Department of Higher Education, Govt. of M.P.
Under Graduate Semester wise Syllabus
as recommended by Central Board of Studies and approved by the Governor of M.P.
with effect from Session 2016-2017

Class: B.Sc.
Max. Marks: 85 + (CCE) 15 = 100
Semester: **VI**
Subject: **Physics**
Title of Paper: **SOLID STATE PHYSICS AND DEVICES**

Unit-I: SOLID STATE PHYSICS-1 **15 Lectures**

Crystal Structure and bonding: Crystalline and amorphous solids. Translational symmetry. Lattice and basis. Unit cell. Reciprocal lattice. Fundamental types of lattices (Bravias Lattice). Miller indices Lattice planes. Simple cubic. Face centered cubic. Body centered cubic lattices. Laue and Bragg's equations. Determination of crystal structure with X-rays, X-ray spectrometer. Ionic, covalent, metallic, van der Waals and hydrogen bonding. Band theory of solids. Periodic potential and Bloch theorem. Kronig-Penny model (Qualitative).

Unit-II: SOLID STATE PHYSICS-2 **15 Lectures**

Lattice structure and properties: Dulong Petit, Einstein and Debye theories of specific heats of solids. Elastic and atomic force constants. Dynamics of a chain of similar atoms and chain of two types of atoms. Optical and acoustic modes. Electrical resistivity. Specific heat of electron. Wiedemann-Franz law. Hall effect. Response of substances in magnetic field, dia-, para- and ferromagnetic materials. Classical Langevin theory of dia and paramagnetic domains. Curie's law. Weiss' theory of ferromagnetism and ferromagnetic domains. Discussion of BH hysteresis**.**

Unit-III: SEMICONDUCTOR DEVICES-1 **15 Lectures**

Electronic devices: Types of Semiconductors (**p** and **n**). Formation of Energy Bands, Energy level diagram. Conductivity and mobility. Junction formation, Barrier formation in **p**-**n** junction diode. Current flow mechanism in forward and reverse biased diode (recombination), drift and saturation of drift velocity. Derivation of mathematical equations for barrier potential, barrier width. Single **p**-**n** junction device (physical explanation, current voltage characteristics and one or two applications). Two terminal devices. Rectification. Zener diode. Photo diode. Light emitting diode. Solar cell. Three terminal devices. Junction field effect transistor (JFET). Two junction devices. Transistors as **p**-**n**-**p** and **n**-**p**-**n**. Physical mechanism of current flow. Characteristics of transistor.

Unit-IV: SEMICONDUCTOR DEVICES-2 **15 Lectures**

Amplifiers (only bipolar junction transistor). CB, CE and CC configurations. Single stage CE amplifier (biasing and stabilization circuits), Q-point, equivalent circuit, input impedance, output impedance, voltage and current gain. Class **A**, **B**, **C** amplifiers (definitions). RC coupled amplifiers (frequency response). Class **B** push-pull amplifier. Feedback amplifiers. Voltage feedback and current feedback. Effect of negative voltage series feedback on input impedance. Output impedance and gain. Stability, distortion and noise. Principle of an Oscillator, Barkhausen criterion, Colpitts, RC phase shift oscillators. Basic concepts of amplitude, frequency and phase modulations and demodulation.

Unit-V: NANO MATERIALS **15 Lectures**

Nanostructures: Introduction to nanotechnology, structure and size dependent properties. 3D, 2D, 1D, 0D nanostructure materials and their density of states, Surface and Interface effects. Modelling of quantum size effect. Synthesis of nanoparticles - Bottom Up and Top Down approach, Wet Chemical Method. Nanolithography. Metal and Semiconducting nanomaterials. Essential differences in structural and properties of bulk and nano materials (qualitative description). Naturally occurring nano crystals. Applications of nanomaterials.

References:

1 Introduction to Solid State Physics, C. Kittel, VIIIth Edition, John Wiley and Sons, New York, 2005.

2 Intermediate Quantum theory of Crystalline Solids, A. O. E. Animalu, Prentice–Hall of India private Limited, New Delhi 1977

3 Solid State Physics, N. W. Ashcroft, and N. D. Mermin, Harcourt Asia (P) Ltd. 2001

4 The Physics and Chemistry of Nanosolids: Frank J. Owens, and Charles P. Poole Jr., Wiley Inter Science, 2008

5 Physics of Low Dimensional Semiconductors: An introduction; J.H. Davies, Cambridge University Press, U.K., 1998