

## Mathematical methods for physicists

Level: General

Prerequisites: Linear algebra

- Infinite series
  - Convergence tests;
  - Algebra of series;
  - Power series;
  - asymptotic series;
  - improvement of convergence;
  - Pade approximants;
  - Shanks transformation;
  - Richardson extrapolation;
  - Borel transform;
  - Euler-Maclauring integration formula;
- Complex variable
  - Complex algebra;
  - Cauchy-Riemann conditions;
  - Cauchy integral theorem;
  - Cauchy integral formula;
  - Taylor and Laurent expansions;
  - Conformal mappings;
  - Poles and branch points;
  - Residue theorem;
  - Application of the residue theorem to the calculation of definite integrals and series;
  - Method of steepest descent;
  - Analytic continuation of the Riemann zeta function;
  - Abel-Plana formula (and its application to Casimir effect for parallel plates)
  - Schwartz's interpolation method
- Perturbation theory and JWKB

- Perturbation theory in classical mechanics (Lindstedt-Poincaré method, method of multiple scales)
- Perturbation theory in quantum mechanics (Rayleigh-Schrödinger perturbation theory)
- Resummation of perturbation theory
- JWKB method

### **Bibliography**

- Arfken and Weber, Mathematical methods for physicists, Academic press
- Hinch, Perturbation methods, Cambridge University press
- Bender and Orszag, Advanced mathematical methods for scientists and engineers, Springer