1990 US PARTICLE ACCELERATOR SCHOOL COURSE DESCRIPTIONS

PHYSICS 274 — Introduction to Accelerator Physics
4 Harvard Units*
Dr. Donald A. Edwards - SSC Laboratory

Topics in the design and performance of particle accelerators, with emphasis on the basic physics involved. Single particle dynamics of linacs and synchrotrons, including nonlinear motion. Intensity dependence, including space charge effects, coherent instabilities, and statistical phenomena. Examples of current accelerator research and development, chosen from large synchrotron (SSC/LHC) and linear collider activity.

PHYSICS 275 — Introduction to Charged Particle Beams
4 Harvard Units*
Dr. Stanley Humphries, Jr. - University of New Mexico

Text: Charged Particle Beams by Stanley Humphries, Jr. (John Wiley and Sons, New York, 1990), 830pp.

The course introduces the generation, transport and behavior of charged particle beams. Material covers applications over a broad range of current and kinetic energy. Topics include a review of emittance and brightness, introduction to space-charge effects, design of particle injectors, and beam transport through vacuum and plasma environments. The course leads to an understanding of beam instabilities and the generation of coherent electromagnetic radiation by charged particles.

PHYSICS 276 — Introduction to Modern Dynamics
4 Harvard Units*
Dr. Leo Michelotti - Fermi National Accelerator Laboratory

We are living through a renaissance in the study of dynamical systems which is being driven by combining old ideas with modern tools. This course is an introduction to the language, concepts, and methods of classical mechanics as it is practiced today, with emphasis on models of Hamiltonian systems relevant to particle accelerators. Topics will include phase space, resonances, bifurcations, and chaos.

PHYSICS 277 — Introduction to Free Electron Lasers
4 Harvard Units*
Dr. Jonathan Wurtele - Massachusetts Institute of Technology

This course covers the physics of free electron lasers at an introductory level. Linear and nonlinear FEL theory will be studied. The types of accelerators considered and contrasted are induction, RF, microtron, storage ring and elctrostatic. FEL experiments will be discussed and theoretical ideas will be illustrated through experimental data. Numerical techniques and simulations will be covered and students may learn to use a nonlinear two dimensional FEL code. The course will conclude with a survey of applications and future research directions.

PHYSICS 278 — Introduction to Beam Instabilities
4 Harvard Units*
Dr. Alexander W. Chao - SSC Laboratory

Review of relativistic single particle motion in synchrotrons. Electromagnetic fields due to the beam-cavity interaction and the resistive wall. Wakefields and impedance. Coasting beam instabilities. Introduction to dispersion relations and Landau damping. Physical models of bunched beam instabilities. Coherent modes and beam signals. The course includes an introduction to various mechanisms of beam instability and a brief survey of experimental observations.

PHYSICS 279 — Physics of Particle Acceleration
4 Harvard Units*
Dr. Robert B. Palmer - Brookhaven National Laboratory

This course covers the phenomena associated with the acceleration of particle beams, including DC and RF acceleration, transverse focusing, space charge, cavity modes and wake fields. Applications to linacs, cyclotrons and switched power devices will be considered. The physics behind new accelerator ideas will be studied, in particular accelerators using the inverse Cerenkov effect, a metallic grating, the ponderomotive force, a plasma wake, a wake field and the inverse Free Electron Laser effect. We will develop the beam and acceleration requirements for future FEL drivers and Linear Colliders.

*4 Harvard Units is equivalent to 3 semester hours of credit.