EE1101: Circuits and Network Analysis

Assignment - 01

Handed out: 09 - Aug - 2024 **Due : 19 - Aug - 2024 (before 5 PM)**

Instructions :

1. Please upload your assignment solutions to the course page on the Canvas platform. Only solutions submitted through this page will be reviewed. For specific guidelines, refer to the instructions provided on the course page.
2. Submissions received after the deadline will attract negative marking.
3. It is suggested that you attempt all the problems. However, it is sufficient to submit solutions for problems that total 10 points.
4. Ensure that your submissions are named in the following format: RollNo-Assignment-01.pdf.

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1. (6 points) Consider the circuit [1] shown in Fig. 1.

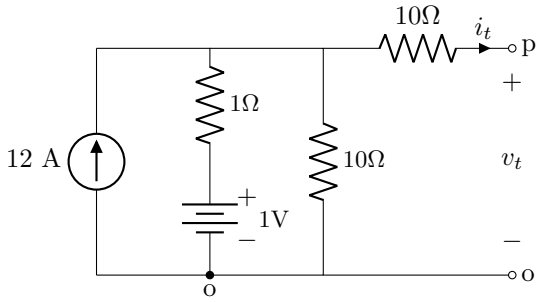

Fig. 1: Simple resistive circuit (Question 1)

   (a) (2 points) Compute the open circuit voltage and short circuit current of the port $p - o$.

   (b) (2 points) Compute the equivalent (input) resistance as seen from the port $p - o$.

   (c) (2 points) If a resistor of 1Ω is connected across the port $p - o$, compute the power dissipated by the resistor.

2. (4 points) Compute the output voltage (v_o) and current supplied by the battery (i_i) for the circuit shown in Fig. 2.

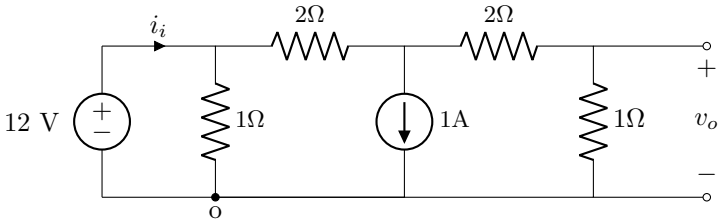

Fig. 2: Resistive circuit for Question 2

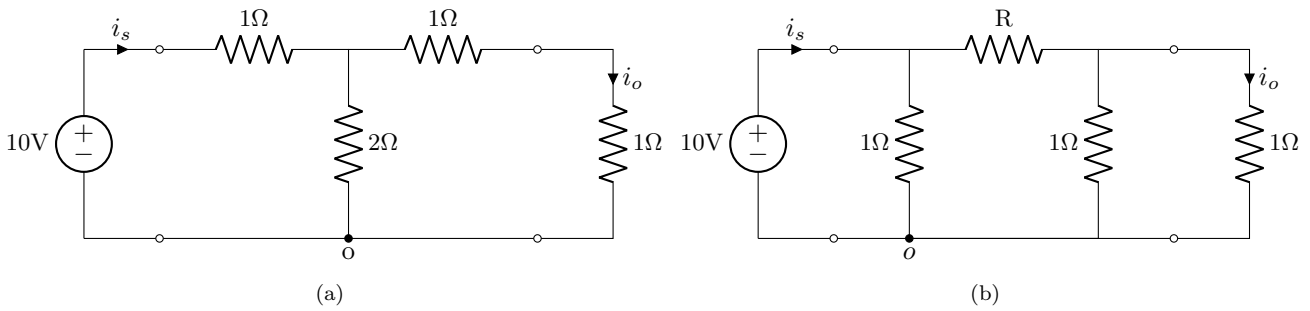

Fig. 3: Circuits for Question 3

3. (6 points) Consider the two circuits shown in Fig. 3.

   (a) (2 points) For the circuit shown in Fig. 3(a), compute i_s and i_o.

   (b) (2 points) For the circuit shown in Fig. 3(b), compute the value of R such that i_o in the circuit is same as i_o in the circuit shown in Fig. 3(a).

   (c) (2 points) For the circuit shown in Fig. 3(b), compute the value of R such that i_s in the circuit is same as i_s in the circuit shown in Fig. 3(a).

4. (4 points) For the circuit shown in Fig. 4,

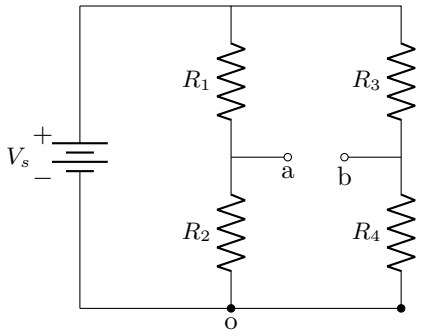

Fig. 4: Circuit for question 4

   (a) (2 points) derive an expression for the equivalent (input) resistance as seen from the port a-b.

   (b) (2 points) derive an expression for the equivalent (input) resistance as seen from the terminals to which the DC source is connected.

5. (5 points) Prove or disprove the following statement: The algebraic sum of power in any DC circuit [2] is always zero.

6. (5 points) How can the node equations for the circuit in Fig. 5 be expressed in the form $\mathbf{G}_{uu}\mathbf{v}_u + \mathbf{G}_{uk}\mathbf{v}_k = \boldsymbol{i}$, where $\mathbf{v}_u$ is the vector of unknown node voltages and $\mathbf{v}_k$ is the vector of known node voltages? Clearly specify the entries (and the dimensions) of the vectors and matrices.

[1] The basis for this circuit is the equivalent circuit of a photovoltaic (PV) cell
[2] since we covered DC circuits so far

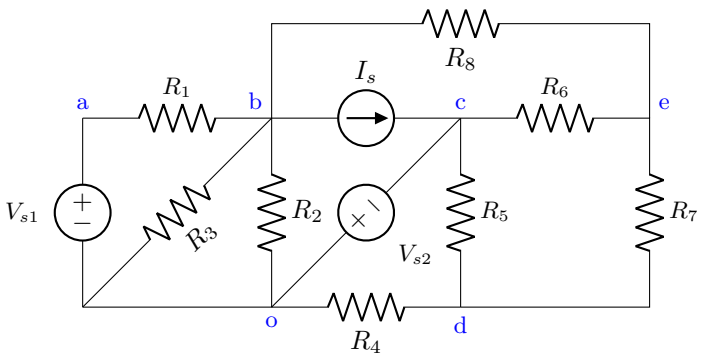

Fig. 5: Circuit for questions 6 and 7

7. (5 points) For the circuit shown in Fig. 5, if all the resistors are of 1Ω, the voltage sources are of 10 V and the current source is of 1 A, compute the voltage between the nodes c and e i.e., v_{ce}.