PROGRAMMA di
- Nonlinear Optics and Spectroscopy

The course was thought and is taught as an introduction to the immense field of classical nonlinear optics and nonlinear spectroscopies. Two general models are presented: the anharmonic classical oscillator, suitable for the description of parametric processes, and the Maxwell-Bloch equations, necessary in the case of resonant processes.
Experimental evidence of the nonlinear interaction of the radiation field with matter in the 0.1 – 10 eV energy range are presented both in terms of "first evidence" and of "recent advances".
Some relevant spectroscopic techniques based on NLO are discussed in details.

- **NonLinear Optics (NLO)**

the Lorentz oscillator model for the non-resonant optical parametric interactions – series expansion of the material polarization and its limit – symmetry properties of the dielectric susceptibility tensor – solution of the coupled-wave equations for all the second-order optical interactions – phase-matching and quasi-phase-matching techniques – the nonlinear refractive index and two-photon absorption – the nonlinear Schrodinger equation in one-dimension – linear and nonlinear dispersion – self-phase modulation – self-focusing – pulse compression – temporal solitons – stimulated light scattering – two-level-atom approximation and the optical Bloch equations – Rabi oscillations – the Maxwell-Bloch equations – self-induced transparency – power broadening – optical bistability – comparison of the different models for the optical susceptibility

- NonLinear Spectroscopy (NLS)

multi-photon absorption – laser-induced birefringence and dichroism – Coherent Anti-Stokes Raman spectroscopy – pump-probe spectroscopy – frequency combs – applications of nonlinear optics to laser beam transformations and modulation

- Laboratory practice

optical birefringence and second harmonic generation – optical bistability – electro-optics and acousto-optics –z-scan

- Reference textbooks:

R.W. Boyd *Nonlinear Optics (III ed), Academic Press 2008*

also useful :
W. Demtroder, *Laser Spectroscopy (IV ed), Springer 2008*
B.E.A. Saleh, M.C. Teich, Fundamental of Photonics (II ed), Wiley 2007