Study Guide for Ph.D. Examination in Math 313 (Numerical Analysis)

Interpolation and Approximation:

a. Polynomial Interpolation. Lagrange and Newton interpolation formulas. Section 2.1.

b. Trigonometric Interpolation. Sections 2.3.1, 2.3.4.

c. Tschebyscheff Polynomials. Sections 8.2, 8.3 and 8.4 in [1], pp. 60-64 and 146-152 in [2].

d. Cubic Spline Interpolation. Existence, uniqueness and convergence of such spline. Section 2.4.

Numerical Integration:

a. Newton Cotes rules, convergence. Section 3.1.

b. Peano error estimate. Section 3.2.

c. Gaussian quadrature. Section 3.6.

Linear System of Equations $Ax = b$. Sections 4.1-4.6.

a. LU factorization, row exchange, partial pivoting, condition number.

b. Round off error analysis.

c. Application to special classes of matrices such as positive definite and diagonally dominant.

Least Square Problems:

Sections 4.7, 4.8.1, 4.8.2, 4.8.5.

Note: Sections referred to are from [6] unless indicated otherwise.

References:

1. R. Burden and J. Faires, *Numerical Analysis*, PWS-Kent, 1989.
2. P. Davis, *Interpolation and Approximation*, Dover, 1975.
3. G. Golub and C. Van Loan, *Matrix Computations*, John Hopkins University Press, 1983. (there is an updated version).
4. T.J. Rivlin, *An Introduction to the Approximation of Functions*, Dover, 1969.
5. G. Strang, *Linear Algebra and Its Applications*, 3rd edition, Harcourt Brace Jovanovich, 1988.
6. J. Stoer and R. Bulirsch, *Introduction to Numerical Analysis*, Springer-Verlag, 1980.