Introduction and Motivation:

The Solid State Devices is a Group Elective course in the B.Tech(ICT) program designed to give an introduction to Silicon Devices, primarily MOSFETs which are currently commercially the most important family of devices. While the characteristics of such devices are discussed in the set of Foundation courses required to be taken by all DA-IICT students, the physical principles are discussed in this elective course. Some introduction to other solid state devices of interest to Communication engineers like lasers and LEDs and some ideas of silicon planar CMOS technology are also discussed.

The elective is recommended for all students interested in pursuing a career related to Electronic hardware, particularly research. The fundamentals of device physics are of considerable importance in high quality circuit design, particularly for analog circuit design. Till recently, this had been part of the compulsory program; today, due to the information explosion particularly in the three key areas of Electronics, Communication Engineering and Computer Science, it has become an elective course. Nevertheless, it is strongly recommended for all students seeking to be an expert in Electronics.

Course Outline:

- Properties of Semiconductors
  - Review of Maxwell Equations, Poisson and Continuity Equation
  - Crystal structure, Miller Indices
  - Quantum mechanics, One dimensional crystal, Direct and Indirect Band-gap semiconductors, Density of State function & FD Statistics
  - Carrier concentrations, Current Flow in Semiconductors, Diffusion current, Direct and Indirect recombination, Continuity Equation Solutions
- Semiconductor devices with an emphasis on silicon
  - P-n junctions
  - Diodes and zeners, tunnel diodes
  - Metal semiconductor junctions
  - MOS Capacitor
  - MOSFET
  - Short Channel Effects
  - BJT
- Other Semiconductor Devices
  - P-n-p-n structures
  - Optoelectronic devices
- Introduction to silicon planar technology
  - CMOS processes
• Technology Scaling

Text books:
– Microelectronic Devices – D. Nagchoudhuri
– Semiconductor Devices – Jasprit Singh
– Semiconductor Physics and Devices- D. A. Neamen