‘SYSTEMS’ Revision

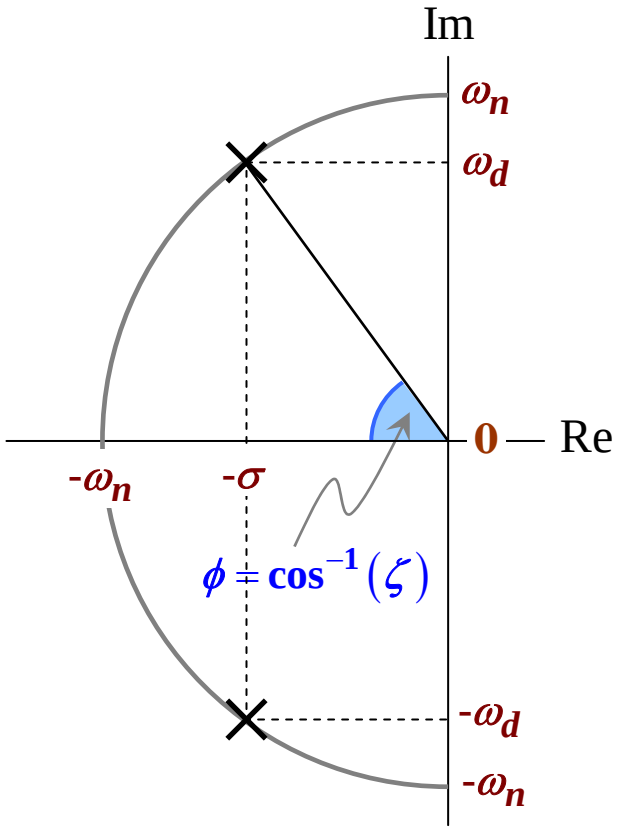
1. Basic linear time-invariant (LTI) systems and their transfer functions.

(a) Application of entries in the Laplace transforms and properties tables. (Proofs of Laplace transform properties not required.)

(b) Modeling of standard first-order systems by the general transfer function $\left[G(s) = \frac{K}{sT+1} \right]$ and second-order systems by the general transfer function $G(s) = \frac{K\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$.

(c) Specific meanings of ζ, ω_n, σ and ω_d for standard <u>under-damped</u> second-order systems modeled by:

$$G(s) = \frac{K\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2} = \frac{K\omega_n^2}{(s+\sigma)^2 + \omega_d^2}.$$



2. LTI system models of circuit.

(a) Deriving differential equation (DE) models for R,L,C circuits. Solution to DE using Laplace transform.

(b) Deriving transfer function models for R,L,C circuits either by applying Laplace transform to DE model or by direct impedence method.

3. Responses of LTI systems.

(a) Finding output of LTI systems for a given input using transfer functions and inverse Laplace transform.

(b) *Unit-Step* response and *Unit-Impulse* response of a system: their relationships in *t-domain* and *s-domain*

(c) *Sinusoidal* response of a system: its relationship to the system sinusoidal input and the system frequency response.

(d) Application of Initial and Final Value Theorems.

4. Bode (Straight-line) Plots.

(a) Drawing and Interpreting Bode straight-line plots. (Concepts of Pole factor, Zero factor, Integrator, Differentiator, DC Gain.)

5. Parameters of LTI systems.

(a) Finding poles and zeros from transfer function and Bode straight-line magnitude plot.

(b) Finding time constants of a first-order systems from its transfer function, unit impulse response plot or unit step response plot.

(c) Finding damping factor and undamped natural frequency of a second-order systems from its transfer function, unit impulse response plot or unit step response plot.

(d) Finding DC gain of a system from its transfer function, Bode magnitude plot or unit step response plot.

(e) Extension of (b), (c) and (d) to systems with a dead-time.

(f) Evaluation of system stability by inspection of system poles.