Real Analysis:

- Metric spaces, Normed spaces, $l_p$ spaces
- Weierstrass approximation theorem
- Completeness, Fixed point (contraction mapping) theorem
- Baire Category theorem
- Compactness, Arzela-Ascoli theorem
- Measure and integration in $\mathbb{R}^n$
- Lebesgue convergence theorems
- $L_p$ spaces, completeness
- Fubini-Tonelli theorem
- Hilbert basis, orthogonal projection

References:

- H.L. Royden: *Real Analysis* (Prentice Hall)
- Rudin: *Real and Complex Analysis* (McGraw-Hill)
- K.T. Smith: *Primer of Modern Analysis* (Springer-Verlag)
- Kolmogorov and Fomin: *Introductory Real Analysis* (Dover)
Complex Analysis:

• Analytic functions, Cauchy-Riemann equations
• Conformal maps, Linear fractional (Möbius) transformations
• Contour integrals (piecewise $C^1$)
• Cauchy theorems (homotopy versions)
• Maximum principle, open mapping theorem
• Fundamental theorem of algebra, argument principle (Rouche)
• Power series
• Singularities, Laurent series
• Residues, residue theorem

References:

Alfhors: *Complex Analysis* (McGraw-Hill)

Hille: *Analytic Function Theory* (Blaisdell Publishing Company)

Conway: *Functions of One Complex Variable* (Springer-Verlag)
Linear Algebra:

- Matrices, matrix operations, determinants
- Systems of linear equations
- Abstract vector spaces, bases and dimension
- Inner product spaces
- Linear transformations, eigenvalues, diagonalization
- Minimal and characteristic polynomials
- Jordan canonical form
- Spectral theorem (finite dimensional version)

References:

- Hoffman and Kunze: *Linear Algebra* (Prentice-Hall)
- Friedberg, Insel, Spence: *Linear Algebra* (Prentice-Hall)