Iqar national university Peshawar

Department of electrical engineering

Open ended lab

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IQRA NATIONAL UNIVERSITY

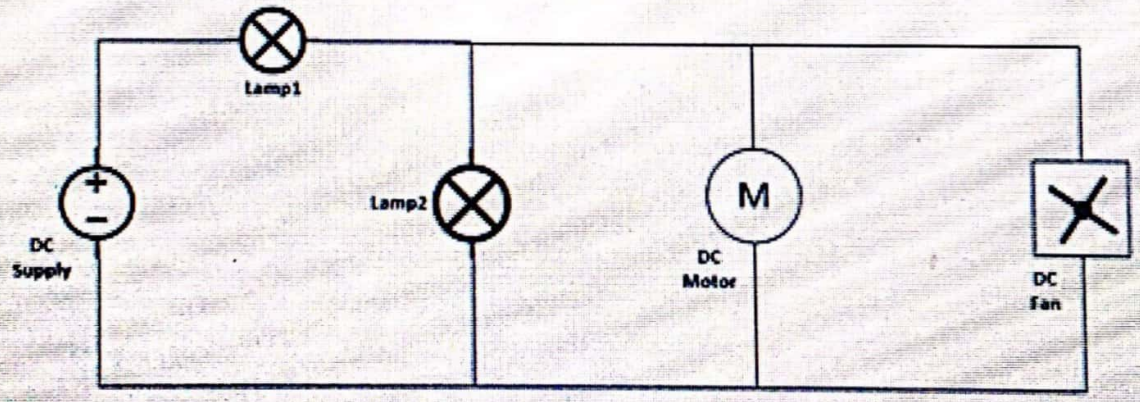
DEPARTMENT OF ELECTRICAL ENGINEERING

Linear Circuit Analysis (LAB)

Open Ended Lab

Consider a DC circuit in which two lamps, one DC motor and one DC fan are connected in series-parallel combination to a 12V DC power supply as shown in the figure below. Resistances of two lamps are denoted by R_1 and R_2 respectively. Resistance of the coil of DC motor is denoted R_3 and resistance of the coil of DC fan is denoted by R_4. Using any of the circuit analysis techniques, compute the below given parameters:

1) Current flowing through each lamp, DC motor and DC fan.
2) Voltage across each lamp, DC motor and DC fan.
3) Power loss in each lamp, DC motor and DC fan



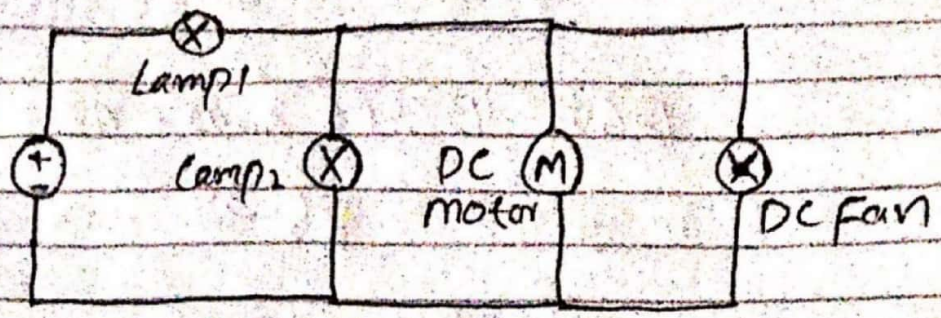
Note:

a) Each student should take different value of R_1, R_2, R_3, and R_4.
b) Verify the result practically through a circuit simulation software.

(1)

Question::

Ans: Figure:



Solution:

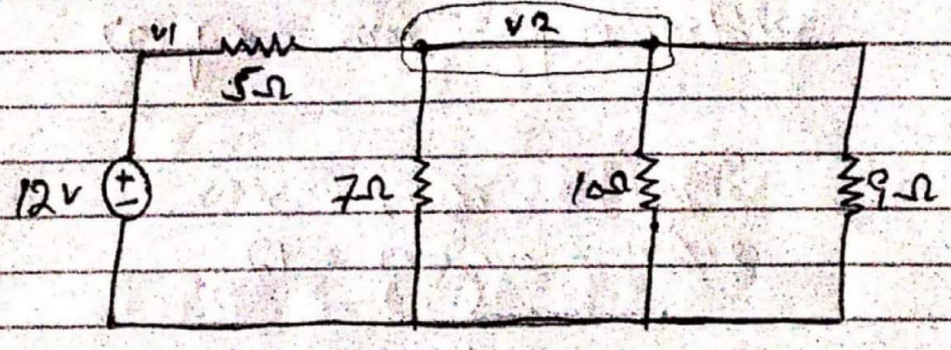
Solving though nodals

Let $R_1 = 5$

$R_2 = 7$

$R_3 = 10$

$R_4 = 9$



Applying KCL on V_1

$$\frac{V_2 - V_1}{5} = 12$$

$$V_1 - V_2 = 60$$

Applying KCL on node 2

$$\frac{V_2 - V_1}{5} + \frac{V_2}{7} + \frac{V_2}{10} + \frac{V_2}{9} = 0$$

$$\frac{126V_2 - 126V_1 + 90V_2 + 63V_2 + 70V_2}{630} = 0$$

$$\frac{-126V_1 + 349V_2}{630} = 0$$

$$-0.2V_1 + 0.6V_2 = 0$$

xing 0.1 with eq (1)

$$0.2V_1 - 0.6V_2 = 12 \quad \text{---(2)}$$

Subtracting from eq (2)

$$-0.2V_1 + 0.6V_2 = 0$$
$$0.2V_1 - 0.2V_2 = 12$$

$$= 0.4V_2 = 12$$

$$\boxed{V_2 = 30V}$$

Putting in eq (a)

$$0.2V_1 = 18$$

(3)

$V_1 = 90V$

(1) Find current

current across R_1

$I = V/R$

$I = 90/5 = 18A$

current across R_2

$I = V/R$

$= 30/7 = 4.3A$

current across R_3

$I = V/R$

$= 30/10 = 3A$

current across R_4

$I = V/R$

$I = 30/9 = 3.3A$

Result = $I_1 = 18A$

$I_2 = 4.3A$

$I_3 = 3A$

$I_4 = 3.3A$

(ii) Find voltage

voltage across R_1

$V = IR$

$V = (18)(5) = 90V$

V across R_2

$V = IR$

$V = (4.3)(7) = 30.1V$

V across R_3

$V = IR$

$V = (3)(10) = 30V$

V across R_4

$V = IR$

$V = (3.3)(9) = 29.7$

Result:

$V_1 = 90V$

$V_2 = 30.1V$

$V_3 = 30V$

$V_4 = 29.7V$

(iii) Finding power across each resistor

$P(R_1) = (I_1)(V_1)$

$= (18)(90)$

$= 1620$ mw

$P(R_2) = (I_2)(V_2)$

$= (4.3)(30.1)$

$= 129.43$ mw

$P(R_3) = (I_3)(V_3)$

$= (3)(30)$

$= 90$ mw

$P(R_4) = (I_4)(V_4)$

$= (3.3)(29.7)$

$= 98.01$ mw

Result: $P_1 = 1620$ mw

$P_2 = 129.43$ mw

$P_3 = 9$ mw

$P_4 = 98.01$ mw