[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
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1369

B. Tech 3rd Semester Examination

Electrical Machines-I (O.S.)

EE-3003

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question from each of the section A, B, C and D and all the subparts of the question in Section E. All questions carry equal marks and assume missing data if any suitably.

SECTION - A

1. (a) Derive the expression for the emf induced in transformer windings. **(10)**

   (b) A 5 KVA single phase transformer has a core loss of 40 watts and full load ohmic loss of 100 watts. The daily variation of load on the transformer is as follows:

   7 AM to 1 PM : 3 kW at pf 0.6

   1 PM to 6 PM : 2 kW at pf 0.8

   6 PM to 1 AM : 6 kW at pf 0.9

   1 AM to 7 AM : No load

   Determine the all day efficiency of transformer. **(10)**

2. (a) Explain the back to back test on single phase transformers with the help of a diagram, clearly stating its purpose, information it conveys and precautions to be observed during this test. **(10)**

(b) A 50 kVA, 2200/110 V, 50 Hz, single phase transformer gave the following test results:

Open circuit test (on l.v. side): 110 V. 10 A, 400 Watts.

Short circuit test (on h.v. side): 90 V. 20.5 A, 808 Watts.

Compute the parameters of the equivalent circuit referred to high voltage and low voltage sides. Also draw the exact equivalent circuit referred to the low voltage side. **(10)**

SECTION - B

3. (a) Prove that autotransformers are more economical than two winding transformers. **(10)**

(b) A 20 kVA, 2000/200 V, two winding transformer is to be used as an auto transformer, with a constant source voltage of 2000V. At full load of unity power factor, calculate the power output, power transferred and power conducted. If the efficiency of two winding transformer at 0.7 power factor is 97%, find the efficiency of the autotransformer. **(10)**

4. (a) Explain three to two phase conversion and its application. **(10)**

(b) A small industrial unit draws an average load of 100 A at 0.8 lagging power factor from the secondaries of its 2000/200 V, 60 kVA star/delta transformer bank. Determine: (a) power consumed by unit in kW (b) the total kVA used (c) primary line and phase current. **(10)**

SECTION - C

5. (a) Derive the emf equation for a DC generator and state the various factors affecting it. **(10)**

(b) The DC armature is built up of laminations having an external diameter of 42 cm. The flux density in the armature core is 0.85 T. The armature is wave connected with 72 slots, with 3 conductors per slot. If the number of poles is 6, find the emf generated when the armature is rotated at 600 rpm. **(10)**

6. (a) Explain the problem of commutation in DC machines and how it is minimized? **(10)**

(b) Explain the various characteristics of a DC shunt generator. **(10)**

SECTION - D

7. The Hopkinson's test on the two machines gave the following results for full load: Line voltage 250 V; line current, excluding field current, 50 A; motor armature current 38 A; field current 5A and 4.2 A. Calculate the efficiency of each machine. Armature resistance of each machine is 0.02 ohm. **(20)**

8. (a) Explain the Ward Leonard system of speed control. **(10)**

(b) Explain the torque speed characteristic of DC series motor. **(10)**

SECTION - E

9. Give brief answers to the followings:

(a) State working principle of transformers

(b) State the importance of transformer equivalent circuits.

(c) State the applications of potential transformers.

(d) State factors affecting choice of connection in 3-phase transformers.

(e) State working principle of shunt generator.

(f) State the limitation of generators.

(g) State the copper losses in DC machines.

(h) State the condition for maximum efficiency in transformers.

(i) State the difference between cumulative and differentially compounded generators.

(j) State the application of 12-phase transformers.

(2x10=20)