Solid State Physics and Statistical Thermodynamics
F.Y.B.Tech. (M-group) Semester II
Course code: PH-19005 (SSPST)

Teaching Plan

Teaching Scheme
Lectures : 3hrs/week
Practical : 2hrs/week

Examination Scheme
Test 1 & 2 : 40 marks
End-Sem Exam - 60.

Unit	Lecture	Topic to be covered
1 Structure of Solids and its Characterization	**1**	• Crystalline state • Concept of Lattice • Concept of Space lattice • Numericals
	2	• Basis and crystal structure • Unit cell • Primitive cell • Numericals
	3	• Lattice parameters • Crystal systems in brief • Numericals
	4	• Miller indices • Inter planer distance of lattice plane • Numericals
	5	• Linear density • Planar density • Density of crystals • Numericals
	6	• X-ray diffraction: • Bragg spectrometer • Numericals
	7	• Analysis of XRD spectra for cubic system • Numericals
2 Solid State Physics	**1**	• Somerfield's free electron theory
	2	• Density of states • 1Dimentional • 2 Dimensional • 3Dimentional
	3	• Nearly free electron theory

	4	• Origin of band gap • Magnitude of band gap
	5	• Classification of solids on the basis of band theory
	6	• Fermi energy level • Electron distribution function • Fermi-Dirac probability function
	7	• Position of Fermi level in intrinsic (with derivation),
	8	• Carrier concentration -Intrinsic semiconductor -Extrinsic semiconductor
	9	• Intrinsic semiconductor conductivity • Extrinsic semiconductor conductivity
	10	• **Numericals (Practice)**
Unit 3 **Statistical Thermodynamics**	**1**	• Micro and macro states
	2	• Basic postulate of statistical mechanics • Concept and types of ensembles
	3	• Partition function • Numericals
	4	• Classification of statistical distribution function
	5	• Corollary of first law of thermodynamics • Second law of thermodynamics • Third law of thermodynamics • Numericals
	6	• Statistical interpretation of basis thermodynamic variables • Pressure, work • Numericals
	7	• Statistical interpretation of basis thermodynamic variables • Energy, entropy • Numericals
	8	• Helmholtz free energy • Gibb's free energy • Numericals

4 **Thermal properties of solids**	**1**	• Introduction • Thermal vibrations
	2	• Specific heat of solids • Dulong Petit law • Numericals
	3	• Einstein's theory of specific heat • Numericals
	4	• Debye's theory of specific heat: vibrational modes • Numericals
	5	• Density of vibrational mode, Debye's approximation • Numericals
5 **Magnetism**	**1**	• Introduction to magnetic materials • Diamagnetic • Paramagnetic • Ferromagnetic • Antiferromagnetic • Ferrimagnetic
	2	• Types of magnetic interactions • Concept of magnetoresistance
	3	• Curie law in paramagnetism (using statistical partition function) • Numericals
	4	• Ferrites: types and structures
	5	• Application: magnetic storages
	6	• Vibrating sample magnetometer (VSM).
Unit 6 **Superconductivity**	**1**	• Introduction to superconductivity
	2	• Properties of superconductor
	3	• • Type-I and Type-II superconductors
	4	• Concept of cooper pair
	5	• AC/DC Josephson effect SQUID magnetometer: principle and working
	6	• Numericals

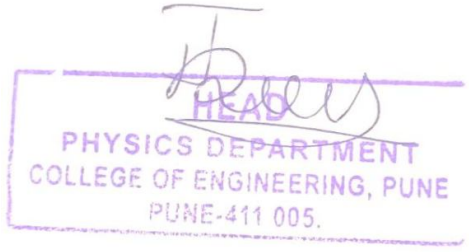
References:

1. Elements of X-ray Diffraction, B. D. Cullity, Addison-Wesley Publishing Company, Inc.
2. Introduction to Solid State Physics, Charles Kittel, Wiley.
3. Solid State Physics, S. O. Pillai, New Age International Publishers.
4. Solid state electronic devices, Ben G. Streetman, Sanjay Banerjee Pearson Prentice-Hall.
5. Fundamentals of statistical Mechanics, B. B. Laud, New Age International Publishers
6. Fundamentals of Statistical and Thermal Physics by F. Reif, Levant Pub.
7. Statistical Mechanics, Shang-Keng Ma.
8. Text Book of Engineering Physics by Avadhanulu & Kshirsagar, S. Chand Pub.
9. Introduction to Magnetic Materials, B. D. Cullity, Wiley.
10. Introduction to Magnetism and Magnetic Materials, David Jiles, Springer-Science.

Objectives:

Students are expected to understand

- Different types of structure of solids and its characterization by x-ray technique.
- Band structure of solids, categorization of solids based on band structure, ideas about Fermi level positions in semiconductors.
- Foundation of statistical mechanics, basic concepts and various terms and formulations.
- The connection between statistics and thermodynamics, understanding thermodynamics by statistical point of view and its techniques.
- Thermal properties of solids, specifically, specific heat and some models for specific heat calculation.
- Origin of magnetism, various types of magnetic materials and its use in modern technology.



Head
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