| BRANCH | Subject Title | Subject Code |
|---|---|---|
| B.Sc.(Physics–Major) | Solid State Physics and Electronics | PYM1-161 |

**Course learning outcomes**

On successful completion of this course, the students will be able to

1. Know the crystal structure and its applications.

2. Explain the atomic structure and physical matters

3. Analyze the molecular spectra such as electronic rotational and vibration

4. Identify the various maternaling Rama spectroscopic techniques.

**Content**

**Unit -1**

## Crystal Structures

An overview of thermal and hydro electric power plants inMadhyaPradesh.1 Premier Indian Institutes and their contribution: Bhabha Atomic Research Centre, Mumbai, Advanced Materials and Processes Research Institute (AMPRI), Bhopal, Defense and Research Development Organization, New Delhi, Indian Institute of Science. Bangalore, Bose Institute, Kolkata, Raja Ramanna Centre for Advance Technology, Indore

2. Classification of solids and space lattice: Crystalline and amorphous solids; Space lattice; Basis; Lattice translational vector; Unit cell; Primitive and non-primitive cells; Bravais lattice in two and three dimensions; Seven crystal systems; Fundamentals of elements of symmetry; Point groups and space groups; Lattice planes and miller indices; Relation between interplanar spacing and lattice constants.

3. Simple crystal structures: Simple cubic; Face centered cubie (NaCl); Body centered cubic (CsCI); Hexagonal closed packed; Diamond and Zinc sulfide structure; Coordination numbers and atomic packing fraction.

4. Reciprocal Reciprocal lattice and its properties, Diffraction in crystal: Laue's and Bragg's equations; Determination of crystal structure by X-rays (Powder method).

**Unit -2**

## Physical properties of matter

1. Specific heat Specific heat of solid and its variation with temperature; Classical theory of Dulong and Petit, Einstein model assumptions and derivation for specific heat, Debye model assumptions and derivation for specific beat. Outcomes of different models.

2. Lattice vibrations in crystal: Mono-atomic lattice vibration and dispersion relation, Brillouin Zones; Concept of phonons

3 Motion of electrons in metals: Lorentz Drude theory. Electrical resistivity and electrical conductivity, Ohm's Law (1) Wiedemann Frenz law, Hall Effect, Hall coefficients and experimental determination.

**Unit-3**

**Solid state devices and applications**

**1.** Energy bands and semiconductors: Formation of energy bands in solid; Semi-conductors: Intrinsic and extrinsic; Concept of Fermi energy and Fermi energy level; Mobility and drift velocity of charge carriers; Conductivity of semiconductors; Derivation for expression of concentration of electrons and holes in an intrinsic and extrinsic semiconductor; P-N Junction, depletion layer, expression for potential barrier, Current equation for P- N junction diode,

2. Construction, operation and characteristic curve of diodes. P- N Junction Diode in forward and reverse bias, Characteristics curve, Static and dynamic resistance; Avalanche and Zener Breakdown; Zener diode and its application as a voltage regulator, Photodiode, Light Emitting diode and Solar cell.

3. Rectification Half wave, full wave and bridge rectifier: Electrical circuit and working, Determination of efficiency Ripple factor and voltage regulation, Unregulated and regulated power supply.

**Unit-4**

**Transistor and amplifier**

**1.** Transistors: Bipolar Junction Transistors (PNP and NPN): Biasing and operation; Operation of transistors in common base, common emitter and common collector modes and their characteristic curves, Relation between current gains (α, β and y): Hybrid (h) parameters of transistor, JFET and MOSFET and its characteristic curve.

2. Transistor biasing: Biasing stabilization in transistor; Thermal runway and stability factor, Method of transistor biasing (voltage dividing method).

3. Amplifiers: Amplifiers and their classification in brief Single stage common emitter amplifier, RC coupled Amplifier, Q-point, load line and frequency response curve. Power amplifiers (only introduction).

**Unit–5**

**Oscillators, Modulation and demodulation**

**1.** Oscillators: Principle of feedback amplifiers; Positive and negative feedback amplifier, Principle of an oscillator and Barkhausen criterion; Introduction to Phase shift and Wien bridge oscillator.

2. Modulation: Definition; Theoretical analysis of amplitude modulation; Modulation index; Side bands and band width; Power dissipation in modulated wave.

3. Frequency modulation Definition and mathematical analysis of frequency modulated wave; Modulation index, frequency spectrum and band width.

4. Phase modulation: Definition and theoretical analysis, Comparison among amplitude, frequency and phase modulation.

4. Demodulation: Principle of detection of Amplitude Modulated wave, P-N diode as square law detector

**PRACTICAL**

1. To study characteristic curve of a PN Junction diode.
2. To study characteristics curve of a Zener diode.
3. To study characteristics curve of a light emitting diode (LED),
4. To determine the energy band gap of a semiconductor using P-N diode in reverse bias.
5. To determine ripple factor and voltage regulation of half wave and full wave rectifiers.
6. To determine ripple factor and voltage regulation of a full wave rectifiers using filter circuit.
7. To study unregulated and regulated power supply.
8. To study characteristics curves of PNP/ NPN transistor in common base mode configuration and determination current gain.
9. To study characteristics curves of PNP/ NPN transistor in common emitter mode configuration and determination current gain.
10. To study characteristics curves of Junction field effect transistor.
11. To study thermal bias stability of transistor in common emitter mode.
12. To study frequency response curve of single stage RC amplifiers in CE mode.
13. Measurement of h-parameters of a transistor.
14. Find out closed loop gain of feedback amplifier.
15. Study of wave form of Wein bridge oscillator and to measure frequency of oscillations.
16. Study of amplitude modulated wave and determination of modulation Index using CRO.
17. Study of frequency modulated wave and determination of modulation index using CRO.
18. Study of characteristic curve of Photodiode.
19. To study the characteristic curve of Light Dependent Resistor (LDR).
20. Study of characteristic curve of solar cell.