Laplacetransformering av elektriska kretsar

Idag

1. Laplacetransform (rep.)
2. Impedanas för komponenter
3. Lösning av kretsar

Lösning av ODE med LT: så funkar det (2)

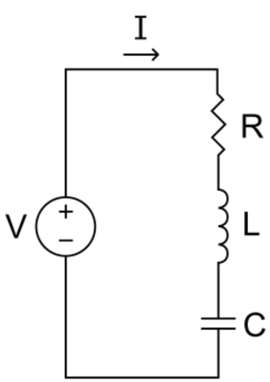
Linjära ordinära differentialekvationer med konstanta koefficienter

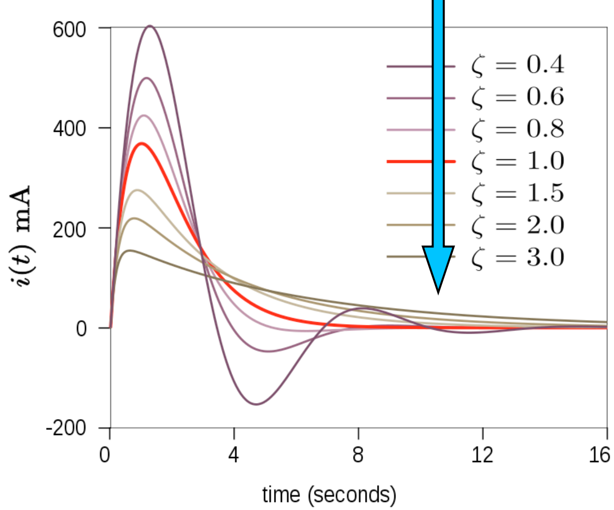
$$a_n y^n + a_{n-1} y^{n-1} + \ldots + a_1 y' + a_0 y = \cancel{f(t)} \; 0$$

$$y(t) = y_p(t) + \boxed{y_h(t)}$$

partikulär lösning

homogen lösning





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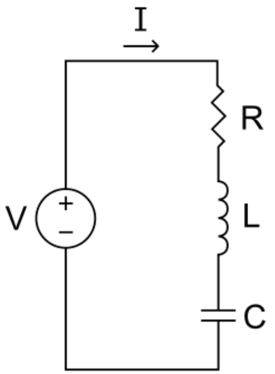
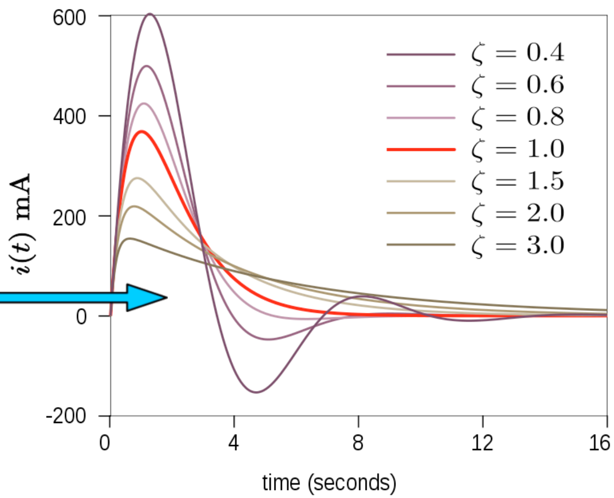
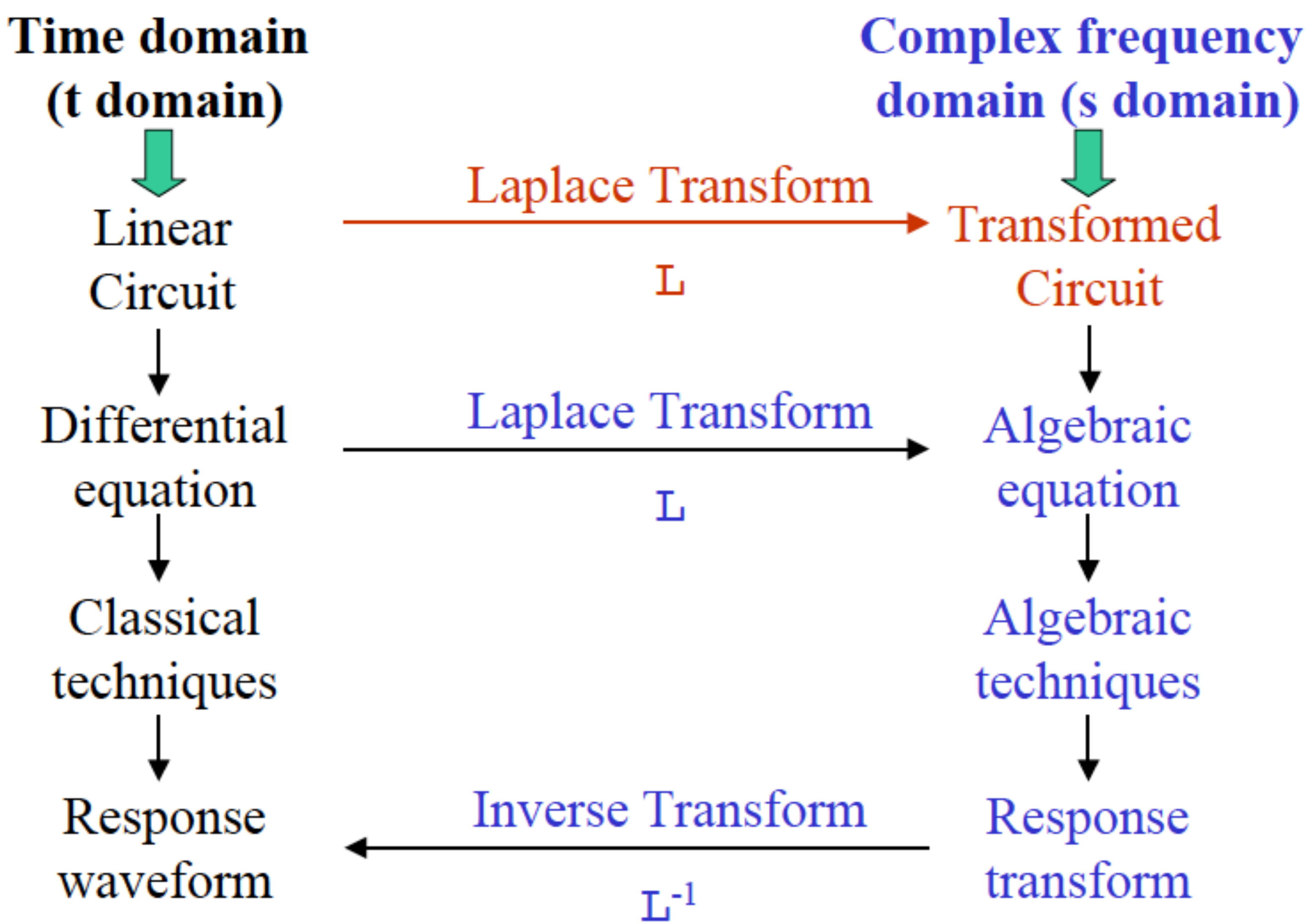




Källor i s-Domän



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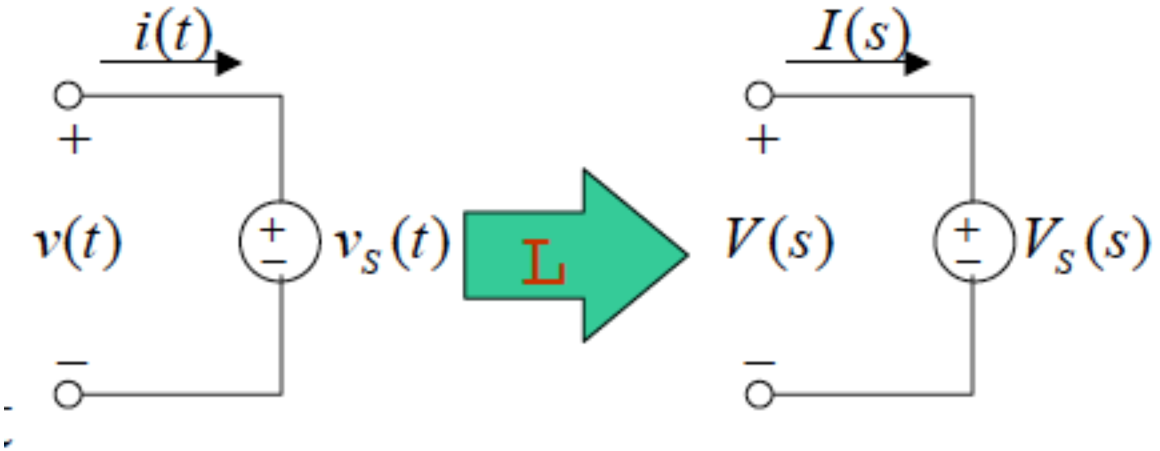
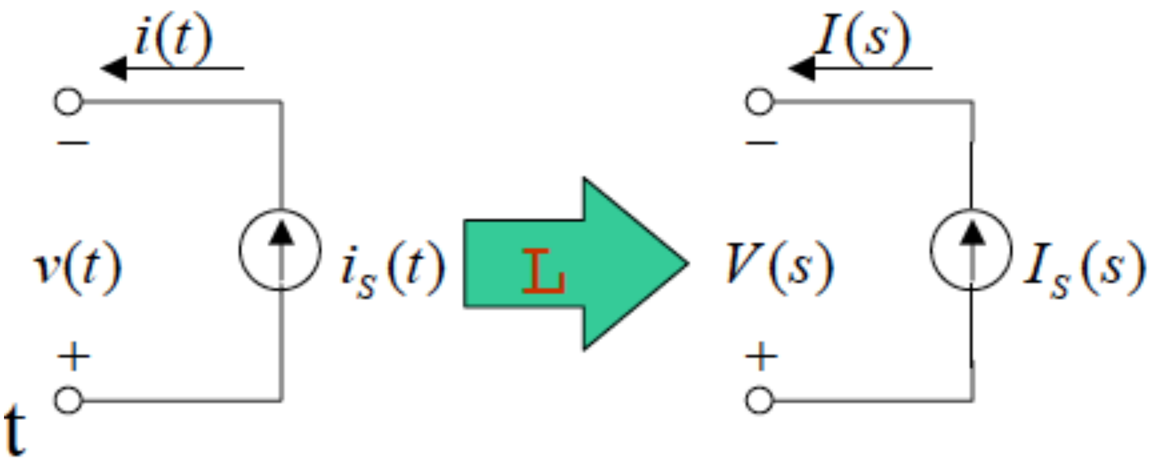




S-domän

Ohm’s lag i komplex form

$$V(s) = Z(s)\, I(s)$$

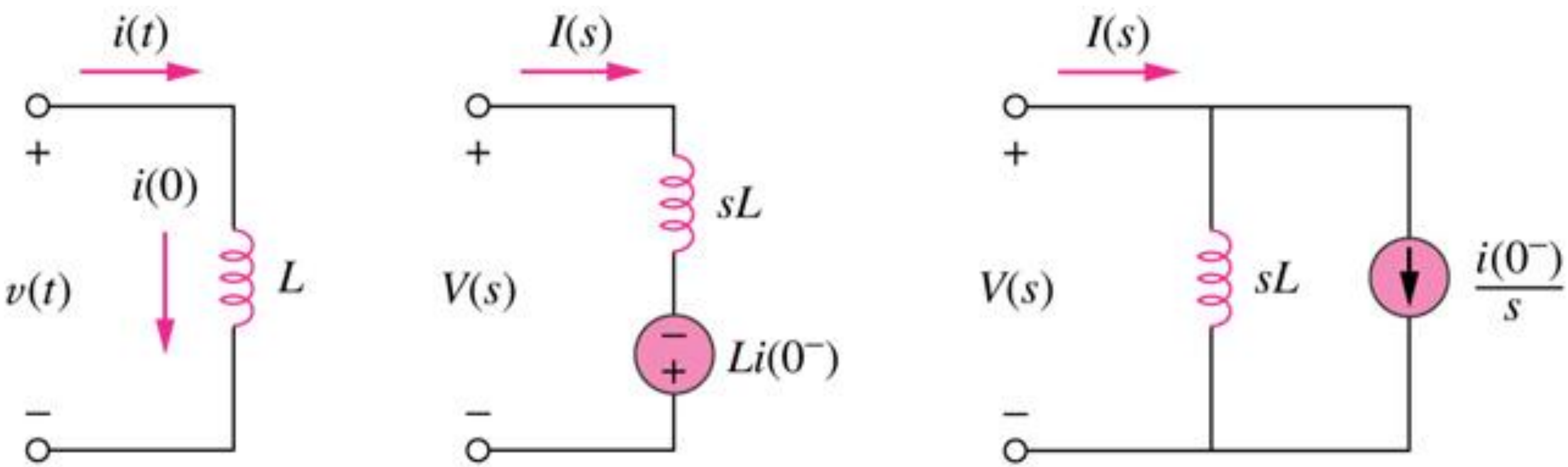
Där
V(s) är (laplacetransformen av) spänningen över komponenten
I(s) är strömmen över komponenten
Z(s) impedansen för komponenten

S-domän model för spole

$$\because v(t) = L\frac{di(t)}{dt}$$

$$\Rightarrow \quad V(s) = L\left[sI(s) - i(0^-)\right] = \boxed{sLI(s) - Li(0^-)}$$

$$I(s) = \frac{1}{sL}V(s) + \frac{i(0^-)}{s}$$

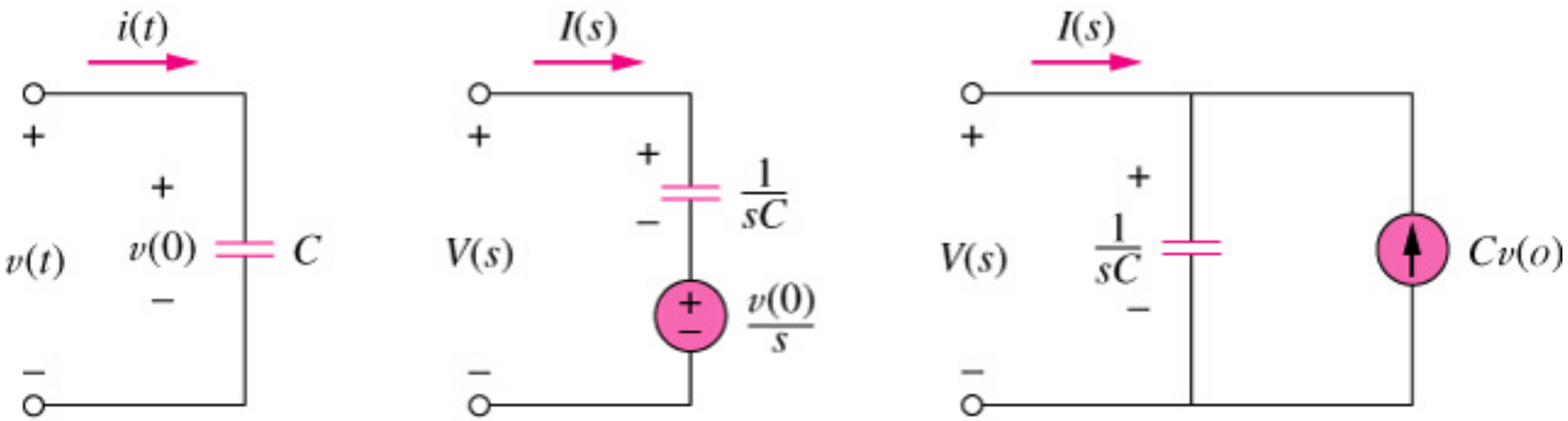


S-domän model för kapacitor

$$\because i(t) = C\frac{dv(t)}{dt}$$

$$\Rightarrow \quad I(s) = C\left[sV(s) - v(0^-)\right] = sCV(s) - Cv(0^-)$$

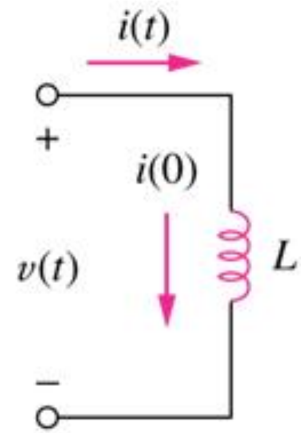
$$\boxed{V(s) = \frac{1}{sC}I(s) + \frac{v(0^-)}{s}}$$



Ekvivalent krets i S-domän

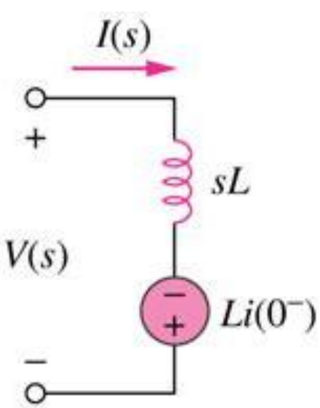
Resistor

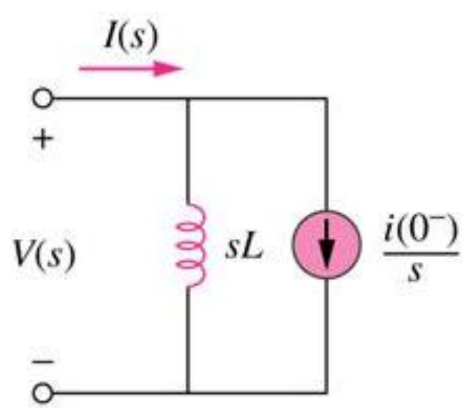
$$L\left[v(t)\right] = L\left[Ri(t)\right]$$
$$\Rightarrow V(s) = RI(s)$$



spole

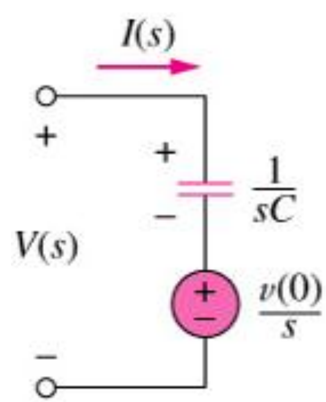
$$V(s) = sLI(s) - Li(0^-)$$
$$I(s) = \frac{1}{sL}V(s) + \frac{i(0^-)}{s}$$

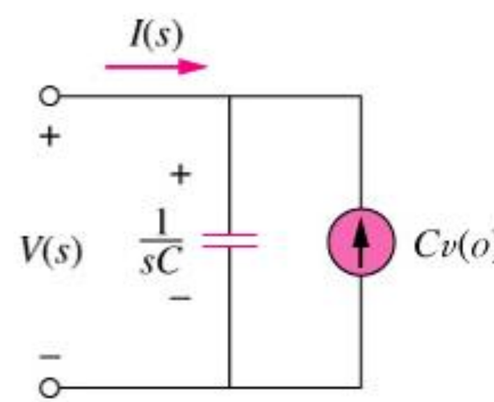




kapacitor

$$I(s) = sCV(s) - Cv(0^-)$$
$$V(s) = \frac{1}{sC}I(s) + \frac{v(0^-)}{s}$$



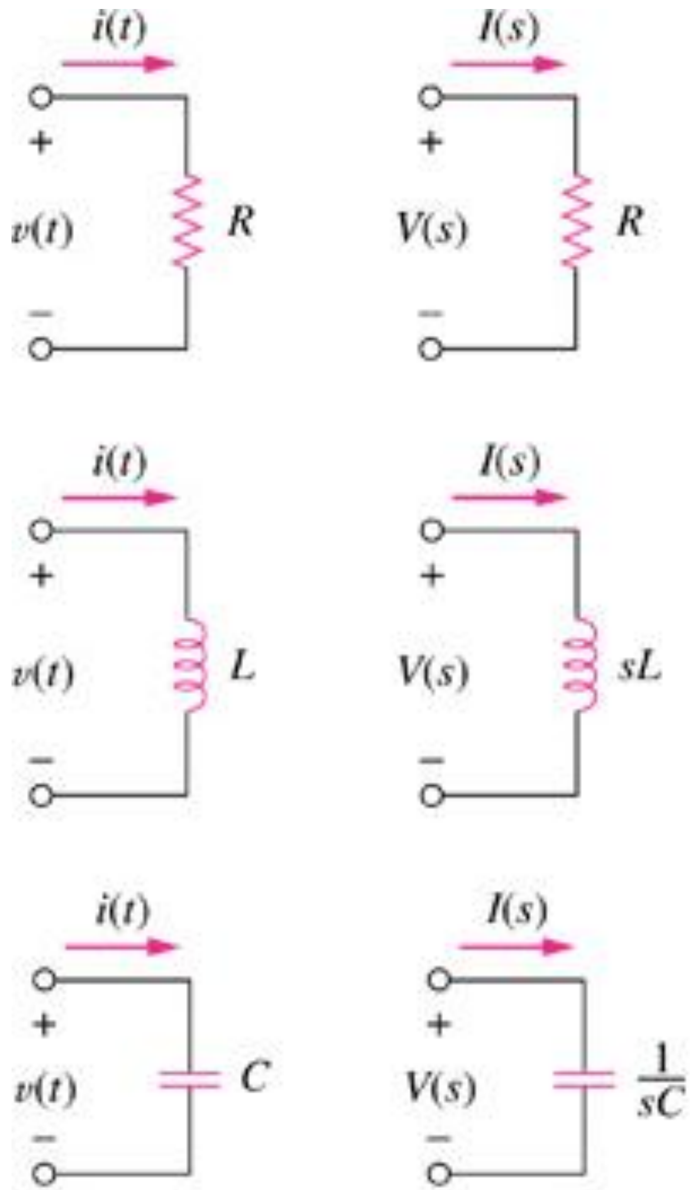


Ekvivalent krets i S-domän: Noll ursprungliga vilkoren

Impedance in the *s* domain

$Z(s)=V(s)/I(s)$

Element	Z(s)	Z(jω)
Resistor	R	R
Inductor	sL	jωL
Capacitor	1/sC	1/jωC



Exemplar…