Syllabus for Q-exam on Linear Algebra, Signals, and Systems

References: linear algebra at the level of Gilbert Strang's *Introduction to Linear Algebra* (see also the MIT couseware http://web.mit.edu/18.06/www/) or Sheldon Axler's *Linear Algebra Done Right.* Signals and systems concepts at the level of A. V. Oppenheim and A. S Wilsky's *Signals and Systems.*

Linear algebra: vector spaces, linear mappings, spanning sets, bases and dimension of finite-dimensional vector spaces; nullspace, range, and rank of arbitrary real and complex matrices; determinant, trace, invertibility, eigenvalues, and eigenvectors of square real and complex matrices; inner-product spaces and orthogonal/unitary diagonalizability of Hermitian matrices; singular-value decomposition of arbitrary real and complex matrices; condition number of invertible square matrices.

Signals basics: real- and complex-valued continuous- and discrete-time signals; convolution in continuous and discrete time.

Systems basics: single-input single-output LTI systems in continuous and discrete time; impulse response; causality and BIBO stability of SISO LTI systems (definitions and impulse-response criteria).

Spectral concepts in continuous time: Fourier series of continouous-time periodic signals; Fourier transforms of continuous-time signals; the idea of frequency content and bandwidth of continuous-time signals; frequency response of continuous-time LTI systems; ideal filters.

Spectral concepts in discrete time: the discrete-time Fourier transform and the Sampling Theorem; frequency response of discrete-time LTI systems; The DFT and the FFT for N-point signals.

Other transforms and applications: the two-sided z-transform and two-sided Laplace transform; transfer functions of continuous- and discrete-time SISO LTI systems; criteria for BIBO stability in terms of transfer functions.