Preparation for exam

Theory subjects (titles are based on the lecture slides)

Note: the subjects below can be adjusted (shortened, grouped differently) at the exam, so don't consider this as an absolute definitive list

Chapter I. Sampling

1. Sampling: definition, equation, sampling of harmonic signals, sampling theorem (statement only), what is aliasing, what is anti-alias filtering

Chapter II. Signals and Systems

2. Basic signals (unit impulse, unit step, unit ramp, exponential signal): equations and representation.
3. Types of discrete signals: energy, power, periodic, non-periodic, even, odd, even plus odd parts
4. Operations on discrete signals: time shifting, time reversal, subsampling, interpolation, mathematical operations
5. Classification of discrete systems: memory, time invariance, linearity, causality, stability. Relation with impulse response h[n] (memory, causality, stability).
6. Impulse response, convolution, properties of convolution (no proof for assoc., proof for the other two), properties of LTI systems expressed with impulse response (identity, series, parallel, unit step)
7. FIR and IIR: definition of support, FIR and IIR systems, recursive and non-recursive implementations, what are initial conditions
8. Correlation and autocorrelation: definition, relation to convolution, properties of autocorrelation (1,2: with proof, 3rd: no proof)

Chapter III. The Z transform

9. Z transform: definition (also for Region of Convergence), polynomial interpretation, regions of convergence, properties (only linearity, shifting in time, convolution in time - with proofs)
10. Poles and zeros of rational Z transforms: definition, conditions for real signals, position of 1 pole / 1 pair of conjugate poles and behavior in time (not for double pole)
11. System function H(z): definition, particular cases (FIR, IIR, all-pole), stability of a system and H(z)

12. Responses: natural and forced response, zero-state and zero-input response, transient and permanent response, transient and permanent regime. Definitions (what do they mean), relation between them

Chapter IV. Frequency analysis of discrete signals

12. Fourier series (discrete periodic signals): definition, expressing signal as sum of sinusoids, basic properties, properties (linearity, shifting in time, convolution) with proof (first two)
13. Fourier transform (discrete non-periodic signals): definition, basic properties, properties (linearity, shifting in time, convolution - no proofs), relation with Z transform, relation with Fourier series
14. Properties of the Fourier transform: linearity, shifting in time, convolution (with proofs), Parseval theorem (no proof), interpretation of Parseval theorem, time-frequency duality

Chapter V. Frequency analysis of discrete systems

15. Response of LTI systems to exponential signal, cosine/sine, periodic inputs, non-periodic inputs (with proofs)
16. Linear-phase filters: definition, symmetry conditions for FIR, proofs for positive/negative symmetry + odd/even M (one case out of the four)

Exercises

Based on all exercises from the laboratories/seminars + examples done during lectures (for example the exercise of computing the Inverse Z transform via partial fractions, done during a lecture)