CLASS: B.Tech.   SEMESTER: IV
BRANCH: EEE   SESSION: SP/2023

SUBJECT: EE251 DC MACHINES AND TRANSFORMER

TIME: 3 Hours   FULL MARKS: 50

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

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Q.1(a)   i.   Explain why the core flux in a transformer is almost independent of load   [5]   1,   3
current.   3, 5
ii.   Why is the short circuit test generally performed at the reduced voltage
on the high voltage side?

Q.1(b)   The parameters of the equivalent circuit of 150 kVA, 2400/240 V transformer are: [5]   3,   4
$R_1 = 0.2\ \Omega$ $R_2 = 2 \times 10^{-3}\ \Omega$ 4, 5
$X_1 = 0.45\ \Omega$ $X_2 = 4.5 \times 10^{-3}\ \Omega$
$R_i = 10.0\ k\Omega$ $X_m = 1.6\ k\Omega$ (as seen from 2400 V side)
a) Draw the circuit model as seen from the HV side.
b) Determine the voltage regulation and efficiency when the transformer is
supplying full load at 0.8 lagging power factor on the secondary side at rated
voltage.

Q.2(a)   Draw the phasor diagram of a transformer as seen from any one side for zero   [5]   1, 2   1
voltage regulation.

Q.2(b)   The figure shows two 1-phase ideal transformers T_1 and T_2 connected with their   [5]   3,   4
primaries in parallel across a source. For R=10 ohm, determine the current taken   4, 5
from the source, primary input impedance, and power input.
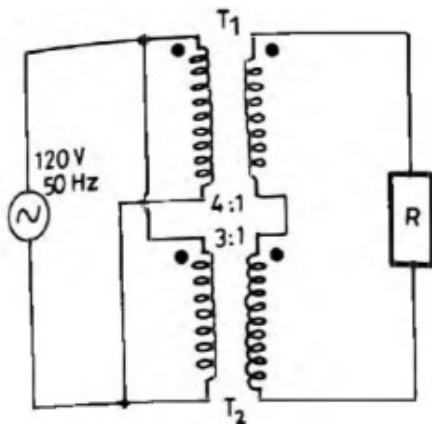
Q.3(a)   Draw a neat diagram of a 4-pole DC machine. Label all its parts and mention the   [5]   1,   2
material used for each part. What are the two functions of a commutator in DC   2, 5
machines?

Q.3(b)   Draw the developed winding diagram of a progressive lap winding for 4-pole, 16   [5]   1,2,   6
slots single layer showing the position of poles, the direction of motion, the   3,4,
direction of induced emf, and the position of brushes.   5

Q.4(a)	Sketch and explain the load characteristics of a DC shunt, series, and compounded generator. What do you mean by cumulative and differential compounding?	[5]	1,2, 3,5	2
Q.4(b)	A DC generator is connected to 220 V DC mains. The current delivered by the generator to the mains is 100 A. The armature resistance is 0.1 ohm. The generator is driven at a speed of 500 rpm. Calculate:	[5]	1,3, 4,5	4

       (i) the induced emf
       (ii) the electromagnetic torque
       (iii) the mechanical power input to the armature neglecting iron, winding, and
            friction losses,
       (iv) Electrical power output from the armature,
       (v) armature copper loss.

Q.5(a)	Derive the torque equation of a DC motor.	[4]	2,3	3
Q.5(b)	A 250 V, 20 kW shunt motor running at 1500 rpm has a maximum efficiency of 85% when delivering 80% of its rated output. The resistance of the shunt field winding is 125 ohms. Determine the speed of the motor when it draws 100 A from the mains.	[6]	3, 4	4