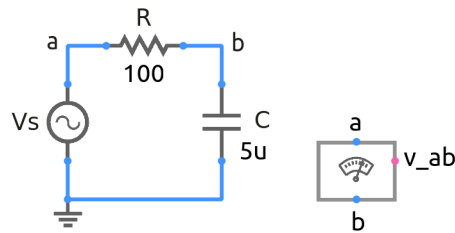


ee101_rc_ac_2.sqproj



The purpose of this simulation is to study the effect of component values on the frequency response of the series RC circuit shown in the figure. The simulation is performed in the frequency domain. In particular, we are interested in the magnitude and phase of the output voltage (V_b in the figure) as a function of frequency.

Exercise Set

1. Derive expressions for the magnitude and phase of \mathbf{V}_b with $\mathbf{V}_s = V_m \angle 0$, where V_m is 1 V.
2. For the component values specified in the figure, compute the corner frequency (3-dB frequency). Check your answers against simulation results¹.
3. Keeping C constant, increase R by 2, 3, 4, 5, and simulate the circuit for each case. Plot $|\mathbf{V}_b|$ and $\angle \mathbf{V}_b$ versus frequency on the same plot. Comment on the trends seen in the plot.
4. Repeat the above exercise for a constant R and varying C .
5. Similarly, make plots for the current waveform phasor \mathbf{I} and explain the trends you observe in the plots.
6. For constant values of R and C (say, $R = 100 \Omega$, $C = 5 \mu\text{F}$), plot $|\mathbf{V}_R|$ and $|\mathbf{V}_C|$ (the magnitudes of the voltages across the resistor² and capacitor, respectively) versus frequency. Explain the salient features of the plot.

¹In plots involving a large range of frequencies, the frequency axis (used as the x -axis) should be logarithmic. On the y -axis, magnitudes should be plotted on a logarithmic scale, while phases should be plotted on a linear scale (since phase does not vary by orders of magnitude).

²To access the AC voltage between two nodes, the element `voltmeter_scale.gme` can be used.