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:
J.J. Sakurai "Modern Quantum Mechanics", Addison Wesley Reading, Mass., 1994

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:
J.D. Jackson, Classical Electrodynamics. John Wiley & Sons, Inc., New York, 1998

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:
K. Huang, "Statistical Mechanics", John Wiley & Sons, 1987

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:
J. D. Jackson, Classical Electrodynamics, Wiley (1999).
C. A. Brau, Modern Problems in Classical Electrodynamics, Oxford University Press (2004).
W. Greiner, Classical Electrodynamics, Springer (1998).
L. D. Landau e E. M. Lifshitz, The Classical Theory of Fields, Butterworth-Heinemann (1975).

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

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

Bibliography:
L. H. Reichl, A Modern Course in Statistical Physics, Wiley (2009).
R. K. Pathria and P. D. Beale, Statistical Mechanics, Elsevier (2011).
J. J. Binney, N. J.Dowick, A. J. Fisher and M. E. Newman, The Theory of Critical Phenomena, Oxford University Press (1993).
W. D. McComb, Renormalization Methods, A Guide for Beginners, Oxford University Press (2004).
H. Risken, The Fokker-Planck Equation, Springer (1996).
C. W. Gardiner, Handbook of Stochastic Methods, Springer (2009).

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:
W. Greiner, Relativistic Quantum Mechanics, Springer (2000).
J. J. Sakurai, Advanced Quantum Mechanics, Addison Wesley (1971).
A. Zee, Quantum Field Theory in a Nutshell, Princeton University Press (2010).
A. Altland e B. Simons, Condensed Matter Field Theory, Cambridge University Press (2006).
A. Fetter e J. Walecka, Quantum Theory of Many-Particle Systems, McGraw Hill (1971).
Eduardo C. Marino, Quantum Field Theory Approach to Condensed Matter Physics, Cambridge University Press (2017).

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:
J. V. José and E. J. Saletan, Classical Dynamics: A Contemporary Approach, Cambridge University Press (1998).
V. I. Arnold, Mathematical Methods of Classical Mechanics, Springer-Verlag (1989).
H. Goldstein, C. Poole e J. Safko, Classical Mechanics, Addison-Wesley (2002).
N. Lemos, Mecânica Analítica, Livraria da Física (2007) - In protuguese.
S. H. Strogatz, Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering, Westview Press (2014).
E. Ott, Chaos in Dynamical Systems, Cambridge University Press (2002).