MATHEMATICAL QUESTIONS

Question 1

Exploit the symmetry of the circuit to find i_1 in Fig. 1.

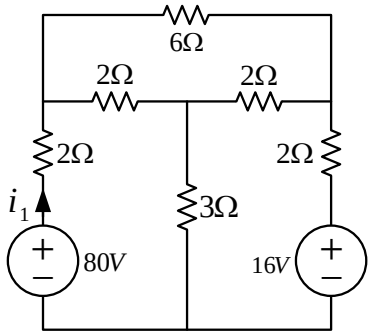

Figure 1: A resistive network.

Question 2

For the circuit of Fig. 2, determine all four nodal voltages using node analysis.

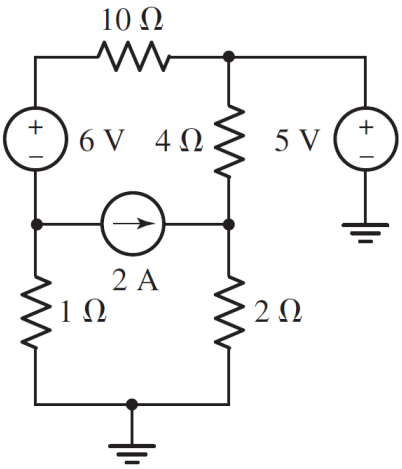

Figure 2: A resistive circuit for which node analysis is desired.

Question 3

Calculate the three mesh currents labeled in the circuit diagram of Fig. 3.

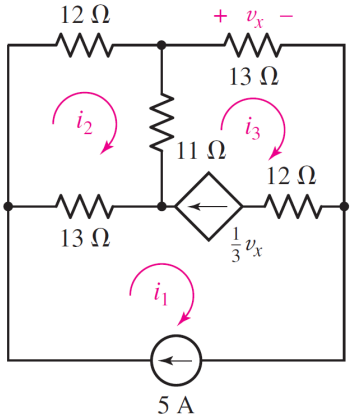

Figure 3: A resistive circuit for which mesh analysis is desired.

Question 4

Determine the Thevenin and Norton equivalents of the circuit shown in Fig. 4, as seen by an unspecified element connected between terminals a and b.

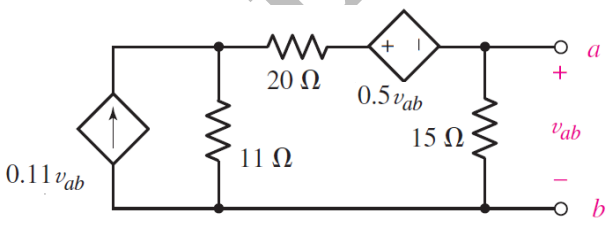

Figure 4: A simple network for which Thevenin and Norton equivalents are required.

Question 5

Consider the diode circuit in Fig. 5, where $R_1 = R_2 = R_3 = 100\ \Omega$, $V_s = 10$, and $v_s(t) = 0.1\sin(t)$. The diode characteristic curve is described by $i = I_s(e^{\frac{v}{V_T}} - 1)$, where the reverse bias saturation current $I_s = 25$ nA and the thermal voltage $V_T = 25.852$ mV.

Question 5 continued on next page...

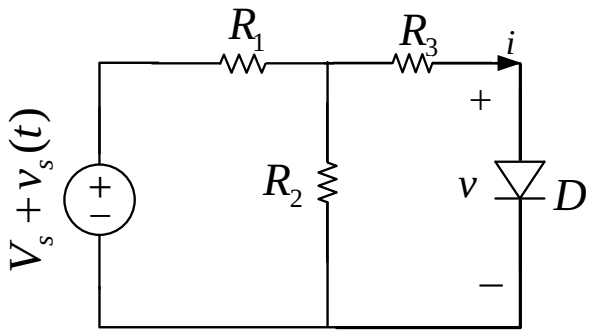

Figure 5: A nonlinear circuit with diode.

(a) Plot the characteristic curve of the diode and approximate its forward voltage V_D.

(b) Find the Thevenin equivalent circuit seen from the diode.

(c) Find the voltage V and the current I of the operating point of the diode.

(d) Find the small signal model of the circuit and use it to calculate $i(t)$ and $v(t)$ when the circuit is supplied by $V_s + v_s(t)$.

(e) How do the values I and V differ from their corresponding values obtained for ideal diode model?

Question 6

Find the characteristic curve of the diode circuit shown in Fig. 6.

Question 6 continued on next page...

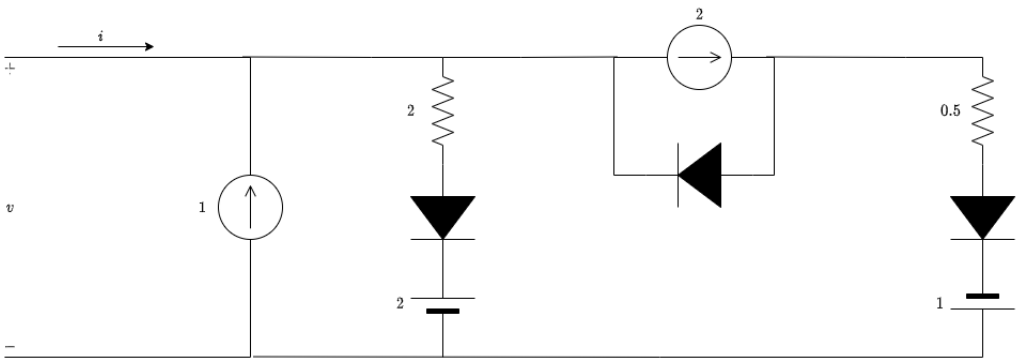

Figure 6: A circuit with three ideal diode.

SOFTWARE QUESTIONS

Question 7

Employ PSpice DC sweep simulation to obtain the characteristic curve of the circuit shown in Fig. 6 in a more realistic scenario, where real 1N4148 diodes are used. Is there any difference between the characteristic curves obtained by the simulation and analysis? Investigate the impact of the temperature on the circuit performance using temperature sweep simulation.

BONUS QUESTIONS

Question 8

Return your answers by filling the LaTeXtemplate of the assignment.

EXTRA QUESTIONS

Question 9

Feel free to solve the following questions from the book *"Engineering Circuit Analysis"* by W. Hayt, J. Kemmerly, and S. Durbin.

1. **Chapter 4, question 11.**
2. **Chapter 4, question 12.**
3. **Chapter 4, question 13.**
4. **Chapter 4, question 13.**
5. **Chapter 4, question 18.**
6. **Chapter 4, question 22.**
7. **Chapter 4, question 34.**
8. **Chapter 4, question 35.**
9. **Chapter 4, question 44.**
10. **Chapter 4, question 45.**
11. **Chapter 5, question 13.**
12. **Chapter 5, question 18.**
13. **Chapter 5, question 30.**
14. **Chapter 5, question 31.**
15. **Chapter 5, question 50.**
16. **Chapter 5, question 60.**
17. **Chapter 5, question 66.**