USPAS Program

Sponsoring University:

Colorado State University

Course:

Accelerator Physics

Instructors:

Alex Bogacz and Geoffrey Krafft, Jefferson Lab

Purpose and Audience
Accelerator and beam physics is a broad discipline that draws on concepts from linear and nonlinear mechanics, electrodynamics, special relativity, plasma physics, statistical mechanics, and quantum mechanics. The applications of particle accelerators are equally far ranging, including particle and nuclear physics, energy production, chemistry, materials and biological sciences, and medicine. This course will survey the fundamental concepts of accelerator physics that represent areas of current research and development. Typically, a topic first will be discussed abstractly and then applied to a specific facility or device. This course is designed for graduate students pursuing accelerator physics as a career or graduate engineers who want to learn in more detail about the basic physics of accelerators.

Prerequisites
Courses in classical mechanics, electrodynamics, and physical or engineering mathematics, all at entrance graduate level; and the USPAS course "Fundamentals of Accelerator Physics & Technology" or equivalent.

It is the responsibility of the student to ensure that he or she meets the course prerequisites or has equivalent experience.

Objectives
On completion of this course, the students are expected to understand the physical principles that make accelerators function, the limits of present technologies, the promise of future technologies, and the issues presented by forefront applications.

Instruction Method
This course includes a series of lectures and exercise sessions. Homework problems will be assigned which will be graded and answers provided in the exercise sessions.

Course Content
Acceleration principle, longitudinal stability, multipole magnets, beam transport, lattice design, coupled betatron motion, synchrotron radiation, space charge, coherent synchrotron radiation, collective and beam-beam effects, phase space cooling, free-electron lasers, collider accelerator physics.

Reading Requirements
(to be provided by the USPAS) "Particle Accelerator Physics", (third edition) by Helmut Wiedemann, Springer, 2007.

Credit Requirements
Students will be evaluated based on the following performances: Homework assignments (40%), Midterm exam (20%), Final exam (40%).

IU/USPAS course number P570