

## 1º SEMESTRE DE 2019

### FI204 - Tópicos de Física da Matéria Condensada I - Propriedades Ópticas de Sólidos

**Turma A**

**Horário**

Segunda – 8h às 10h na sala IF14

Quarta – 8h às 10h na sala IF14

**Créditos 4**

**Docente**

Luiz Eduardo Moreira Carvalho de Oliveira

**Ementa**

Electronic band structure of periodic solids. Optical reflectivity. Photoemission. Characteristic energy loss spectra. Classification of optical processes. Optical coefficients. The complex refractive index and dielectric constant. Optical materials. Linear response, screening and dielectric response. Self-consistent field approximation. Current-current correlations and the fluctuation-dissipation theorem. Plasmon and characteristic energy losses. Maxwell's equations and the dielectric function. Analysis of charge and current densities. The dielectric tensor. Dielectric and optical properties of solids. Phonons, Raman and Brillouin scattering. Polarons and polaritons. Absorption and dispersion. Quantum theory of absorption and dispersion. Oscillator strengths and sum rules. The absorption coefficient, optical conductivity, and the dielectric function. Dispersion relations and sum rules. Kramers-Kronig relations. Reflectivity and phase shift dispersion relations. Interband transitions. Joint density of states and critical points. Donors, acceptors, Mott-Wannier and Frenkel excitons. Effects of external electric and magnetic fields. Superlattices, quantum wells, quantum wires and quantum dots. Optical properties and Coulomb-bound states in low-dimensional nanostructures. Nonlinear optics. Photonics and metamaterials.

Some references:

F. Wooten, Optical Properties of Solids, Academic Press (1972).

F. Bassani, G. P. Parravicini, and R. A. Ballinger, Electronic states and optical transitions in solids, Franklin Boo Co. (1993).

Mark Fox, Optical properties of solids, Oxford Univ. Press (2001).

M. S. Dresselhaus, Optical properties of solids – MIT lecture notes (2001).

Peter Y. Yu and Manuel Cardona, Fundamentals of Semiconductors - Physics and Materials Properties, 4th ed., Springer (2010).

Conceito dos alunos (no caso de # estudantes  $\leq$  10): seminários pelos alunos – assunto escolhido de tópicos de interesse + paper aprox. 4 pgs, formato Phys. Rev.