MODULE HANDBOOK

Course:	**Solid State Physics**
Module Level:	Undergraduate
Code:	FIM 301
Sub-heading, if	-
Courses included in the	-
Semester/Term:	6th / Third Year
Module Coordinator	Dr. Ir. Aminatun, M.Si.
Lecturer(s):	Dyah Hikmawati, SSi.,M.Si., Drs. Adri Supardi, M.Si., and Drs. Djoni Izak R., M.Si
Language:	Bahasa Indonesia
Classification within the	Compulsory Course / ~~Elective Course~~
Teaching format / class hours per week during semester:	3 hours of lectures (50 min / hour)
Workload:	3 hours of lectures, 3 hours of structural activities, 3 hours of individual study, 14 weeks per semester, and total of 126 hours per semester ~ 4,2 ECTS*
Credit Points:	3
Requirement(s):	Quantum Physics, Statistical Physics
Learning Goals/Competencies:	**General Competence (Knowledge):** After following this course, students will able to analyze the crystal structure and physic properties of materials. **Specific Competence:** 1. Explain the concepts of unit cell, basis lattice, crystal structure and bonding in solid 2. Analysis of crystal structure 3. Describe and explain the dynamics of the crystal lattice 4. Describe and explain the Drude and Free Electron Models of conduction in solids. 5. Describe the basic thermal, electrical, optical, magnetic and superconducting properties of solids. 6. Apply physical principles to solve numerical problems based on the physical properties of solids.

Contents:	**Introduction of crystalline states**, crystal lattices, vector bases, unit cells, primitive cells, nonprimitive cells, Bravais lattices and crystal systems, directional crystals, crystal planes, Miller indices, spacing between planes. Inter-atomic forces, van der Waals interactions, Lennard-Jones models, cohesive energies, spring models, types of bonds between atoms, ionic bonds, Madelung constants, covalent bonds, metal bonds, hydrogen bonds **X-ray diffraction and Resiproficial Lattice** Bragg's law, long scattering, scattering vectors, atomic scattering factors, crystal factors, geometric structure factors, lattice structure factors, Fourier analysis, reciprocal lattice, diffraction requirements and Bragg's law, Laue equations, Brillouin zones, reciprocating lattices for various lattices, x-ray diffraction experiments **The dynamics of the crystal lattice** Elastic waves, monoatomic lattice vibrations, first Brillouin zones, speed groups, diatomic grating vibrations, acoustic branches and optical branches, phonons, classic calorific heat capacity, Einstein caloric capacity and vibration range, vibration range (DOS) Debye, Debye's law, thermal conductivity. **Electrons in metal** Classical free electron model, conduction electrons, Drude model, resistivity, conduction electron heat capacity, Fermi gas electron model, FD distribution, three dimensional free electron gas, Fermi surface, Fermi energy, electron state meeting (DOS) electrons, electron heat capacity electrons, electrical conductivity, Hall effect, metal thermal conductivity, Wiedemann-Franz law **Electrons in solids** The energy spectrum (atom, molecule, solid), Bloch function, solid-state energy, Brillouin zone, electronic state meeting (DOS) electronics, almost free electron model, Bragg reflection and energy gap, Kronig-Penney model, energy band for conductor, insulators and semiconductors, effective mass of electrons, holes, electrical conductivity, Hall effect **Semiconductors** Crystalline structure and bonding, covalent bonding, ribbon structure, intrinsic semiconductor, carrier concentration, semiconductor statistics, impurity state, extrinsic semiconductor, n-type semiconductor, p-type semiconductor, extrinsic semiconductor statistics, semiconductor band structure, pn junction, , transport symptoms in semiconductors, mobility, conductivity, magnetic field effects, Gunn effect, optical properties **The dielectric and magnetic properties of solids** Review electric-magnetism, polarization, depolarization, dielectric constant and polarizability, Clausius-Mossotti relation, classical theory of electronic polarizability, piezolectricity, ferroelectricity. Magnetic moment, magnetic susceptibility, reference materials, Langevin diamagnetism, paramagnetism, ferromagnetism, ferromagnetism in isolators, ferromagnetism in metals, antiferromagnetism, nuclear magnetic resonance; **Superconductor**

Soft Skill Attribute:	Effort and ethic
Study/Exam Achievements:	Students are considered competent and eligible to pass the course upon obtaining at least 40 of maximum score for the exams (midterm test and final exam), structured activity(group discussion). Final score is calculated as follow: 20% assignment + 20% Quiz + 30% midterm test + 30% final exam Final grade is defined as follow: A : 75 – 100
	AB : 70 - 74.99 B : 65 - 69.99 BC : 60 - 64.99 C : 55 - 59.99 D : 40 - 54.99 E : 0 - 39.99
Forms of Media:	Powerpoint slides, LCD projectors and whiteboards
Learning Methods:	Lecture, assessments and group discussion
Literature(s):	1.Cyrot, M. & Pavuna, D., 1992, ***Introduction to Superconductivity and High - Tc Materials***, Word Scientific Co. , Singapore. 2. Kittel, C., 2004, 7th ed. , ***Introduction to Solid State Physics***, John Wiley & Sons,New York. 3. Moliton, A., 2007, ***Solid-State Physics for Electronics***, John Wiley & Sons, New York. 4. Neaman, D.,2003, 3rd ed., ***Semiconductor Physics and Devices, Basic Principles***, McGrawHill, New York 5. Omar, M.A., 1975, ***Elementary Solid State Physics,*** Addison-Wesley Massachussets 6. Patterson, J., & B. Bailey, 2007**,** ***Solid-State Physics, Introduction to the Theory,*** 2th ed, Springer, Heidelberg
Notes:	*Total ECTS = {(total hours workload × 50 min) / 25 hours Each ECTS is equals with 25 hours.