Study programmes: MASTER STUDIES – Astronomy and Astrophysics

Course name: Solid State Physics

Lecturers: Jablan Dojčilović and other lecturers

Status: Optional

ECTS: 8

Attendance prerequisites: Quantum Theory Physics and Fundaments of Statistical Physics

Course aims: Obtaining the basic knowledge in various fields of Solid State Physics and education necessary for the starting of the study of modern physics of condensed systems.

Course outcome: Understanding of the phenomena in crystalline and amorphous systems. Adaptation of the experimental techniques necessary for independent student work.

Course content:

Basics of crystallography. Intercellular bonds in crystals. Determinantion of the structure of solid bodies. Grid dynamics. Briluen's zone. Acoustic and optical oscillation mode. The notion of phonons, statistics and phonon features. Heat properties of solid bodies. Models of specific heat of solid bodies. Thermal expansion of solid bodies. Thermal conductivity, trophonics processes. Zomerfeld's theory. Zonal model of solid body: Schrodinger equation for a solid body, Bloch functions, The concept of energy zones, Kroning-Penigs model. Effective mass of electrons. Intrinsic and permeable conductivity of semiconductors, Fermi level, Fermi-Dirac integral. Electrical conductivity of metal. Thermoelectric and galvanomagnetic phenomena in solid bodies.

Superconductivity: Basic phenomena. Theories of classical superconductivity, BCS theory, Couper's pairs. High temperature superconductivity. Ionic conductivity of condensed systems. Solid electrolytes. Dielectrics: Classification of dielectrics. Mechanisms of elastic and thermal polarization. The relationship between permeability and polarizability. Born model. Dependency on frequency permeability and temperatures.

Dielectric losses. Nonlinear dielectrics (ferroelectrics, antiferroelectrics, piezoelectrics and non-feasible ferroelectrics). Magnetic properties of solid bodies: Classification of magnetics. The nature of paramagnetism (Langevin's theory, Curie's law), Van Fleck's paramagnetism. Ferromagnetism (molecular field theory, Einstein-de-Has experiment, Curie-Weiss law). Exchange interactions, spin waves. Antifero-magnetism and ferrimagnetism, ferromagnetic domains. Magnetic Resonance (EPR, NMR).

Literature:

1. J. Dojčilović, Fizika čvrstog stanja, Faculty of Physics, 2007.
2. Н. Ашкрофт, Н.Мермин, Физика твердого тела, "Мир", Москва, 1979.
3. S. Carić, Fizika čvrstog stanja: Eksperimentalne vežbe, Naučna knjiga, 1990.

Number of hours: 7	**Lectures**: 3	**Tutorials**: 2	**Laboratory**: 0	**Research**: 2

Teaching and learning methods:

Lectures, problems solving classes, homework, experimental exercises, colloquium.

Assessment (maximal 100 points)

Course assignments	**points**	**Final exam**	**points**
Lectures	5	Written exam	-
Exercises / Tutorials	30	Oral exam	45
Colloquia	-	Written-oral exam	-
Essay / Project	20		