Mathematical Techniques for Condensed Matter Physics: (Sets of Problems)

Diploma Program 2014-2015

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PACS numbers:

1. Quadratic equation.
2. Graph plotting.
3. Complex integration.
   (a) Analytic functions.
   (b) Contour integrals.
   (c) Cauchy theorem and Cauchy integral formula.
   (d) Taylor expansion.
   (e) Laurent expansion.
   (f) Calculus of residues.
4. Gaussian integrals.
5. Approximate and qualitative methods.
6. Dirac's delta-function.
7. Operators and matrices.
   (a) Hilbert Space in Quantum Mechanics.
   (b) Diagonalization of Hermitian matrices.
8. Vector analysis.
   (a) Cartesian coordinates.
   (b) Curvilinear coordinates.
9. Fourier series and Fourier integral.
10. Differential Equations.
    (a) Ordinary differential equations with separable variables.
    (b) Linear first-order differential equations.
    (c) Second-order homogeneous equations with constant coefficients.
    (d) Second-order inhomogeneous equations with constant coefficients.
    (e) Partial differential equations: wave equation, Poisson equation, diffusion equation.
11. Statistical distributions: Poisson and Gaussian distributions.

Main references:

- G.B. Arfken and H.J.Weber, *Mathematical Methods for Physicists*, Elsevier, 2005.
- K.F. Riley, M.P. Hobson and S.J. Bence, *Mathematical Methods for Physics and Engineering*, 3rd edition, CUP, 2006.

Other sources:

- A.O. Gogolin, *Lectures on Complex Integration*, Springer, 2014 (please contact me for a pdf file of this book).
- C.Harper, *Introduction to Mathematical Physics*, Prentice-Hall, 1976.
- F.B. Hildebrand, *Advanced Calculus for Applications*, Prentice-Hall, 1976.