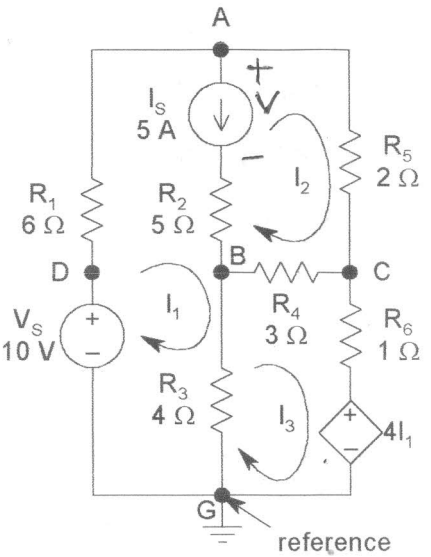
Department of Electrical Engineering
Indian Institute of Technology, Kanpur

ESc 201 | **Quiz 1A** | **30.8.18**
Full Marks: 15 | **Total Time: 30 mins.**

Name Key **Section No.** ____ **Roll No.** ____

a) Determine I_1, I_2, and I_3, using the *mesh current technique*. **8**
b) Using the results of part a), calculate the node voltages at nodes A, B, and C, with respect to the reference node G (ground). **4.5**
c) Hence, determine the voltage dropped across the 5 A current source (I_S), clearly specifying its polarity. **2.5**



a) Due to presence of I_S, mesh eqns for meshes ① and ② can't be written. But $I_1 - I_2 = 5A$ $\Rightarrow I_1 = I_2 + 5$

Invoke Supermesh 1: DACGD

$\Rightarrow 10 = 6I_1 + 2I_2 + I_3 + 4I_1$

$\Rightarrow 12I_2 + I_3 = -40$ or $12I_1 + I_3 = 20$ . . . . ①

Supermesh 2: DACBGD

$\Rightarrow 10 = 6I_1 + 2I_2 + 3(I_2 - I_3) + 4(I_1 - I_3) \Rightarrow 15I_2 - 7I_3 = -40$ or $15I_1 - 7I_3 = 35$ . . ②

Mesh 3: GBCG $\Rightarrow 4(I_3 - I_1) + 3(I_3 - I_2) + I_3 + 4I_1 = 0 \Rightarrow -3I_2 + 8I_3 = 0$ . . . ③

Any 2 among Eqs. (1) - (3) would be enough.

Solving any pair, $I_1 = 1.77A$ $I_2 = -3.23A$ $I_3 = -1.24A$

b) $V_A = V_S - I_1 R_1 = -0.62V$ $V_B = R_3(I_1 - I_3) = 12.04V$ $V_C = V_A - R_5 I_2 = 5.84V$

c) $V_A - V_B = V + R_2 I_S \Rightarrow V = -37.66V$, with polarity as shown in the fig.

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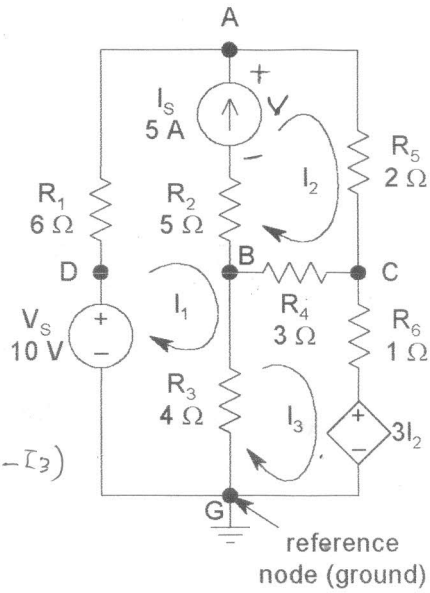
ESc 201 **Quiz 1B** **30.8.18**
Full Marks: 15 **Total Time: 30 mins.**

Name Key _____ **Section No.** ____ **Roll No.** _____

a) Determine I_1, I_2, and I_3, using the *mesh current technique*. **8**
b) Using the results of part a), calculate the node voltages at nodes A, B, and C, with respect to the reference node G (ground). **4.5**
c) Hence, determine the voltage dropped across the 5 A current source (I_S), clearly specifying its polarity. **2.5**



a) $I_2 - I_1 = 5A \Rightarrow I_2 = I_1 + 5$

Supermesh 1: DACGD $\Rightarrow 10 = 6I_1 + 2I_2 + I_3 + 3I_2$

$\Rightarrow 11I_1 + I_3 = -15$ or $11I_2 + I_3 = 40$ . . . (1)

Supermesh 2: DACBGD $\Rightarrow 10 = 6I_1 + 2I_2 + 3(I_2 - I_3) + 4(I_1 - I_3)$

$\Rightarrow 15I_1 - 7I_3 = -15$ or $15I_2 - 7I_3 = 60$ . . . (2)

Mesh 3: GBCG $\Rightarrow 4(I_3 - I_1) + 3(I_3 - I_2) + I_3 + 3I_2 = 0$

$\Rightarrow -I_1 + 2I_3 = 0$ or $-I_2 + 2I_3 = -5$ . . . (3)

Solving: $I_1 = -1.3A$ $I_2 = 3.7A$ $I_3 = -0.7A$

b) $V_A = V_S - I_1 R_1 = 17.8V$ $V_B = R_3(I_1 - I_3) = -2.4V$ $V_C = V_A - I_2 R_5 = 10.4V$

c) $V_A - V_B = V - R_2 I_S \Rightarrow V = 45.2V$, with polarity as shown in the fig.