Reg. No. \_\_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov / Dec – 2019**

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| **Code :** | **14EE2009** | **Duration :** | **3hrs** |
| **Sub. Name :** | **ELECTRICAL MACHINE DESIGN** | **Max. Marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Discuss about the choice of Specific Electric Loading and Specific Magnetic Loading. | CO1 | 8 |
| b. | Derive the output equation of a DC and AC Machines. | CO1 | 12 |
| **(OR)** | | | | |
| 2. | a. | Calculate the ampere turns required for the air gap of a DC machine given the following data. Gross core length = 40cm, air gap length = 0.5 cm, number of ducts = 5, width of each duct = 1.0cm, slot pitch = 6.5cm, average value of flux density in the air gap = 0.63T, Field form factor = 0.7, Carter’s coefficient = 0.82 for opening/gap length = 1.0 and Carter’s coefficient = 0.82 for opening/gap length = 1.0, and Carter’s coefficient = 0.72 for opening/gap length = 2.0. | CO1 | 10 |
| b. | Calculate the apparent flux density at a section of the tooth of the armature of a DC machine with the following data at that section. Slot pitch = 2.4cm, slot width = 1.2 cm, armature core length including 5 ducts each 1.0cm wide = 38cm, stacking factor = 0.92, true flux density in the teeth at the section is 2.2T for which the ampere turns/m is 75000. | CO1 | 10 |
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| 3. |  | Determine the main dimensions of the armature core, armature winding and commutator segments for a 350kW, 500V, 450 rpm, 6 pole shunt generator assuming a square pole face with pole arc 70% of the pole pitch. Assume the mean flux density to be 0.7T and ampere conductors per cm to be 280 with full load efficiency of 91%. | CO2 | 20 |
| **(OR)** | | | | |
| 4. |  | The commutator of a 10 pole, 1000kW, 500Volt, 300rpm D.C. generator has 450 segments and an external diameter of 1m. Determine a suitable axial length for the commutator, giving details of brushes having regard to commutation and temperature rise. Assume current density as 6A/cm2 , voltage drop due to brush contact as 2.2 volt, brush pressure as 1250 Kg/m2 and co-efficient of friction as 0.25. | CO2 | 20 |
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| 5. | a. | A 250kVA, 6600/400 V, 3-phase core type transformer has a total loss of 4800W on full load. The transformer tank is 1.25mm in height and 1 X 0.5 in plan. Design a suitable scheme for cooling tubes if the average temperature rise is to be C. The diameter of the tube is 50 mm and is spaced 75mm from each other. The average height of the tube is 1.05m. Specific heat dissipation due to radiation and convection is respectively 6 and 6.5 W/m2 – deg.celcius. Assume that convection is improved by 35% due to provision of tubes. | CO3 | 14 |
| b. | Derive the output equation of a Single Phase Transformer. | CO3 | 06 |
| **(OR)** | | | | |
| 6. | a. | A 15,000kVA, 53/6.6 kV, 3 phase star/delta, core type transformer has the following data: Net iron area of each limb = 1.5 x 10-3 m2 ; Net area of yoke = 1.8 x 10-3 m2. Mean length of flux path in each limb = 2.3m; Mean length of flux path in each yoke = 1.6m; Number of turns in H.V.winding = 450. Calculate the no-load current. Use the following data:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | MMF A/m | 130 | 210 | 420 | 560 | 1300 | | Iron loss W/Kg | 0.6 | 1.3 | 1.9 | 2.4 | 2.9 | | CO3 | 10 |
| b. | Determine the core and yoke dimensions for a 250kVA, 50Hz, Single Phase, Core type transformer. EMF per turn = 15V; window space factor = 0.33; current density = 3A/mm2 and Bmax = 1.1T. The distance between the centres of the square section core is twice the width of the core. | CO3 | 10 |
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| 7. | a. | Determine the main dimensions for a 15hp, 400V, 3-phase, 4-pole, 1425 rpm Induction motor. Adopt a specific magnetic loading of 0.45Wb/m2 and a specific electric loading of 230 ac/m. Assume that a full load efficiency of 85% and a full load power factor of 0.88, will be obtained. Design the machine for good overall design. | CO2 | 10 |
| b. | Discuss the rules for the selection of rotor slots for a cage induction rotor. | CO2 | 06 |
|  | c. | Compare squirrel cage induction motor with wound rotor motors. | CO2 | 04 |
| **(OR)** | | | | |
| 8. |  | Estimate the main dimensions, air-gap length, stator and rotor design for a 3-phase, 15hp, 400V, 6-pole, 50Hz, 975 rpm, three phase squirrel caged induction motor. The motor is suitable for star delta starting. Bav = 0.45 Wb/m2 ,Lτ = 0.85, p.f.= 0.85, efficiency = 0.9, ac = 20,000 amp.cond./metre. | CO2 | 20 |
|  | | **Compulsory**: |  |  |
| 9. | a. | A 500kVA, 3.3kV, 50Hz, 600rpm three phase salient pole alternator has 180 turns per phase. Estimate the length of air-gap if the average flux density is 0.54 Tesla. The ratio of pole arc to pole pitch = 0.65 The short circuit ratio = 1.2 The gap contraction factor = 1.15 Winding factor = 0.955 The MMF required for air-gap is 80 percent of no load field MMF. | CO2 | 14 |
| b. | Define Short Circuit Ratio. List out the effects of SCR value in the performance of the machine. | CO2 | 06 |