

The University of Sheffield
Department of Electronic and Electrical Engineering
EEE118 Problem Sheet

Background Knowledge Exercises

- 1 Work out in symbolic terms the Thevenin equivalent circuit of figure 1.

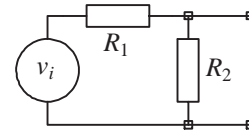


Figure 1

- 2 Analyse figure 2 using loop analysis and superposition and hence evaluate I_1 and V_3 . Calculate the Norton equivalent circuit components that will represent figure 2. What value of V_2 would make $I_1 = 0$? (0.706A, 7.88V, $I_N = 5.58$, $R_N = 1.41\Omega$, 15V)

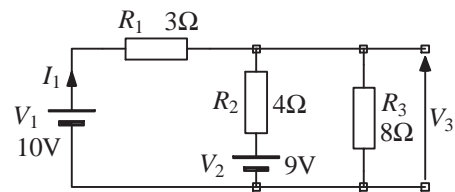


Figure 2

- 3 Analyse figure 3 using loop analysis and superposition and hence evaluate I_1 and V_3 . Calculate the Thevenin equivalent circuit components that will represent figure 3. What value of I would make $V_3 = 0$? (3A, -6V, $V_{TH} = -6$ V, $R_{TH} = 2.4\Omega$, 1.25A)

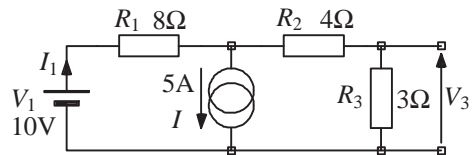


Figure 3

- 4 In the following equations Z represents impedance, R_X (or r_x) represents resistance, C_X represents capacitance, L_X represents inductance and ω is angular frequency. I_X is current, V_X is voltage and x is any subscript. By checking dimensional consistency, identify those equations that must be incorrect together with the term(s) causing the problem.

(i)
$$I_B = \frac{V_1 - V_2}{R_4} + \frac{V_S - V_2}{R_{17} - R_9} + \frac{I_5}{R_6} + \frac{I_4}{2}$$

(ii)
$$V_O - I_2 R_6 = 6V_3 + \frac{I_3 (R_1 + R_2) + I_4 (R_8 + 1)}{\frac{R_7}{R_6} + \frac{R_5}{R_4} + R_3}$$

(iii)
$$r_o = \frac{\frac{(\beta + 1)R_E}{r_{be} + (\beta + 1)R_E} \cdot \frac{R_B // r_{it}}{R_S + R_B // r_{it}}}{\frac{(\beta + 1) R_B // r_{be}}{r_{be} (R_S + R_B // r_{be})}}$$
 where β is a constant.

(iv) $v_i (j\omega)^2 C_1 C_2 R_1 R_2 = v_o (1 + j\omega C_2 R_1 + j\omega (C_1 + C_2) R_2 + (j\omega)^2 C_1 C_2 R_1 R_2 + j\omega C_2 R_1 R_2)$

(v) $\frac{v_o}{v_i} = \frac{-j\omega C_2 R_1}{1 + j\omega (C_1 + C_2) R_2 + (j\omega)^2 C_1 C_2 R_1 R_2}$

(vi) $Z = 1 + \frac{j\omega L}{1 + j\omega CR}$

(vii) $Z = \frac{R_1 - \omega^2 LCR_2 + j\omega(L + CR_1R_2)}{1 - \omega^2 LC + j\omega C(R_1 + R_2)}$

- 5 (i) The capacitor in figure 5 is initially contains zero charge. Sketch a graph to show how the capacitor voltage varies as a function of time if the current generator has the waveform shown.
- (ii) How much charge is in the capacitor at $t = 8\text{ms}$? ($1\mu\text{C}$)

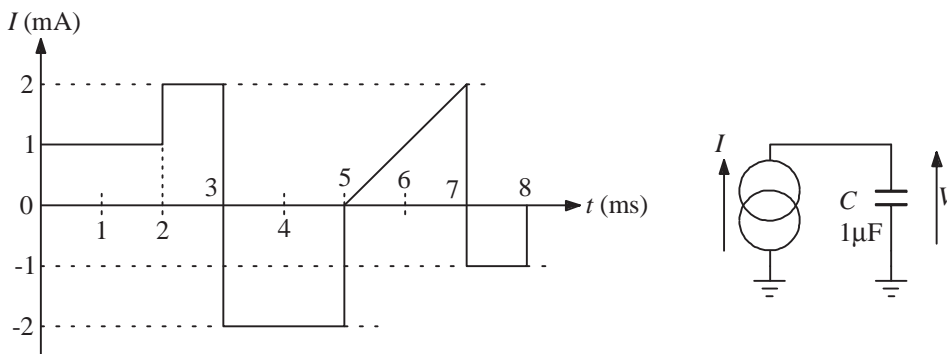


Figure 5

AND FOR EXPERTS

- 6 Draw a graph to show how capacitor current I in figure 6 varies with time. Work out the area and polarity of any impulsive currents. ($-3\mu\text{C}$ @ 2ms , $+2\mu\text{C}$ @ 6ms , $-2\mu\text{C}$ @ 7ms)

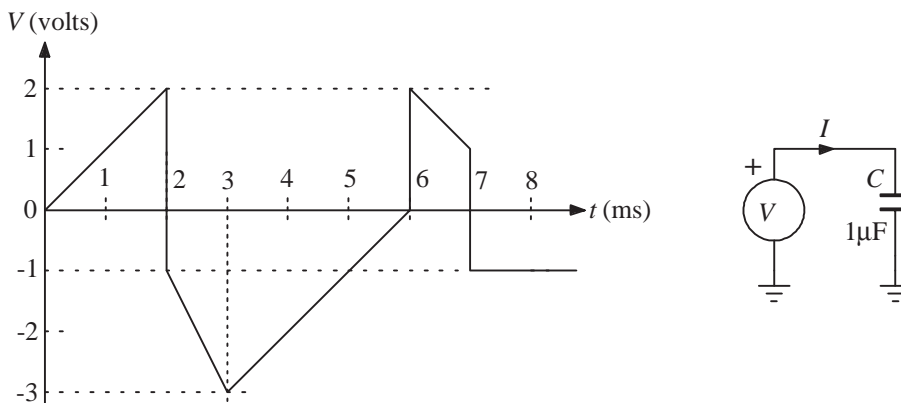


Figure 6