**Course Programs**

**FIS 711 - Quantum Theory I**  
Hours: 75h/semester

The principles of Quantum Mechanics and its mathematical formulation; Symmetries and representations; Angular momentum and spin; Stationary and time-dependent approximation methods; Atom-radiation interaction and transition rates; Scattering.

Bibliography:  

**FIS 713 - Classical Electrodynamics I**  
Hours: 75h/semester

Maxwell's Equations; Electrostatics and Magnetostatics; Boundary-Value Problems; Dielectrics; Plane Electromagnetic Waves; Wave Guides; Resonant Cavities; Simple Radiating Systems and Antennas.

Bibliography:  

**FIS 715 – Statistical Mechanics**  
Hours: 75h/semester

Basic Concepts of Thermodynamics and Statistical Mechanics; Applications of the Canonical Distribution; Thermodynamics and Statistical Mechanics of Gases; Applications of Fermi and Bose Statistics; Systems with Interactions; Fluctuations and Kinetic Theory.

Bibliography:  

**FIS 942 - Advanced Classical Electrodynamics I**  
Hours: 75h/semester

Wave guides and cavities, Radiation, Multimode fields and radiation angular momentum, Antennas; Special relativity and covariant formulation of electrodynamics, Relativistic dynamics of charged particles, Radiation from accelerated charges, radiation damping.

Bibliography:  
FIS 943: Advanced Statistical Mechanics
Hours: 75h/semester

Phase Transitions; Criticality; Introduction to the Renormalization Group; Stochastic Processes and Systems out of Equilibrium.

Bibliography:

FIS 941: Advanced Quantum Theory
Hours: 75h/semester

Relativistic quantum mechanics; quantization of the electromagnetic field; second quantization; many-body systems (fermions and bosons); applications.

Bibliography:
J. J. Sakurai, Advanced Quantum Mechanics, Addison Wesley (1971).
A. Zee, Quantum Field Theory in a Nutshell, Princeton University Press (2010).

FIS 944 - Advanced Classical Dynamics
Hours: 75h/semester

Hamilton-Jacobi theory, integrable systems and canonical perturbation theory; Non-linear dynamics and chaos in conservative and dissipative systems; Classical dynamics of continuous media and classical fields.

Bibliography:
H. Goldstein, C. Poole e J. Safko, Classical Mechanics, Addison-Wesley (2002).
N. Lemos, Mecânica Analítica, Livraria da Física (2007) - In protuguese.