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

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**End Semester Examination – Nov/Dec – 2018**

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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. | Derive the output equation for a DC machine. | CO1 | 10 |
| b. | A 350 kW, 500 V, 450 rpm, 6 pole dc generator is built with an armature diameter of 0.87 m, and Core length of 0.32m, the lap wound armature has 660 conductors. Calculate specific electric and magnetic loading. | CO1 | 10 |
| (OR) | | | | |
| 2. | a. | What are the factors influencing the choice of specific magnetic loading in electrical machines? | CO1 | 10 |
| b. | Find the permeability at the root of the teeth of a dc machine armature from the following data. Slot pitch =2.1cm, width of root =1.07cm. Gross length of armature =32cm. stacking factor =0.9. True flux density at the root of the teeth is 2.25 Wb/m2. Apparent flux density at root is 2.36 Wb/m2. | CO1 | 10 |
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| 3. | a. | Write down the design procedures for the commutator of dc machine. | CO2 | 8 |
| b. | The armature of a 10 pole, 1000kW, 500V,300rpm, dc generator has a diameter of 1.6m. There are 450 coils. Determine suitable axial length and diameter of commutator giving details of brushes, having regard to commutation conditions and temperature rise. The design limitations are: peripheral speed of commutator Image result for not greater than symbol20m/s, pitch of segments Image result for not greater than symbol4mm, current/brush Image result for not greater than symbol70A, temperature rise Image result for not greater than symbol400C. The other data given is: The brushes span 3 segments approximately; brush drop=1.5V, co-efficient of friction =. Make suitable assumptions for clearance between brush boxes, staggering of brushes and end play. | CO2 | 12 |
| (OR) | | | | |
| 4. | a. | What are the factors affects the airgap length of dc machine? | CO2 | 5 |
| b. | Determine the main dimensions, number of poles and length of airgap of 600kW, 500V, 900rpm dc generator. Assume specific magnetic loading 0.6T, specific electric loading 35000ac/m. The ratio of pole arc/pole pitch=0.75, efficiency 91% and gap contraction factor 1.16 | CO2 | 15 |
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| 5. | a. | Derive the output equation of single phase Transformer and three phase transformer. | CO3 | 10 |
| b. | The tank of 2500 kVA, oil natural cooled transformer has the dimensions length, width and height 1×2.55×2.85m respectively. The full load loss 20kW, loss dissipation due to radiation 6 W/m2 oC, loss dissipation due to convection 6.5 W/m2 oC, improvement in convection due to provision of tubes 35%. Temperature rise 400, Length of tube 1m, diameter of each tube 50mm. Find the number of tube. Neglect the top and bottom surface of the tank as regards the cooling. | CO3 | 10 |
| (OR) | | | | |
| 6. | a. | Explain the procedure involved to design the number of cooling tubes for the transformer. | CO3 | 8 |
| b. | Calculate the main dimensions of core of 100 kVA, 2000/400 Volts, 50 Hz, single phase shell type transformer. Voltage per turn = 10 volts. Peak flux density in the core is 1.1 Wb/ m2. Window space factor is 0.33. Ratio of core depth to width of central limb = 2.5. Ratio of window height to window width = 3.0 current density in the winding is 2 A/mm2, Stacking factor = 0.9. | CO3 | 12 |
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| 7. | a. | Determine the main dimensions, airgap length, stator slots, number of conductors and cross sectional area of stator conductors for a 20HP, 400V, 3phase, 4 pole, 1440 pm induction motor. The motor is suitable for star-delta starting. Average gap density 0.45 Wb/mm2. Ampere conductor per meter 20000, full load efficiency 0.9, power factor 0.82, ratio of L/τ=0.85, winding factor=0.955. | CO2 | 14 |
| b. | Define dispersion co-efficient. What are the effects of dispersion co-efficient on the performance of induction machine? | CO2 | 6 |
| (OR) | | | | |
| 8. | a. | Design a cage rotor for a 40HP, 3 phase, 400V, 6 pole, Delta connected induction Motor having a full load efficiency of 87% and full load power factor of 0.85. Take D=33cm and L=17 cm, stator slots 54, Conductors/slot=14. Assume suitably the missing data if any. | CO2 | 15 |
| b. | What are the choices of rotor slots for squirrel cage machine? | CO2 | 5 |
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|  | | **Compulsory**: |  |  |
| 9. | a. | Define Short Circuit Ratio. What are the significance of Short Circuit Ratio? | CO2 | 5 |
| b. | What are the factors to be considered for the selection of armature slots for synchronous machine? | CO2 | 5 |
| c. | Determine a suitable number of slots and conductors per slot for the stator winding of a 3 phase, 3300V, 50Hz, 300rpm alternator. The diameter is 2.3m and axial length of core is 0.35m. The maximum flux density in the airgap should be approximately 0.9Wb/m2. Assume sinusoidal flux distribution. Use single layer winding and star connection for stator. | CO2 | 10 |