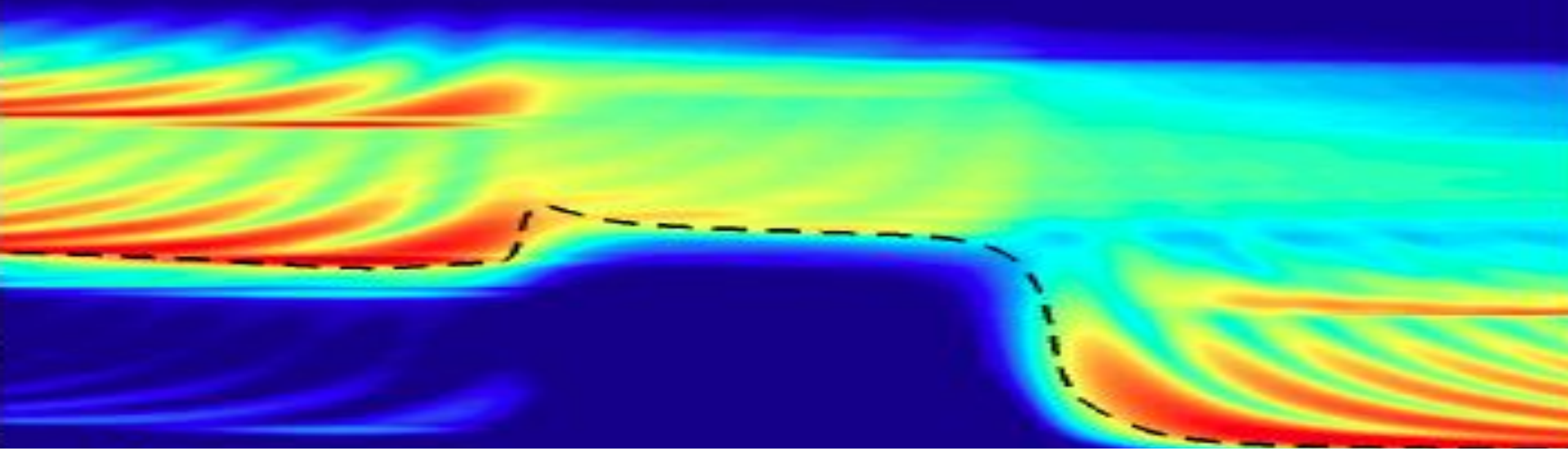

EECS 16B
Designing Information Devices and Systems II
Lecture 6

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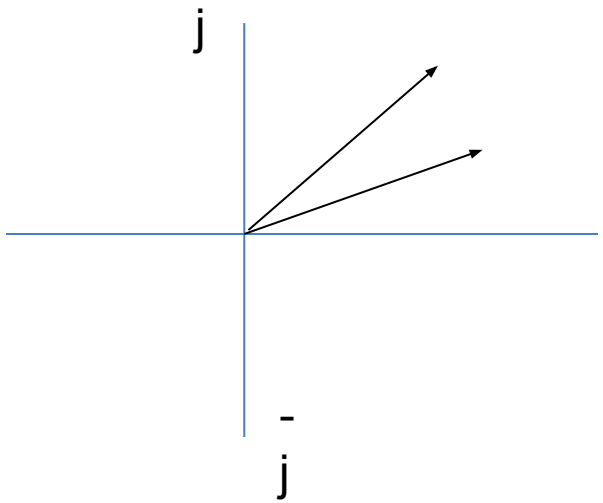
Transient Response

- Outline
  - Power in the AC circuits
  - Transfer Function and Filters

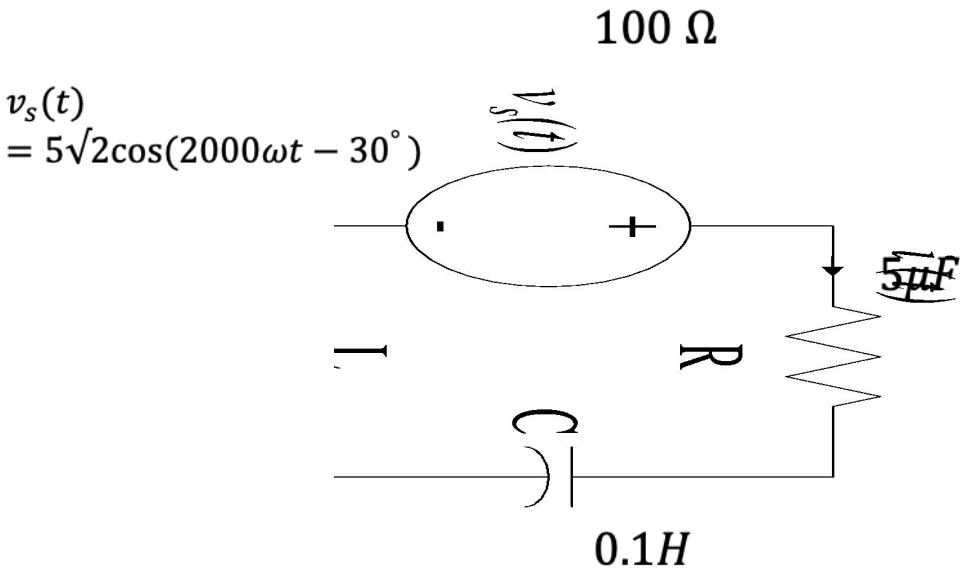
- Reading- Hambley text sections 5.6, 6.1, 6.2, slides

Recap: Phasors and sinusoidal steady state

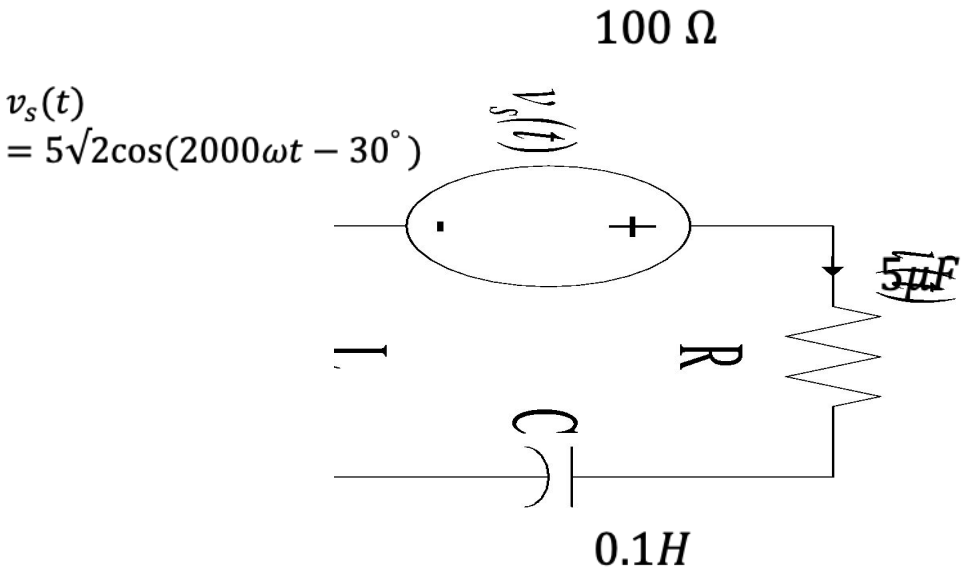


Phasors define phase relationships at an instant of time, i.e., with respect to ωt

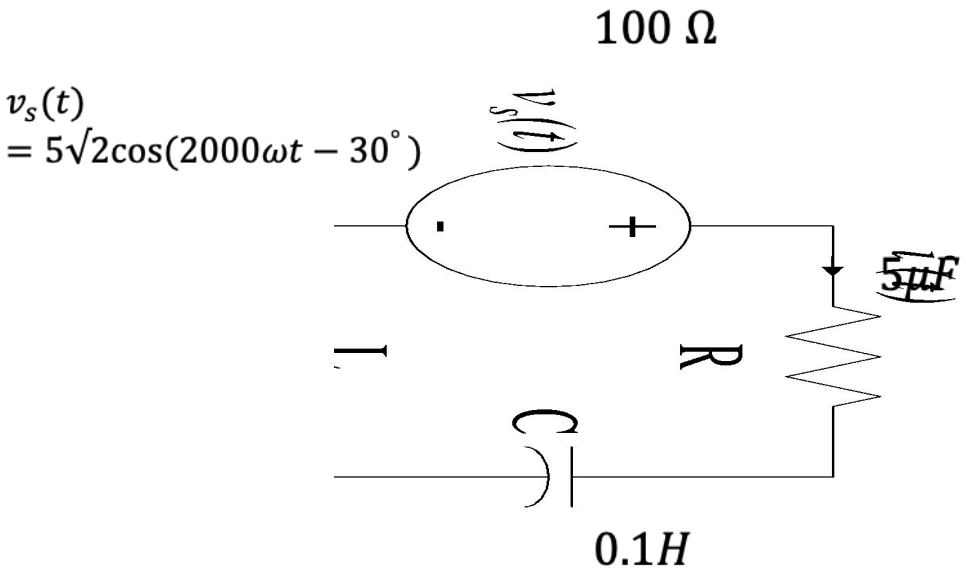
Recap: Solving circuits with R, L and C



Recap: Solving circuits with R, L and C



Recap: Solving circuits with R, L and C



Recap: Power in AC Circuits

Purely resistive Circuit

$$v(t) = V_m cos\omega t$$

$$i(t) = I_m cos\omega t$$

$$P_{avg} = \frac{1}{T}\int_0^T dt\, v(t)i(t) = \frac{V_m I_m}{T}\int_0^T dt \cos^2 \omega t = \frac{V_m I_m}{T} \times \frac{T}{2}$$

$$P_{avg} = \frac{V_m I_m}{2}$$

Power in AC Circuits

Purely Inductive Circuit

$$v(t) = V_m cos\omega t$$

$$i(t) = I_m \cos(\omega t - 90^\circ)$$

$$P_{avg} = \frac{1}{T}\int_0^T dt\, v(t)i(t) = \frac{V_m I_m}{T}\int_0^T dt\, cos\omega t sin\omega t$$

$$= \frac{V_m I_m}{2T}\int_0^T dt\, sin2\omega t$$

Purely Capacitive Circuit

$$v(t) = V_m \cos(\omega t - 90^\circ)$$

$$i(t) = I_m \cos(\omega t)$$

$$P_{avg} = \frac{1}{T}\int_0^T dt\, v(t)i(t) = \frac{V_m I_m}{T}\int_0^T dt\, cos\omega t sin\omega t$$

$$= \frac{V_m I_m}{2T}\int_0^T dt\, sin2\omega t = 0$$

Power in AC Circuits

General case

Power in AC Circuits

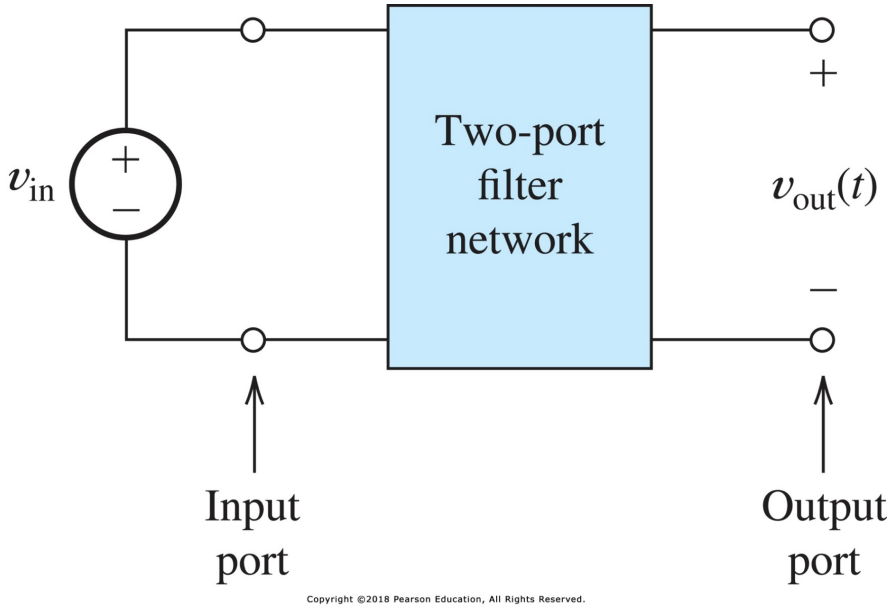
General case

Power in AC Circuits: Power Triangle

Power in AC Circuits: Power Triangle

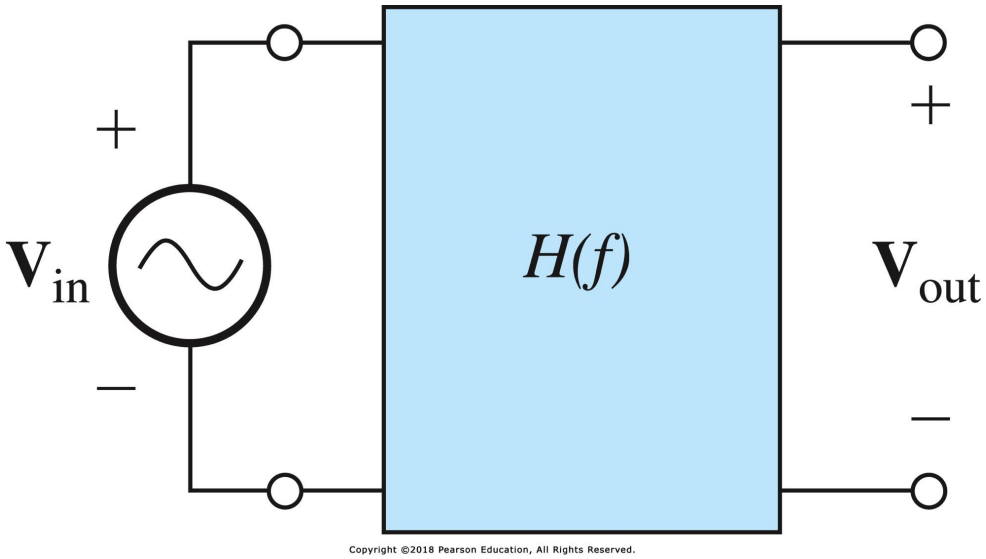
Power in AC Circuits: Maximum Power Transfer

Concept of Transfer Function



Two port Filter Network or more generally Two port network

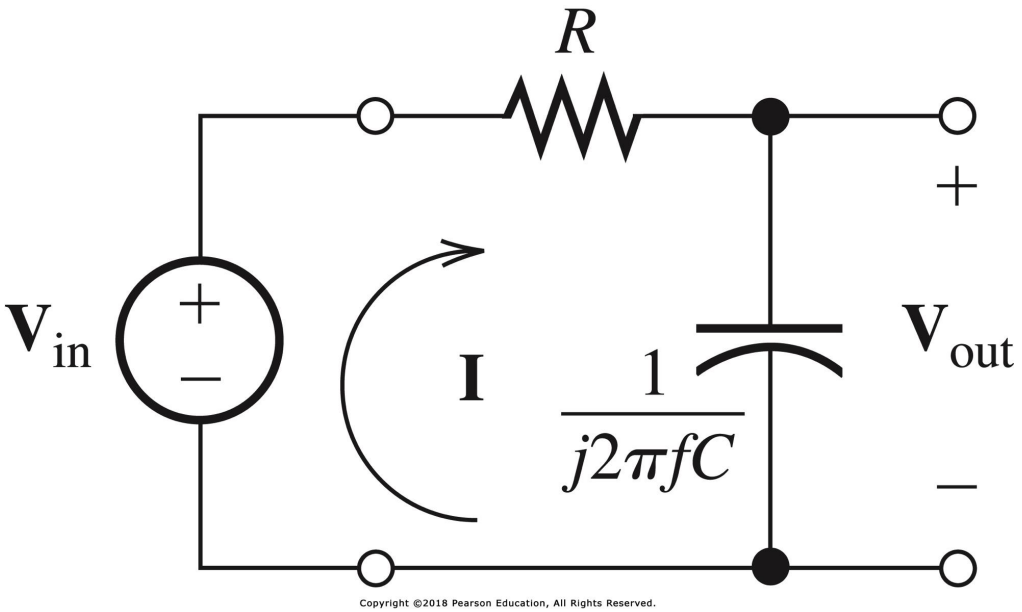
Concept of Transfer Function



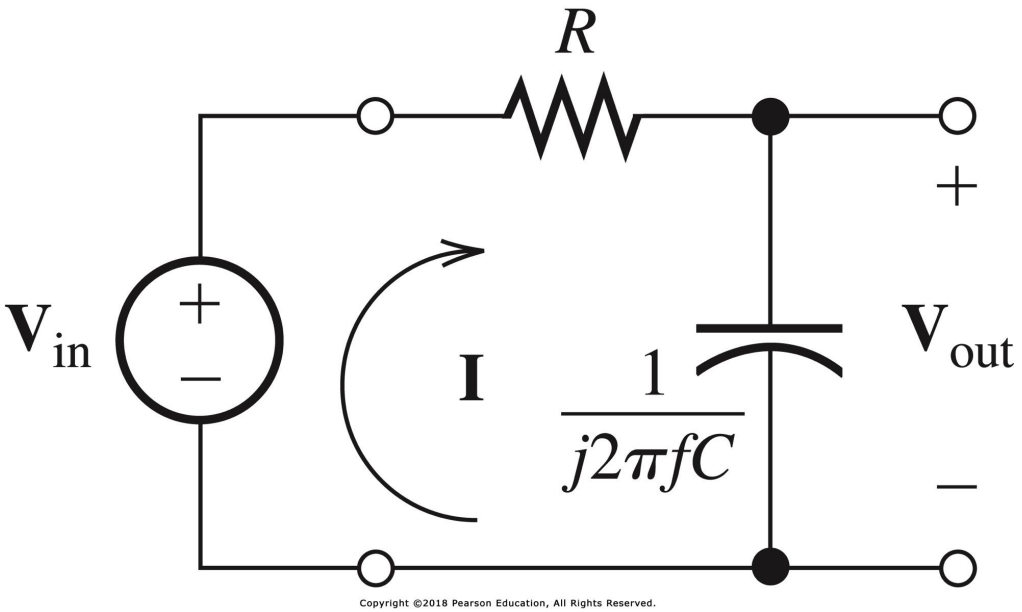
$$H(f) = \frac{V_{out}}{V_{in}}$$

$H(f)$ is a complex number

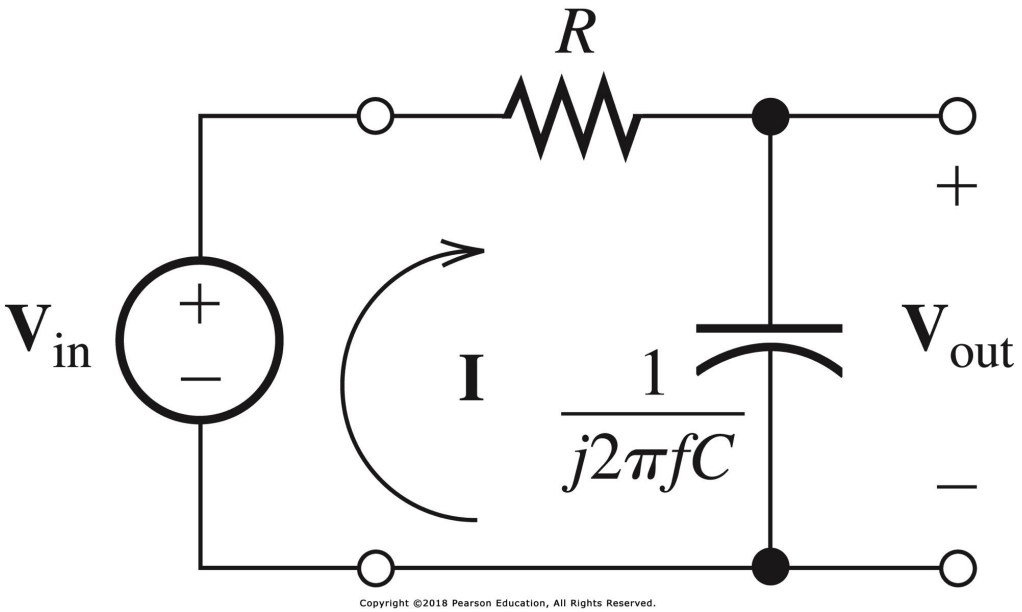
A simple RC Circuit



A simple RC Circuit



First Order low pass filter



Decibels