LEARNING MODULE DESCRIPTION

GENERAL INFORMATION

1. Module title: Solid State Physics I
2. USOS code: 04-F-FCS1-75-3Z
3. Term: 2024/2025 (winter)
4. Duration: 30 + 15
5. ECTS: 5
6. Module lecturer: Bivas Rana
7. E-mail: bivran@amu.edu.pl
8. Language: English

DETAILED INFORMATION

1. Module aim (aims)

The course is specifically designed for undergraduate physics students with the primary goal of imparting a comprehensive understanding of basics of Solid State Physics. The aim is to equip students with the essential knowledge and analytical tools essential for describing the intricate phenomena within solid-state physics. Beyond the foundational aspects, the course strives to demonstrate the pervasive influence of solid-state physics in our daily surroundings, emphasizing its relevance to our interactions with solids in various contexts.
Throughout the duration of the course, students engage in a multifaceted learning experience that extends beyond theoretical concepts. They delve into the practical aspects of investigating fundamental properties inherent to solids, gaining hands-on insights into the methodologies employed in the study of solid-state physics. This multifaceted approach not only enhances theoretical comprehension but also provides students with a practical understanding of how to apply their knowledge to real-world scenarios.

2. Pre-requisites in terms of knowledge, skills and social competences (where relevant)

The student has knowledge in the basic fields of physics (mechanics, optics, electricity, and magnetism) at the level of completing the second year of studies in physics and related disciplines. Additionally, basic knowledge in experimental physics, atomic physics, and quantum physics would be beneficial. Fundamental knowledge and skills in solving physics problems, as well as proficiency in mathematical tools, are required. The student is capable of acquiring information from various sources and utilizing it. Moreover, the student should be adept at working in a group and understand the necessity of collaboration.

READING LIST

[1] Charles Kittel, Introduction to Solid State Physics, John Wiley and Sons
[2] Neil W. Ashcroft and N. David Mermin, Solid State Physics, Holt, Rinehart and Winston
[3] Eleftherios N. Economou, The Physics of Solids: essential and beyond, Springer
[4] John J. Quinn, Kyung-Soo Yi, Solid State Physics, Principles and Modern Applications Second Edition https://doi.org/10.1007/978-3-319-73999-1
[5] Steven M. Girvin, Kun Yang, Modern Condensed Matter Physics, DOI: 10.1017/9781316480649

SYLLABUS:

Week 1: Fundamentals of crystallography, Networks and lattice translation vectors
Week 2: Crystal structure, Bravais lattices, Elements of symmetry in crystals, Packing fraction
Week 3: Miller indices of nodes, directions, and planes
Week 4: Reciprocal lattice, X-ray diffraction, Neutron diffraction
Week 5: Bragg's law and Laue's law
Week 6: Methods of crystal lattice studies
Week 7: Einstein model, Specific heat, Phonon Heat Capacity
Week 8: Debye model of specific heat, Specific heat of conductive electrons in metals
Week 9: Thermal conductivity of solids, Thermal expansion of solids
Week 10: Free electron model, Bloch function, Wave equation of electron in a periodic potential
Week 11: Kronig Penney Model, E-k diagrams, Effective Mass
Week 12: Crystal Momentum of an Electron, Brillouin zone, Metals and Insulators
Week 13: History of magnetism, Magnetism in daily life, Atomic magnetic moments, Magnetic periodic table, Magnetic dipole moment
Week 14:, Diamagnetism, Paramagnetism, Ferromagnetism
Week 15: Antiferromagnetism, Ferrimagnetism, Magnetic domain wall, Ferromagnetic resonance