Branch: Electrical & Electronics Engg.   **Semester: IV**

Title of Course: Electrical Machines-I   **Course Code: EEB251**

Time: 3 Hrs   **Maximum Marks: 50**

Note: Attempt any 5 Questions. Question no. 1 is compulsory, all sub questions carry 2 marks and must be attempted together. All questions carry equal marks.

Q1.   (i) Explain the requirement of starters in a dc motors.

(ii) Derive the expression of induced voltage in the windings of a single-phase transformer.

(iii) Explain electrical and mechanical angle and derive relation between them.

(iv) Explain the various types of losses that take place in rotating electrical machines.

(v) Describe the different losses taking place in a transformer and explain the procedure for separating hysteresis and eddy current loss. Also derive the condition for maximum efficiency of the transformer.

Q2.   A 60 kW, 250 V shunt motor takes 16 A when running light at 1,440 rpm. The resistance of the armature and field are 0.2 W and 125 W respectively when hot. (a) Estimate the efficiency of the motor when taking 152 A. (b) Also estimate the efficiency if working as a generator and delivering a load current of 152 A at 250 V.

Q3.   A 230 V, dc shunt motor takes an armature current of 3.33 Amps at rated voltage and at a no-load speed of 1000 rpm. The resistance of the armature circuit and field circuit are respectively 0.3 Ω and 160 Ω. The line current at full load and rated voltage is 40 A. Calculate, at full load the speed and the developed torque in case the armature reaction weakens the no-load flux by 4%.

Q4.   Explain the effect of armature reaction with suitable phasor diagram. Also explain its effect on the performance of dc machines. Discuss the ways to improve the effects of armature reaction.

Q5.   Explain open-circuit and short-circuit test for single-phase transformer and obtain the generalized expressions for the equivalent circuit parameters. Also draw the generalized equivalent circuit referred to low voltage side.

Q6.   A 100 kVA, 1500/150 V, step-down transformer is designed to operate at maximum efficiency at 70% of its rated load with 0.8 pf lagging. The various parameters of the transformer are: R_1=0.65 Ω, X_1 0.7 Ω, R_2 0.01 Ω, and X_2=0.03 Ω. 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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