Department of Physics, Shri Pundlik Maharaj Mahavidyalaya Nandura (Rly)

Syllabus

Class- B.Sc-III, Sem-VI

Subject- Physics.

STATISTICAL MECHANICS AND SOLID STATE PHYSICS

UNIT-I : Statistical Mechanics Phase space, unit cell, microstates, macrostates, energy states, density of energy states, probability & thermodynamic probability, principle of equal a priori probabilities, most probable distribution, Boltzman entropy relation. Maxwell Boltzman statistics, and its application to molecular speed distribution, Average speed, rms speed & most probable velocity.

UNIT-II: Distinguishable & indistinguishable particles, concepts of boson &fermions. Bose – Einstein statistics : Thermodynamic probability, most probable distribution, application of BE statistics to black body radiation. Fermi- Dirac distribution : Thermodynamic probability, Most probable distribution ,Fermi function, Fermi energy & Fermi temperature.

UNIT-III : Crystallography Solids: - Amorphous and Crystalline Materials; Unit Cell. Millar Indices, Reciprocal Lattice, Coordination Number. Types of Lattices: Diffraction of x-rays by Crystals. Bragg's Law: Determination of lattice parameters of NaCl crystal. Defects in solids – points, line & plane defects.

UNIT -IV :Electrical Properties of Materials Motion of electron:- Free electrons; conduction electrons, electron collision; mean free path, conductivity & Ohm's law; density of states; concept of Fermi energy. Band structure : Electron in periodic potential, nearly free electron model (qualitative), energy band, energy gap, metals, isulators and semiconductors.

UNIT-V: Magnetic Properties of Materials Atomic magnetic moment; magnetization vector; magnetic susceptibility; Dia -, Para-, and Ferromagnetic Materials; Classical Langevin Theory of dia and Paramagnetic Domains; Quantum Mechanical Treatment of Paramagnetism; Curie's law, Weiss's law;. Hysteresis and Energy Loss.

UNIT-VI: Superconductivity & Nano Technology Superconductivity: Introduction to Superconductors; Critical Temperature; Critical magnetic field; Meissner – effect; Type I and type II Superconductors, Idea of BCS theory (No derivation),

Syllabus

Cooper pair; Applications of superconductors. Nano Technology: Introduction to nano size materials, brief History of Nano materials, Effect of reduction of dimensions on physical properties; quantum size effect; Applications of nano materials in different fields.

Practical : The distribution of marks for practical examination will be as follows:

Record Book 10 marks
Viva-voce 10 marks
Experiment 20 marks
Assignment 10 marks
Total 50 marks

A student will have to perform at least ten experiments per semester.
b) The semester examination will be of Four Hour duration and student will have to perform one experiment in the semester examination.
c) In assignment, every student should be asked to submit thedetailed report on one of experiments he or she has performed.
The detailed report should include the theoretical background of the experiment.
LIST OF EXPERIMENTS:
1 To study crystal models and identification of crystal planes.
2 To study Characteristics of Photocell
3 To determine Planck's constant using photocell
4 To determine energy gap of semiconductor using four probe method.
5 To determine activation energy of Thermister.
6 To determine energy gap of semiconductor using reverse bias method
7 To study hysterisis losses in transformer core and plot B-H curve.
8 To measure magnetic susceptibility of solids.
9 To study thermo emf using thermocouple.
10 To Determination of temperature coefficient of resistance of platinum using platinum resistance thermometer.
11 To determine lattice parameter using X-ray diffraction pattern.
12 To determine half life period of radioactive substance by GM counter
13 Determination of dislocation density in alkali halide crystals.
14 Demonstrations- Any 4 demonstrations equivalent to 2 experiments
15 Mini project equivalent to 2 experiments.

Syllabus

16 Computer aided demonstrations (Using computer simulations or animations) (Any 2 demonstrations equivalent to 2 experiments)

17 To study characteristics of Photo diode.

18 To study Zener regulated power supply.

19 Study of transistorized regulated power supply, series pass transistor.

20. Determination of velocity of sound by using sonometer wire.

21. Determination of velocity of ultrasonic wave in liquids.

22. Determination of Band gap energy of a pn junction / zener diode.

REFERENCE BOOKS:

1. Thermodynamics and statistical mechanics-Brijlal Subramanium

2. Statistical Mechanics – An Elementary Outline – Avijit Lahiri – Universities Press

3. Statistical and Thermal physics - By Lokanathan, R.S. Gambhir,

4. Fundamentals of statistical and thermal physics - By F.Reif

5. Perspectives of modern physics - By A. Beiser

6. Fundamental of Statistical Mechanics - By B.B. Laud

7. A primer of Statistical Mechanics - By R.B. Singh

8. Statistical Mechanics - By Gupta, Kumar

9. Solid State Physics, S.O.Pillai, 3rd Edition, New Age International (P) Ltd, Publisher, (1999).

10. Solid State Physics – By Kakani and Hemrajani, S. Chand Publication.

11. Solid State Physics - By Saxena, Gupta and Saxena, Pragati Prakation.

12. Introduction to Solid State Physics, Charles Kittel, John Wiley and Sons, 7th Edition.

13. Solid State Physics, A.J.Dekker, Macmillan India Ltd, (1998).

14. Solid State Physics, R.K. Puri, V.K. Babbar, S. Chand Publication.

15. Problems in Solid State Physics, S.O. Pillai, New Age International (P) Ltd.

16. Solid State Physics, Palanyswamy.

17. Solid State Physics, David, Snoke, Pearson Publication.

18. Introduction to Nanoscience & Nanotechnology by K. K. Chattopadhyay and A. N.Banerjee, Publisher: PHI Learning and Private Limited

19. Nanotechnology, Rakesh Rathi, S Chand & Company, New Delhi

20. Nanotechnology: Principles and Practices by Sulbha K Kulkarni, Capital Publishing Co. New Delhi.

References :

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Syllabus

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissons : Experiments in Modern Physics