

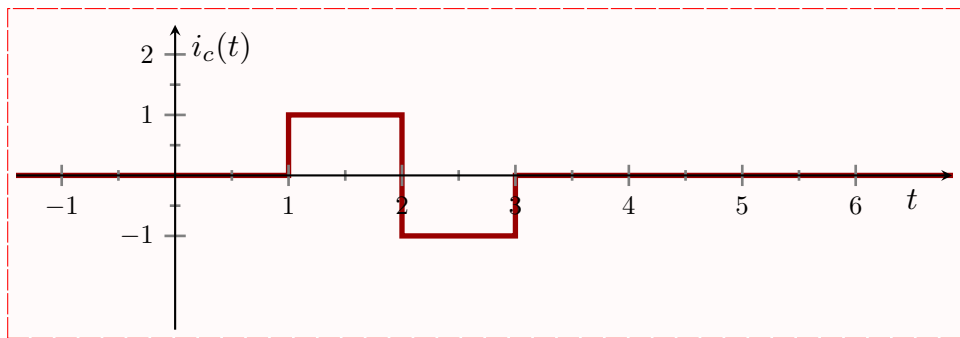
**EE240 Circuits I**  
**Quiz 01 Solutions**

**Total Marks:** 10

**Time Duration:** 20 minutes

**Question 1** (10 marks)

- (a) [4 marks] The current  $i_c(t)$  through the capacitor of capacitance  $\frac{1}{4}F$  is shown in Figure 1 below. Determine the voltage across the capacitor. You must show working to support your answer. Also plot the voltage for  $1 \leq t \leq 5$ .



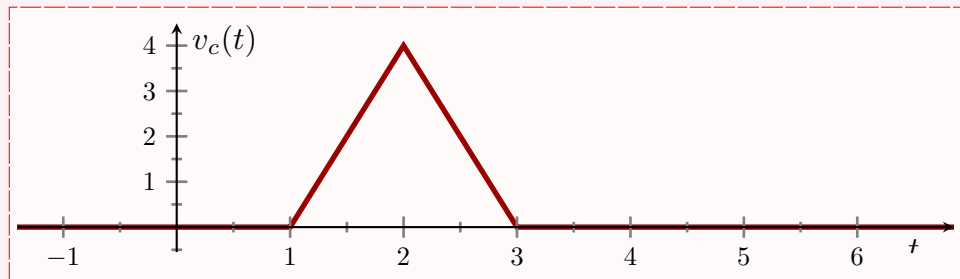
**Figure 1:** Current through the Capacitor.

**Solution:** Voltage across capacitor is given by

$$v_c = \frac{1}{C} \int_{-\infty}^t i_c(t) dt = 4 \int_{-\infty}^t i_c(t) dt$$

$$v_c = \begin{cases} 0 & t \leq 1 \\ 4 \int_1^t (1) dt = 4(t - 1) = 4t - 4 & 1 < t \leq 2 \\ 4 \int_1^2 (1) dt + 4 \int_2^t (-1) dt = 4 - 4t + 8 = -4t + 12 & 2 < t \leq 3 \\ 4 \int_1^2 (1) dt + 4 \int_2^3 (-1) dt = 0 & 3 < t \end{cases}$$

The plot is given below:

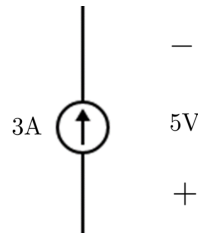


- (b) [1 mark] Plot  $i - v$  characteristics of the ideal DC current source.

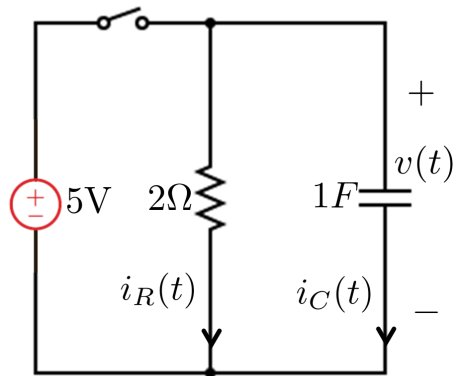
**Solution:** Line parallel to the voltage ( $v$ ) axis on the  $i - v$  plot.

- (c) [2 marks] The voltage across 3A ideal current source connected in a circuit is indicated in the figure below. Determine the power being supplied by the current source.

**Solution:** We have a potential drop in the direction of the current and therefore power  $3 \times 5 = 15W$  is being absorbed by the source or  $-15W$  is being supplied by the source (using passive sign convention).



- (d) [3 marks] Consider the circuit given below. The switch is initially opened and is closed at  $t = 0$ . Plot  $v(t)$ ,  $i_R(t)$  and  $i_C(t)$  for all times.



**Solution:**  $v(t) = 5u(t) \text{ V}$ ,  $i_R(t) = 2.5u(t) \text{ A}$ ,  $i_C(t) = C \frac{dv}{dt} = 5\delta(t) \text{ A}$ .