EB/EC/EE/EI 305 Solid State Electronics & Circuits

Module I

Band theory of solids - Conductors, semiconductors and insulators - energy band diagram - Semiconductor materials and their properties: elemental semiconductors - the energy band model of semiconductors. valance band model of semiconductor equilibrium concentration of electrons and holes - the fermi level and energy distribution of carriers inside the bands - temperature dependence of carrier concentration inside the bands. - Carrier transport in semiconductors - drift of carriers in electric fields, carrier flow by diffusion - constancy of fermi level across junction, Excess carriers in semiconductors - injection of excess carriers - recombination of excess carriers - continuity equation - current flow equation.

Module II

PN junction- Abrupt PN junction - energy band diagram - barrier potential, biasing PN junction, excess carrier calculation - current components diffusion - drift - boundary conditions for long and short diodes - PN junction characteristics - calculation of diffusion - depletion layer capacitance - simple model - principle of Zener and avalanche diodes - photodiodes -LDR - tunnel diode and PIN diode - varactor diode.

Module III

Bipolar junction transistors - NPN, PNP types , Basic structures - biasing - mechanism of carrier flow - current components in transistors boundary conditions in active region - solution for short base width - base width modulation - Transistor configurations - Characteristics - current amplification factors - relations between alpha & beta - comparison Ebbers - Moll model - Field effect transistors : JFET - basic structures - principle of operation - Characteristics and current equation - basic principles of phototransistors - UJT, characteristics.

Module IV

MOSFET - semiconductor surfaces - C-V characteristics - the Si - SiO2 System - basic structures and operating principles - current equation - V-I characteristics - simple model - CMOS. Compound semiconductor - semiconductor heterojunctions - V-I characteristics - real heterojunctions - frequency limitation of transistor - transit time effect - heterojunction bipolar transistor.

Module V

DC power supplies - power transformers - rectification - half wave, full wave, bridge - expression for ripple factor, efficiency, comparison, diode ratings. filters - capacitor - inductor LC filters- use of bleeder resistor - voltage multipliers - dual power supplies - simple voltage regulator. Series regulators - IC regulators.

Text Books:-

1) Ben G. Streetman and Sanjay Kumar Banerjee, *Solid State Electronic Devices*, 6th International Edition, Prentice Hall India, 2005., (Module I to IV)
2) K. Venkata Ramanan, *Functional Electronics*, 1st Edition, Tata McGraw Hill, New Delhi, 2004. (Module V)

References:

1.) Robert F. Pierret, *Advanced Semiconductor Fundamentals*, 2nd Edition, Prentice Hall, 2002.
2.) Sima Dimitrijev, *Principles of Semiconductor Devices*, Oxford University Press, New

York, 2006.

3.) Yannis Tsvidis, *Operation and Modeling of the MOS Transistor*, 2nd Edition, McGraw Hill, 1999.
4.) S. M. Sze, *Physics of Semiconductor Devices*, 2nd Edition, Wiley Interscience, 1981.
5.) Andy S. Grove, *Physics and Technology of Semiconductor Devices*, John Wiley, 1967 .
6.) Betty Lise Anderson and Richard L. Anderson, *Fundamentals of Semiconductor Devices*, 1st Edition, McGraw-Hill, 2004.
7.) Richard P. Feynman, R. B. Leighton, and M. Sands, *The Feynman Lectures on Physics: Quantum Mechanics*, Addison-Wesley, Reading, MA, 1965.
8.) Robert F. Pierret, *Semiconductor Device Fundamentals*, 2nd Revised Edition, Addison Wesley, Reading, MA, 1996.
9.) Michael S. Shur, *Physics of Semiconductor Devices*, 1st Edition, Prentice Hall, 1990.
10.)Richard S. Muller and Theodore I. Kamins, *Device Electronics for Integrated Cir cuits*, 3rd Edition, Wiley, New York, 2003.
11.)Sima Dimitrijev, *Understanding Semiconductor Devices*, Hardback, Oxford University Press, 2000.
12.)Manijeh Razeghi, *Fundamentals of Solid State Engineering*, 2nd Edition, Springer, 2006.
13.)Charles Kittel, *Introduction to Solid State Physics*, 7th Edition, Wiley, New York, 1996.
14.)Shyh Wang, *Fundamentals of Semiconductor Theory and Device Physics*, Prentice Hall, 1989.
15.)John Philip McKelvey, *Solid State and Semiconductor Physics*, Harper and Row, New York, 1966.