UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN and
THE US PARTICLE ACCELERATOR SCHOOL

1991 Course Descriptions

PHYSICS 398C — Introduction to Accelerator Physics
3 Semester Hours
Dr. Swapan Chattopadhyay - Lawrence Berkeley Laboratory

The course will introduce the fundamental electromagnetic building blocks of synchrotrons and linear accelerators. Particle orbits will be analyzed in terms of their linear and nonlinear properties. Phase space concepts, including transfer maps, will be studied, along with modern methods to study nonlinear perturbations. Multiparticle dynamics of charged particle beams, including fluctuations, coherence and instabilities, will be introduced. The course will conclude with a brief account of synchrotron radiation and free electron lasers. Additional Instructor: Ming Xie

PHYSICS 398D — Experimental Methods in Accelerator Physics
3 Semester Hours
Dr. Stephen D. Holmes - Fermi National Accelerator Laboratory

A review of particle accelerator diagnostic devices: operating principles, signal processing, interpretation of data, diagnosis of problems, and strategies for enhancement of accelerator performance. Representative topics to be covered include: beam position, beam loss, profile monitors, Schottky detectors, wide and narrow band pickups, dampers, feedback, data acquisition, and the use of such devices in understanding accelerator performance characteristics. Additional Instructor: Gerald P. Jackson

PHYSICS 398E — Nonlinear Dynamics in Particle Accelerators
3 Semester Hours
Dr. Ronald D. Ruth - Stanford Linear Accelerator Center

In this course we trace the problem of single particle dynamics in accelerators from the fundamental equations of motion up through the analysis of stability under the influence of nonlinear forces. Topics include: review of Hamiltonian mechanics, review of linear equations with periodic coefficients, coupling, perturbation theory, nonlinear resonances, stability criteria, invariant surfaces, breakdown of KAM tori, and symplectic maps. Additional Instructor: Robert L. Warnock

PHYSICS 398F — Relativistic Electronics
3 Semester Hours
Dr. Victor L. Granatstein - University of Maryland

Electromagnetic wave theory. Relativistically correct equations of electron motion. Re-entrant cavities. Electron beam fundamentals. Space charge waves and cyclotron waves. Klystrons. Gyrotrons. Free electron lasers. Emphasis on understanding the principles of RF power sources.

PHYSICS 398G — Charged Particle Optics
3 Semester Hours
Dr. Karl L. Brown - Stanford Linear Accelerator Center
and Dr. Roger Servranckx - University of Saskatchewan

This course will use standard matrix methods, phase ellipse theory, and techniques for handling higher order aberrations to present basic optics modules that are useful in the design of more complex systems, in particular, beam lines, spectrometers, closed circular machines, and linear colliders. Among the different types of moaules will be FODO arrays; matching transformers; eta-suppressors; phase space rotators; first- and second-order achromats; chromatic correction sections, high gamma-t cells, and -I chromatic correction cells. A problem set will be provided each day to illustrate the basic principles being presented and some well-known computer codes will be made available for students to exercise their skills. In addition, an excursion into new optical tools and computer codes that are in the process of being developed will be presented, to demonstrate the most recent evolutionary developments in the field.