

- **The electron liquid:** Drude's phenomenological kinetic theory of metals; Sommerfeld's quantum theory; Landau diamagnetism; Pauli paramagnetism.
- **Crystalline structure:** lattices, their characterization and classification; common examples; reciprocal lattices, Brillouin zones and lattice planes; graphene, and Moiré and related materials; the X-ray diffraction technique.
- **Electrons in crystalline settings:** Bloch's theorem; crystal momentum and band indices; the Fermi surface; the density of states; weak periodic potentials; spin-orbit coupling; the tight-binding approach; Wannier wave functions; techniques for electronic-structure calculations.
- **Electron dynamics:** semiclassical electron dynamics; electric and magnetic fields; holes; the Hall effect and magneto-resistance; electrical and thermal conduction in metals; probing the Fermi surface; examples of band structures; electron scattering; the Boltzmann description; impurity scattering; correlations and screening; cohesive energy.
- **Lattice vibrations:** failures of the static lattice picture; classical harmonic normal modes of vibration; quantized modes (*i.e.*, phonons); probing phonon dispersion relations; neutron scattering; effects of anharmonicities; phonons in metals.
- **Insulators:** classification of solids; band, Anderson and Mott insulators; dielectric and optical properties.
- **Semiconductors:** homogenous semiconductors; carrier statistics; intrinsic and extrinsic types; impurity-band conduction; inhomogeneous semiconductors; junctions, wells, dots and devices.
- **Geometry, topology and related topics:** modern theory of polarization; topological insulators; angle-resolved photo-emission and scanning probe spectroscopies; weak and strong localization; mesoscopics; integer quantum Hall effect.
- **Ordered states of matter:** ferromagnetism; spin-wave excitations; magnetic structure and domains; quasicrystals; superconductivity, its essential phenomenology and microscopic origin; flux quantization; Josephson effects; Aslamazov-Larkin paraconductivity; topological classification of defects; Kondo effect; fractional quantum Hall effect and the Laughlin wave function.

Grading Policy for the Course: In determining final grades, the weights given to the components of a student's work will approximately be: TBD for homework and TBD for any examinations.

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Student Accessibility Support Center (SASC) Statement: If you have a physical, psychological, medical or learning disability that may impact your course work, please contact the Student Accessibility Support Center (SASC), Stony Brook Union Suite 107, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the staff at the Student Accessibility Support Center (SASC). For procedures and information go to the following website:

Environmental Health and Safety.

Academic Integrity Statement: Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the *Academic Judiciary* website.

Critical Incident Management: Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.

AI Use: At the beginning of the semester we shall discuss in class what the most suitable stance is for this course, bearing in mind that the issue is a complex and rapidly evolving one. At that stage, a policy statement will be provided.