electrical machine? Explain. **5**  
 ii. Explain the factors those limit the design of electrical machine. **5**  
 iii. What are the desirable properties of insulating material? Explain the classification of insulating material based on maximum temperature. **5**
- Q.3 Attempt any two:
- i. Define specific magnetic loading and specific electric loading. What are advantages and disadvantages of using higher specific loading? **5**  
 ii. State and explain the factors which govern the choice of specific magnetic loading in a D.C machine. **5**  
 iii. Derive an expression for the leakage reactance of the transformer. **5**
- Q.4 Attempt any two:
- i. Derive the output power equation for design of 1-phase transformer. **5**  
 ii. Obtain an expression for no load current of single-phase transformer. **5**  
 iii. Write the stepwise procedure for designing of L.V. and H.V. winding of single-phase transformer. **5**
- Q.5 Attempt any two:
- i. From first principles deduce an expression for output equation of a DC machine. **5**

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- ii. Give the step by step procedure of designing a shunt field coil for a DC machine. **5**
- iii. Calculate the diameter and length of armature for a 7.5 kW, 4 pole, 1000 rpm, 220 V Dc shunt motor. Given full load efficiency: 0.83, Maximum flux density: 0.9 Wb/m<sup>2</sup>; Specific electric loading: 30000 AC/m field form factor: 0.7- Assume that the maximum efficiency occurs at full load and field current is 2.5 A of rated current. The pole face is square. **5**
- Q.6 Attempt any two:
- i. Discuss the factors to be considered while designing the length of air gap for an induction Motor. **5**
- ii. A 3-phase, 4 pole, 50 Hz induction motor has 24 stator slots and 28 rotor slots. Prove that it has a tendency to run as synchronous motor at a speed of 214.3 rpm. **5**
- iii. Estimate the stator core dimensions, number of stator slots, and number of stator conductors per slot for a 100 kW, 3300 V, 50 Hz, 12 pole, star connected slip ring induction motor. Take the average gap density of 0.4 Wb/m<sup>2</sup>, electrical loading 25000 ac/m, efficiency: 90 %, power factor: 0.9 and winding space factor : 0.96. Choose the main dimensions to give best p.f. the slot loading must not exceed 500 ac. **5**

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**Marking Scheme**  
**EE2EL06 Electrical Machine Design**

Q.1	i.	Which of the following is the major considerations to evolve a good design? (d) All of these	1
	ii.	The design of mechanical part is particularly important in case of ..... speed machine. (c) High	1
	iii.	The value of exciting or magnetizing current depends upon which of the following factors? (d) All of these	1
	iv.	_____ are used for construction of core of electromagnets. (a) Soft magnetic material	1
	v.	Power Transformer have rating (c) Above 200 kVA	1
	vi.	Yokes with rectangular Cross- section are used for (a) Small capacity transformer	1
	vii.	Inter poles in DC machines are provided to reduce (b) Armature reaction	1
	viii.	DC motor yoke is generally made of (d) Steel.	1
	ix.	In case of induction motor, with increase in supply voltage, which of the following increases? (c) Torque	1
	x.	In the design of induction motors, normally the number of slots per pole per phase is taken as (c) Three or more	1
Q.2		Attempt any two:	
	i.	Limitations in the design of electrical machine 1 mark for limitations (1 mark * 5)	5
	ii.	Factors those limit the design of electrical machine 1 mark for factor (1 mark * 5)	5
	iii.	Properties of insulating material 2 marks Classification of insulating material 3 marks	5
Q.3		Attempt any two:	
	i.	Specific magnetic loading 1 mark	5

		Specific electric loading 1 mark	
		Advantages 1.5 marks	
		Disadvantages 1.5 marks	
	ii.	Factors which govern the choice of specific magnetic loading 1 mark for each factor (1 mark * 5)	5
	iii.	Leakage reactance of the transformer 2 marks Derivation 3 marks	5
Q.4		Attempt any two:	
	i.	Output power equation for design of 1-phase transformer Basic equations of 1-Ø transformer 2 marks Output power equation derivation 3 marks	5
	ii.	No load current of single-phase transformer Basic equations of 1-Ø transformer 2 marks No load current equation derivation 3 marks	5
	iii.	Designing of L.V. winding of single-phase transformer 2.5 marks Designing of H.V. winding of single-phase transformer 2.5 marks	5
Q.5		Attempt any two:	
	i.	From first principles deduce an expression for output equation For DC machine diagram 1 mark Introduction of basic parameters 2 marks Final derivation 2 marks	5
	ii.	Designing a shunt field coil For DC machine diagram 1 mark Introduction of basic parameters 2 marks Final derivation 2 marks	5
	iii.	Calculate the diameter and length of armature For steps 2 marks For calculation of diameter 1.5 marks For calculation of length of armature 1.5 marks	5
Q.6		Attempt any two:	
	i.	Factors for designing the length of air gap for an induction Motor 1 mark for each factor (1 mark * 5)	5
	ii.	It has a tendency to run as synchronous motor at a speed of 214.3 rpm. For correct steps of proof 4 marks	5

	For correct final equation	1 mark	
iii.	Final Answer of stator core dimensions	1 mark	<b>5</b>
	Final Answer of number of stator slots	1 mark	
	Final Answer of number of stator conductors per slot	1 mark	
	For correct formula	2 marks	

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