IQRA NATIONAL UNIVERSITY

Linear circuit analysis (LAB)

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ASSIGNMET :   Open ended lab

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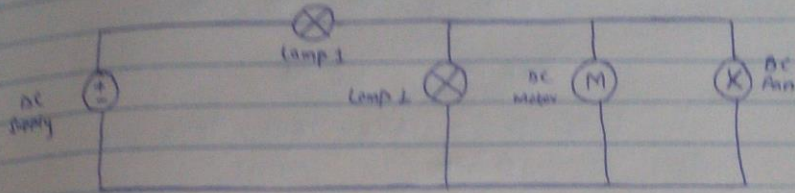
1) Current flowing through each lamp, DC motor and DC fan.
2) Voltage across each lamp, DC motor and DC fan.
3) Power loss in each lamp, DC motor and DC fan
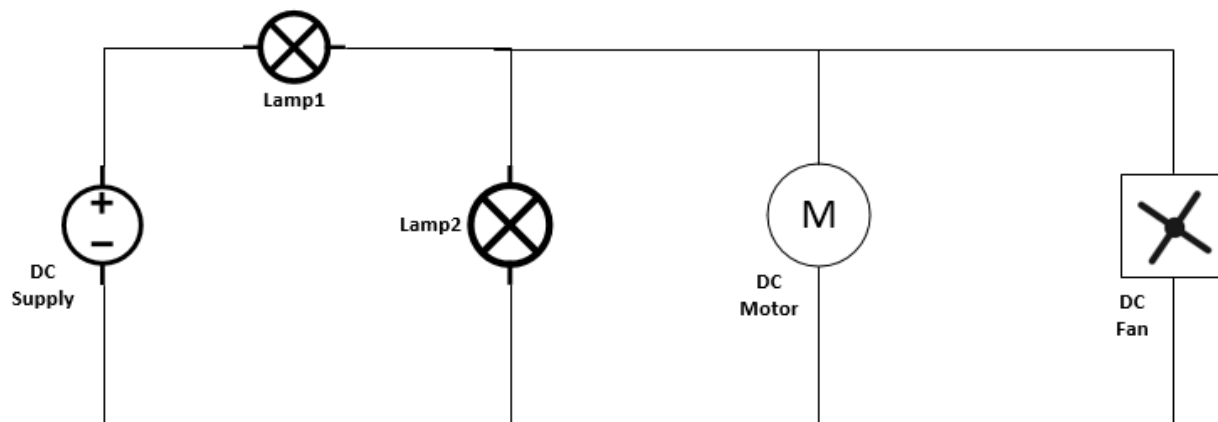
Note:

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.

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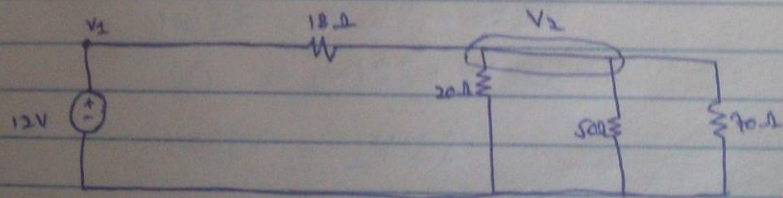
Requiredn

Current across each resister = ?
Voltage across each resister = ?
Power absorbed by each = ?

Soln

Find Current through nodel
analysis for this identifying nodes.

Applying kcl on node 1

$$\frac{V_1 - V_2}{18} = 12$$

$$V_1 - V_2 = 216$$

Applying KCL on node 2.

$$\frac{V_2 - V_1}{18} + \frac{V_2}{20} + \frac{V_2}{50} + \frac{V_2}{70} = 0$$

Taking LCM

$$\frac{350 V_2 - 350 V_1 + 315 V_2 + 126 V_2 + 90 V_2}{6300} = 0$$

$$-350 V_1 + 881 V_2 = 0$$

Taking eq ① × 350

$$V_1 - V_2 = 216$$

$$350 V_1 - 350 V_2 = 75600 \quad —\ⓐ$$

adding eq ⓐ with eq ②

$$350 V_1 - 350 V_2 = 75600$$
$$-350 V_1 + 881 V_2 = 0$$
$$\overline{}$$
$$531 V_2 = 75600$$

$$V_2 = 142.4 \ V$$

Putting V_2 in eq ①

$$V_1 - 142.4 = 216$$
$$V_1 = 358.4 v$$

Current across resistor ①

$$I = \frac{V_A}{R}$$

$$I = \frac{358.4}{18}$$

$$I_{18\Omega} = 19.9 \text{ A}$$

Current across resistor ②

$$I_{20\Omega} = \frac{V_2}{R}$$

$$= \frac{142.4}{20}$$

$$I_{20\Omega} = 7.12A$$

Current across resistor ③

$$I_{50\Omega} = \frac{142.4}{50}$$

$$I_{50\Omega} = 2.84A$$

Current across resistor ④

$$I_{70\Omega} = \frac{142.4}{70}$$

$$I_{70\Omega} = 2.03A$$

Result :

Current across bulb1 = 19.9A

Current across bulb2 = 7.12A

Current across fan = 2.84A

Current across Motor = 2.03A

(ii) Finding voltage across each

Voltage across R_1 :

$V = IR$

$= (19.9)(18)$

$V = 358.2 V$

Voltage across R_2 :

$V = IR$

$= (9.12)(20)$

$V = 142.4$

Voltage across R_3

$V = (2.84)(50)$

$V = 142$

Voltage across R_4

$V = IR$

$= (2.03)(70)$

$V = 142.1$

Result:

V across Bulb 1 = 358.2 V

V across Bulb 2 = 142.4 V

V across Motor = 142 V

V across Fan = 142.1 V

Finding Power across each resistor:

$$P(R_1) = (I_1)(V_1)$$
$$= (358.1)(19.9)$$
$$= 7.6 mW$$

Power for

$$P(R_2) = (I_2)(V_2)$$
$$= (9.12)(142.4)$$
$$= 0.403 mW$$

$$P(R_3) = (I_3)(V_3)$$
$$= (2.84)(142)$$
$$= 0.403 mW$$

$$P(R_4) = I_4 V_4$$
$$= (2.03)(142.1)$$
$$= 0.288 mW$$

Results

$$P_1 = 7.6 mW$$
$$P_2 = 0.403 mW$$
$$P_3 = 0.403 mW$$
$$P_4 = 0.288 mW$$

Circuit by simulation: