A BRIEF COURSE ON SUPERCONDUCTIVITY

PROF. SAURABH BASU
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IIT Guwahati

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 4 weeks (24 Jan' 22 - 18 Feb' 22)
EXAM DATE : 27 Mar 2022

PRE-REQUISITES : Solid State Physics

INTENDED AUDIENCE : B.Tech (Material Science) and M.Sc (Physics, Material Science) and PhD students, lecturers (Solid state Physics)

INDUSTRIES APPLICABLE TO : Companies into material science and ceramic research will be benefitted.

COURSE OUTLINE :

The course deals with the basics of superconductivity, including Meissner effect, electrodynamic response, -type-I and type-II superconductors etc. BCS theory, the only microscopic theory of superconductivity is discussed in details with a view to understand superconducting transition temperature and its relation to the pairing gap. Further Ginzburg Landau theory is introduced which is a phenomenological theory that is applicable in general to second order phase transitions. A few experimental methods to explore the superconducting gap are discussed. Unconventional superconductivity is elaborately talk about with regard to the unusual normal phase of the high Tc cuprates and ramification due to the breakdown of Landau's Fermi liquid theory therein is emphasized. Finally Josephson effect is introduced and its applications to superconducting circuits are studied. Special emphasis is given to DC SQUID which uses Josephson junctions and has a variety of applications, such as sensors, amplifiers, magnetometers etc .

ABOUT INSTRUCTOR :

Prof. Saurabh Basu is a professor at the Department of Physics, IIT Guwahati. The area of expertise is Theoretical Condensed Matter Physics, with special emphasis on the correlated boson and fermion systems, topological insulators. He has about 90 research publications in different refereed international journals.

COURSE PLAN :

Week 1**:** Principles of Superconductivity, London equations, Penetration depth, Coherence Length

Week 2**:** Type-I and Type-II superconductors, linear response theory, BCS theory, Boundary value problems at high frequencies

Week 3**:** Basics of Josephson junctions, SQUIDS, Application of SQUIDS, Quantum Logic circuit

Week 4**:** Introduction to High-Tc superconductivity, Graphite superconductors, Fe- based superconductors