Semester	JAN 2022
Open to semester	6,12
Course code	**PH3224**
Course title	**Condensed Matter I**
Credits	4 /
Course Coordinator & participating faculty (if any)	Prasenjit Ghosh
Nature of Course	Lectures
Pre-requisites	Knowledge of basic Quantum Mechanics, Thermodynamics and Statistical Mechanics. This course is also a prerequisite to the advanced Condensed Matter Physics II.
Objectives (goals, type of students for whom useful, outcome etc)	Objectives: Condensed matter is a vast subject and encompasses within itself several concurrent themes of contemporary interests spanning diverse physics areas. The present course shall focus on the solid state part of it with emphasis on properties of crystalline solids, i.e., solids whose structure is compatible with one of the most fundamental symmetries of nature, namely, the discrete translational invariance. Most of the discussions will be restricted to the single-particle picture of electrons and phonons and how they determine the structure and electronic properties of a solid. The course is expected to be useful to any student who is aspiring to do Physics in future. The course would essentially teach the language of the reciprocal space (or the momentum space) and use that to explore some of the fascinating properties of crystalline solids, including the transport (of heat and electricity), thermal and magnetic properties and of phases as exotic as superconductivity.
Course contents (details of topics /sections with no. of lectures for each)	1) Crystal structure, symmetries and X-ray diffraction (3) 2) Reciprocal space (2) 3) Free electron theory and properties of metals (5) 4) Electrons in weak periodic potential; band theory of solids: nearly free electron model and tight binding approximation. (5) 5) Effective mass, concepts of holes, Fermi surfaces, Experimental methods to determine Fermi surface. (3)

	6) Lattice vibrations and mechanical and thermal properties. (5) 7) Dielectrics and ferroelectrics (3) 8) Magnetism in solids: glimpses of dia-, para-, ferro- and antiferromagnetism. (3) 9) Landau levels, Integral Quantum Hall Effect in 2D electron gas. (2) 10) Superconductivity (Bare introduction: how electrons with opposite spin and momentum pair-up to form cooper pairs) (2) * The no. of lectures given in bracket are indicative. The actual nos. might vary.
Evaluation /assessment	End-Sem Examination-40% Mid-Sem Examination-30% Others-30%
Suggested readings (with full list of authors, publisher, year, edn etc.)	Introduction to Solid State Physics, Charles Kittel, John Wiley & Sons Inc. Solid State Physics, N. W. Ashcroft and N. David Mermin; Thomson Brooks/Cole Atomic and Electronic Structure of Solids, E. Kaxiras; Cambridge University Press.