NATIONAL INSTITUTE OF TECHNOLOGY, DELHI

Name of Examination: Mid Semester(Jan-19) MARCH 2019

Branch: Electrical & Electronics Engineering **Semester: IV**

Title of Course: Electrical Machines-I **Course Code: EEB 251**

Time: 2 Hrs **Maximum Marks: 25**

Note: Attempt any five Questions. Question no. 1 is compulsory.

Q1. All questions are compulsory and must be solved together at same place:

(a) Two transformers of different *kVA* ratings working in parallel share the load in proportion to their *kVA* rating when

i. Per unit leakage impedances on the same *kVA* base are the same.
ii. Per unit leakage impedances on their respective *kVA* ratings are equal.
iii. Ohmic values of the leakage impedances are inversely proportional to their ratings
iv. Ohmic values of the leakage magnetizing reactance are same.

(b) A 400/100 v, 10 kVA two winding transformer is reconnected as an autotransformer across a suitable voltage source. The maximum rating of such an arrangement would be _____ kVA.

(c) A 10 kVA, 400/200 V, single phase transformer with percentage resistance and reactance of 3% and 6% respectively is supplying a current of 50A to a resistive load. The value of the load voltage is _____volt.

(d) Derive the relationship between electrical and mechanical degrees in an electrical machine.

(e) Explain Faraday's laws of electromagnetic induction and Lenz's law.

Q2. Explain the parallel operation of two single-phase transformers with appropriate phasor diagram for following conditions: (i) identical leakage impedance but different (X/R) ratio and (ii) identical (X/R) ratio but different leakage impedances.

Q3. (A) Draw neat, to the scale, phasor diagram for single-phase transformer for (a) negative voltage regulation, (b) zero voltage regulation and (c) maximum voltage regulation. (2 Marks)

(B) Explain the following test with neat circuit diagram as performed on single-phase transformers: (i) Polarity test and (ii) Sumpner's Test (3 Marks)

Q4. Two single-phase transformers have the following data: ***Transformer-1:***100 kVA, 6600/230 V, z_{ea}= 1.5+j4% and ***Transformer-2:*** 200 kVA, 6600/220 V, z_{eb}= 1.0+j5%. These two transformers are connected in parallel and 6600 V is applied to *h.v.* side. Calculate: (a) no-load circulating current and the ohmic loss caused by it, and (ii) no-load terminal voltage.

Q5. A 110 kVA, 2200/110 V, 60 Hz transformer has following circuit constants: R_1=0.22 ohms, R_2=0.005 ohms, X_1=2 ohms, X_2=0.005 ohms, R_c= 5500 ohms, X_m=1100 ohms. During 24 hours, the transformer has following load cycles: 4 hours on no load, 8 hours on quarter load at a power factor of 0.8 lagging, 8 hours on half load at unity power factor and 4 hours on full load at unity power factor. Assuming core losses to be 1.346 kW find the all day efficiency of the transformer.

Q6. A 120 kVA, 2400/240 V, step-down transformer has the following parameters: R_1=0.75 Ω, X_1=0.8 Ω, R_2=0.01 Ω, X_2= 0.02 Ω. The transformer is designed to operate at maximum efficiency at 70% of its rated load with 0.8 pf lagging. Determine (a) the kVA rating of the transformer at maximum efficiency, (b) the maximum efficiency, (c) the efficiency at full load at 0.8 pf lagging and (d) equivalent core loss resistance.

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