Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech.

Branch	**: Electrical & Electronics Engg.**	**Semester**	**: IV**
Title of the Course	**: Electrical Machines-I**	**Course Code**	**: [redacted] EEB251**

Time: 3 Hours **Maximum Marks: 50**

SECTION-A (10 Marks)

Note: All parts of this question are compulsory and carry two marks each.

Q1. i. Explain with proper justification why dc series motor should not be started at no-load.

ii. Explain the possible reasons for the failure of voltage build up in a dc shunt generator. How each reason can be trouble-shooted?

iii. Explain why the starting current of a dc machines is very high. How can starting current be limited to safe values.

iv. Define voltage regulation of the transformer and derive the conditions for zero and maximum voltage regulation.

v. Explain the advantages of auto-transformer over two winding transformer with proper justification.

SECTION-B (20 Marks)

Note: Attempt any four questions, each question carries 5 marks.

Q2. Derive the relationship between (i) Speed-Armature current, (ii) Torque-Armature current and (iii) Speed-Torque for each of the following motors: (a) DC Shunt Motor (b) DC Series Motor. Also draw the neat characteristics for each case.

Q3. Explain Armature Reaction with suitable phasor diagram. Elaborate its effect on the performance of dc machine and on the commutation process. Also list the methods used for limiting the effects of armature reaction.

Q4. 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.

Q5. A shunt motor with a field resistance of 350 ohms and an armature resistance of 0.2 ohms is connected to a 250 V supply. At a speed of 1000 rpm the armature current is 55 A. Calculate the additional resistance required in the field circuit to increase the speed to 1100 rpm for the same armature current. Also, calculate the speed in rpm with the original field current and an armature current of 100 Amp. Assume linear magnetization curve.

Q6. A 150 kVA, 2500/250 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=0.75 Ω, X_1=0.8 Ω, R_2=0.01 Ω, and X_2=0.02 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.

SECTION-C (20 Marks)

Note: Attempt any two questions, each question carries 10 marks.

Q7. Derive the generalized expression for voltage induced in any generator. Also derive the expression for voltage generated in the armature of a dc machine.

Q8. A 15 kW, 230V, 80 Amps, 1000 rpm dc series motor has the following full load losses expressed in percentage of motor input:
Armature circuit ohmic loss = 2.8%
Field ohmic loss = 2.6%
Rotational loss = 2.2%
Neglecting the armature reaction and magnetic saturation and assume the rotational loss to remain constant. If the motor draws half the rated current at rated voltage, determine (i) Speed in rpm, (ii) shaft power output, (iii) net torque and (iv) motor efficiency.

Q9. 220 V unsaturated shunt motor has an armature resistance (including brushes and interpoles) of 0.04 W and a field resistance of 100 W. (a) Find the value of resistance to be added to the field circuit to increase the speed from 1,200 to 1,600 rpm, when the supply current is 200 A; (b) with the field resistance as in (a), find the speed when the supply current is 120 A. If the machine is run as a generator to give 200 A at 220 V, find (c) the field current at 1,300 rpm, and (d) the speed when the field current is 2 A.

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