

MATHEMATICAL METHODS OF PHYSICS

Physics 330 - Fall Quarter, 2009 - University of Chicago

SUGGESTIONS FOR PROJECTS

It is time to begin thinking about your final project. Remember that the course grade will consist of 50% for weekly problem sets, 30% for the final, 10% for a midquarter exam to be held on Friday, November 6, and 10% for a project paper due on December 4. The project may be undertaken in collaboration with up to two other students in the course. The subject should be chosen by the end of October. You are welcome to choose any subject with some relation to the topics covered in this course, as well as additional topics mentioned below which we have not had time to cover. Either analytic or numerical work (or both) will be acceptable; however, if it is numerical, you should provide a brief introduction containing the fundamentals. Try to keep the length of the paper below 10 pages. A PDF version would be appreciated as we will post all the projects for the benefit of other students in the course.

Here are some preliminary suggestions for possible projects:

Topic	Reference
Chaos and fractals	Peitgen, Jürgens, Saupe (Springer, 1992)
Conformal mappings	Mathews and Walker Ch. 5; Smythe
Digital signal processing	See instructor
Elliptic functions - applications	Bender-Orszag pp. 158-161
Factorization of Schrödinger op.	Infeld and Hull, RMP 23, 21 (1951)
Hyperspherical harmonics	Levine-Roskies PR D9, 421 (1973)
Integrable systems	Scott et al., Proc. IEEE 61, 1443 (1973)
Jeans instability	Astrophysics texts
Mathieu Functions - applications	Bender-Orszag pp. 560-566
Matrix diagonalization method	Mathews-Walker Prob. 6-11
Matrix meth. for 2nd-order eqs.	Courant-Snyder, Ann. Phys. 3, 21 (1958)
Nonlinear differential eqs.	Bender-Orszag Ch. 4
Numerical solns. of diff. eqs.	Hamming, Milne, Press books
Poisson distribution	Mathews and Walker Ch. 14; data
Riemann conjecture	Number theory references
Stability analysis	Bender-Orszag; Peitgen et al.
Supersymmetric quantum mech.	E. Witten, Nucl. Phys. B 188, 513 (1981)
Wavelets	Strang, Amer. Scientist 82, 250 (1994)