

Code No: **R32021****R10****Set No. 1****III B.Tech II Semester Supplementary Examinations, April - 2017****ELECTRICAL MACHINE DESIGN**

(Electrical and Electronics Engineering)

**Time: 3 hours****Max. Marks: 75****Answer any FIVE Questions****All Questions carry equal marks**

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- 1 a) What are the limitations in the design of Electrical Machines? Discuss. [8M]  
b) Explain in different cooling techniques used in electrical machines. [7M]
- 2 a) Explain the following terms: [8M]  
Back pitch, front pitch, winding pitch and Commutator pitch  
b) Find out whether the following windings are symmetrical or not [7M]  
i) 12 pole, 74 slot, 4 coil sides per slot, simplex wave winding  
ii) 4 pole, 63 slot, 3 coil sides per slot, duplex wave winding
- 3 a) Discuss in detail about the choice of specific electric and magnetic loadings for DC Machines [7M]  
b) Determine the total commutator losses for a 500 kW, 400 V, 800 rpm, 10 pole generator. [8M]  
Given commutator diameter = 0.8 m; current density at brush contact =  $40 \times 10^{-3}$  A/mm<sup>2</sup>; brush pressure = 10 kN/m<sup>2</sup>; co-efficient of friction = 0.28; brush contact drop 2 V
- 4 a) Compare the performances of single and three phase transformers in detail. [8M]  
b) Discuss in detail about different methods of cooling of transformers. [7M]
- 5 a) Discuss in detail about the design of single phase transformers. [7M]  
b) Estimate the dimensions of a 3 phase delta/star core type transformer rated at 200 kVA, 3000/400V, 50 Hz. A suitable core with three steps having a circumscribing circle of 0.25 diameter and a leg spacing of 0.4 m is available. the emf per turn is 7V; assuming a current density, 2.5 A/m<sup>2</sup>; window space factor, 0.28 and a stacking factor of 0.9 [8M]
- 6 a) Explain in detail about the design of the stator slots of wound rotor induction machines. [7M]  
b) Find the main dimensions of a 12 kW, 3 phase, 400 V, 50 Hz, 2810 rpm, squirrel cage induction motor having efficiency of 0.95 and a full load power factor of 0.89. [8M]  
Assume: Specific magnetic loading = 0.3 Wb/m<sup>2</sup>; specific electric loading = 24000 A/m.  
Take the rotor peripheral speed as approximately 30 m/s at synchronous speed
- 7 a) Explain in detail about the design of the rotor slots of wound rotor induction machines. [7M]  
b) Calculate the equivalent resistance of rotor per phase with respect to stator, the current in each bar and end ring and the total copper loss for a 415 V, 50 Hz, 4 pole, three phase induction motor having the following data: [8M]  
Stator: Slots = 48; conductors in each slot = 35; current in each conductor = 10A  
Rotor: Slots = 57; length of each bar = 0.12 m; area of each bar =  $9.5 \times 5.5$  mm<sup>2</sup>; mean diameter of end ring = 0.2 m; area of each end ring = 175 mm<sup>2</sup>. Resistivity of copper is 0.02 Ω/m and mm<sup>2</sup>. Full load power factor is 0.85.
- 8 a) With the help of the equation, explain the output of Synchronous Machines in detail. [7M]  
b) Find the main dimensions of a 70 MVA, 11 kV, 50 Hz, 200 rpm, 3 phase water wheel generator. The average gap density is 0.55 Wb/m<sup>2</sup> and ampere conductors per meter are 32000. The peripheral speed should not exceed 40 m/s at normal running speed in order to limit the run-away peripheral speed. [8M]

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