## Mathematical fundamentals

- Taylor's theorem with error
- Inner products and Gram-Schmidt process
- Richardson extrapolation

## Equation solving or root finding

- Bisection method
- Fixed point iteration
- Contraction Mapping Theorem
- Newton's method: 1D and 2D
- Secant method
- Rates of convergence
- Aitken's acceleration

# Polynomial interpolation and approximation

- Lagrange interpolation polynomial with error term
- Divided differences form of Lagrange polynomial
- Hermite interpolation with error term
- Inner products on C[a,b] and orthogonal polynomials
- Least squares approximation with respect to given inner product
- Chebyshev polynomials
- Minimax polynomials

## Numerical Differentiation

• computations with

## Numerical Integration and Differentiation

- Numerical differentiation formulas with error
- Numerical differentiation formulas derived using Lagrange polynomial and derived using Taylor's Theorem
- Simpson's rule, single and composite both with error

- Trapezoid rule, single and composite both with error
- Newton-Cotes formulas with their derivations
- Degree of Precision
- Romberg Integration
- Adaptive quadrature
- Gaussian Quadrature

#### Numerical IVP for ODE

- Euler's method and basic error estimates
- Higher order Taylor methods
- Local truncation error
- RK methods
- Stiffness