

HONOURS SUBJECT
PEI3D001 SOLID STATE DEVICES (4-0-0)

80% University Level:

Module-I

(11 hours)

Introduction to Quantum Mechanics: Principles of Quantum Mechanics , Energy Quanta, Schrodinger's Wave Equation, Applications of Schrodinger's Wave Equation, Extensions of the Wave Theory to Atoms

Introduction to the Quantum Theory of Solids: Allowed and Forbidden Energy Bands, Electrical Conduction in Solids, Extension to Three Dimensions, Density of States Function, Statistical Mechanics: The Fermi-Dirac Probability Function, The Distribution Function and the Fermi Energy

The Semiconductor in Equilibrium: Charge Carriers in Semiconductors, Dopant Atoms and Energy Levels: Qualitative Description, Ionization Energy, The Extrinsic Semiconductor: Equilibrium Distribution of Electrons and Holes, The n_0p_0 Product, The Fermi-Dirac Integral, Degenerate and Non degenerate Semiconductors, Statistics of Donors and Acceptors, Charge Neutrality, Position of Fermi Energy **Level.**

Module-II

(12 hours)

Carrier Transport Phenomena: Carrier Drift: Drift Current Density, Mobility Effects, Conductivity, Velocity Saturation, Carrier Diffusion, Graded Impurity Distribution, The Hall Effect

Non-equilibrium Excess Carriers in Semiconductors: The Semiconductor in Equilibrium, Excess Carrier Generation and Recombination, Characteristics of Excess Carriers, Continuity Equations, Time-Dependent Diffusion Equations, Ambipolar Transport Quasi-Fermi Energy Levels, Excess Carrier Lifetime, Surface Effects

The pn Junction: Basic Structure of the pn Junction, Zero Applied Bias: Built-in Potential Barrier, Electric Field, Space Charge Width, Reverse Applied Bias: Space Charge Width and Electric Field , Junction Capacitance, One-Sided Junctions , Junction Breakdown, Non uniformly Doped Junctions: Linearly Graded Junctions

The pn Junction Diode: pn Junction Current, Small-Signal Model of the pn Junction, Diode current equation, Junction breakdown, Charge Storage and Diode Transients: The Turn-off Transient, The Turn-on Transient.

Metal-Semiconductor and Semiconductor Hetero junctions: The Schottky Barrier Diode, Metal-Semiconductor Ohmic Contacts, Hetero-junctions

Module-III

(10 hours)

The Bipolar Transistor: The Bipolar Transistor Action, Minority Carrier Distribution, Transistor Currents and Low-Frequency Common-Base Current Gain, Nonideal Effects, Equivalent Circuit Models, Frequency Limitations, Large-Signal Switching

B.Tech (E&IE/AE&I) detail Syllabus for Admission Batch 2015-16

The Junction Field-Effect Transistor: JFET Concepts: Basic pn JFET Operation, Basic MESFET Operation, The Device Characteristics, Nonideal Effects, Equivalent Circuit and Frequency Limitations.

Metal–Oxide–Semiconductor Field-Effect Transistor: The Two-Terminal MOS Structure: Energy-Band Diagrams, Depletion Layer Thickness, Surface Charge Density, Work Function Differences, Flat-Band Voltage, Threshold Voltage, Capacitance–Voltage Characteristics, The Basic MOSFET Operation, Frequency Limitations, The CMOS Technology, Nonideal Effects, MOSFET Scaling, Threshold Voltage Modifications.

Text Books:

1. *Solid State Electronic Devices, 7th Edition, Ben. G. Streetman and Sanjay Banarjee, Pearson Education, New Delhi.*
2. *Semiconductor Physics and Devices, 4th Edition, Donald A. Neamen and Dhruves Biswas, Tata McGraw Hill Publishing Company Limited, New Delhi.*

Reference Books:

1. *Solid State Devices and Materials, R.K.Singh & D.S.Chauhan, Wiley India.*
2. *Fundamentals of Semiconductor Devices, M.K. Achuthan and K.N. Bhatt, Tata McGraw Hill Publishing Company Limited, New Delhi.*
3. *Principle of Semiconductor Devices, 2nd Edition, Sima Dimitrijevic, Oxford University Press, New Delhi.*
4. *Semiconductor Device Modeling With SPICE, 2nd Edition, Giuseppe Massobrio and Paolo Antognetti, Tata McGraw Hill Publishing Company Limited, New Delhi.*
5. *Physics of Semiconductor Devices, 3rd Edition, S.M. Sze and Kwok K. Ng, Wiley India Pvt. Limited, New Delhi.*
6. *Solid State Electronics Devices, D.K. Bhattacharya and Rajnish Sharma, Oxford University Press, New Delhi.*