

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2021****Subject Code: 3170909****Date: 27/12/2021****Subject Name: AC Machine Design****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) Define the following words related to transformer design: 03
 (I) Window space factor
 (II) Staking factor
 (III) Circumscribing Circle
- (b) Define 'Specific electric loading' and 'Specific magnetic loading' in connection with 3-phase induction motor. 04
- (c) Derive equation: $E_t = k\sqrt{Q}$, where Q = kVA rating of a transformer. Also explain how service condition of transformer affects the value of K . 07
- Q.2 (a) State the rules for the selection of rotor slots in 3-phase squirrel cage induction motor. 03
- (b) Give reasons for following: 04
 1) Why tapping are provided on HV winding?
 2) Why stepped core is used in transformers?
- (c) A 200 kVA, 6600/440volts, 50Hz, three phase core type transformer has the following design data: Max. flux density : 1.3 wb/m², EMF/Turn : 10 volts, Stacking factor : 0.9, Window space factor : 0.3 , Current density: 2.5 A/mm², width of largest stamping=0.9d. Overall width and overall height are the same. If three stepped core is used to determine overall dimensions. 07
- OR
- (c) Derive an output equation for 3- ϕ induction motor with usual notation. 07
- Q.3 (a) Define SCR and its importance in designing of synchronous machine. 03
- (b) What is the role of damper winding in (i) synchronous generator and (ii) synchronous motor? 04
- (c) Discuss in steps the design of field winding of a salient pole synchronous machine. 07
- OR
- Q.3 (a) List out the factors to be considered while selecting number of armature slots in the design of a synchronous machine & explain any one. 03
- (b) Explain the terms "critical speed" and "run away speed" with reference to synchronous machine. 04
- (c) A 1250 KVA, 3-ph, 6.6 KV, salient pole alternator has the following data: Air gap diameter = 1.6 meter, length of core = 0.45 meter, number of poles = 20, armature ac per meter = 28000, ratio of pole arc to pole pitch = 0.68, stator slot pitch = 28 mm, current density in damper bars = 3amp/mm². Design a suitable damper winding for the machine. 07
- Q.4 (a) How design of 1-phase and 3-phase induction differ from each other. 03

- (b) Explain the effect of harmonic induction torque and harmonic synchronous torque on the performance of 3-ph induction motor. 04
- (c) A 15 HP, 400 volt, 1430 r.p.m, 3-ph induction motor with an efficiency of 80 % and p.f. 0.81 has inner diameter of stator 30 cm and length 12 cm. Estimate the diameter and length for a 50 h.p, 406 volt, 4 pole, 50 Hz induction motor to be designed for 84 % efficiency and 0.85 p.f. assuming same specific loadings as the previous motor. Assume, $\tau = 0.41 \sqrt{L}$. 07
- OR
- Q.4 (a) What do you mean by dispersion co-efficient applied to induction motors. 03
- (b) Prove that output of single phase machine is two third of the output of three phase induction motor. 04
- (c) Explain the importance of circle diagram in designing auxiliary winding for 1- ϕ induction motor. 07
- Q.5 (a) Explain the advantages of finite element method. 03
- (b) Write a note on computer aided design of Induction motor. 04
- (c) Explain different methods of cooling of transformer. 07
- OR
- Q.5 (a) State why a turbo alternator has smaller diameter and large length but hydro alternator has larger diameter and small length? 03
- (b) Discuss the design difference of a salient pole and non salient pole synchronous machines. 04
- (c) Explain significance of FEM in design problem. 07

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII (NEW) EXAMINATION – SUMMER 2022****Subject Code:3170909****Date:06/06/2022****Subject Name:AC Machine Design****Time:02:30 PM TO 05:00 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.

- Q.1**
- (a) Explain heat dissipation in Electrical Machines. **03**
- (b) Explain the factors for choice of specific magnetic loading & specific electric loading. **04**
- (c) Discuss magnetic material and insulating material in detail. **07**
- Q.2**
- (a) Define window space factor and stacking factor. Which factor affecting window space factor? **03**
- (b) Describe design of LV winding of transformer. **04**
- (c) Explain design of cooling tank with cooling tubes in transformer. **07**
- OR**
- (c) What is Dispersion coefficient? Explain the effect of Dispersion coefficient on maximum power factor. **07**
- Q.3**
- (a) Which points are to be considered for selecting number of stator slots in IM? **03**
- (b) Discuss factors affecting air gap length in induction motor design. **04**
- (c) Determine the main dimensions and number of stator turns per phase of a 3.7 kW, 400 V, 3-phase, 50 Hz, 4 pole squirrel cage induction motor having an efficiency of 0.85 and full load power factor of 0.84. **07**
- Assume: Specific magnetic loading = 0.45 Wb/m^2 , specific electric loading = 23000 A/m , winding factor = 0.955, stacking factor=0.9. Induction motor to be started by star delta starter and design for minimum cost.
- OR**
- Q.3**
- (a) State the rules for the selection of rotor slots in 3-phase squirrel cage induction motor. **03**
- (b) What is effect of harmonic induction torque and harmonic synchronous torque on the performance of 3-ph induction motor. **04**
- (c) Determine overall dimensions for a 200 kVA, 6600/440 V, 50 Hz, 3-phase core type transformer. Emf per turn is 10V, maximum flux density 1.3 Wb/m^2 , current density 2.5 A/mm^2 , window space factor 0.3. overall height = overall width, stacking factor=0.9. **07**
- For three stepped core : width of largest stamping is $0.9d$ and net iron area= $0.6d^2$, where d is diameter of circumscribing circle.
- Q.4**
- (a) Enlist the factors for choice of specific magnetic loading and specific electric loading in synchronous machine. **03**
- (b) Discuss steps for field winding design of salient pole synchronous machine. **04**
- (c) Find main dimensions and peripheral speed of a 2500 kVA, 3 phase, 50 Hz, 3000 V, 187.5 rpm salient pole synchronous generator. The specific magnetic loading is 0.6 Wb/m^2 . specific electrical loading is 34000 A/m , winding factor is 0.955. Use circular poles with ratio of core length to pole pitch=0.65. **07**

OR

- Q.4** (a) How MMF is calculated for magnetic circuit in synchronous machine? **03**
(b) Explain design of damper winding in Synchronous machine. **04**
(c) What is SCR? Discuss its effect on synchronous machine performance. **07**
- Q.5** (a) Derive an output equation for 3- ϕ transformer. **03**
(b) Derive an output equation for 3- ϕ induction motor with usual notation. **04**
(c) What are the applications of FEM technique for design problem? Explain the advantages of finite element method. **07**

OR

- Q.5** (a) Distinguish between Distribution transformer and Power transformer. **03**
(b) Explain FEM software for design of machines. **04**
(c) A 11 kW, 3-phase, 220V, 50 Hz, 6-pole star connected induction motor has 54 stator slots, each containing 9 conductors. Number of rotor bars is 64. The machine has efficiency of 0.86 and a power factor of 0.85. The rotor mmf is 85 percent of stator mmf. Determine bar current and end ring current. If current density is 5 A/mm², find area of bar and end ring. **07**
