

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI- HYDERABAD CAMPUS  
**FIRST SEMESTER 2023-2024**  
**COURSE HANDOUT PART II**

Date: 11/08/2023

In addition to Part-I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

**Course No.** : **EEE F216**  
**Course Title** : **Electronic Device Simulation Laboratory**  
**Instructor-in-charge** : **Dr. Sayan Kanungo**  
**Co-Instructor** : **None**  
**Pre-requisite of the Course:** Electronic Devices (F-214)

**Textbooks:**

1. Lab Manual on Electronic Devices and Sentaurus Device User Guide
2. Wu, Yung-Chun, Jhan, Yi-Ruei, 3D TCAD Simulation for CMOS Nano-electronic Devices, Springer
3. Ben Streetman and Sanjay Banerjee, Solid State Electronic Devices.

**1. Scope and objective:**

The proposed elective undergraduate-level course is intended to offer a design-level understanding of the basic electronic devices, an essential requirement for engineers working in different abstraction levels of VLSI design. The laboratory-based course will guide the students in developing hands-on exposure and a basic skill set in numerical device simulation and device design based on the electrostatics and electronic transport aspects of electronic devices. Furthermore, as a part of this course, emphasis will be given to the analysis of the challenges involved in device design for scaled-down technology nodes and their mitigation through different innovative device design approaches.

In this course, the theoretical characterization of materials properties of interest for device design will be briefly introduced using the density functional theory (DFT) based calculation. Subsequently, the underlying physics of electronic devices will be methodically explored in a laboratory environment using an industry-level numerical device simulation package like Sentarus TCAD. A brief project component will be introduced at the final stage of this course to encourage students to apply their understanding of real-world device design problems. Finally, visits and familiarization in clean room environments should develop an overall understanding and exposure to present-day device design scenarios.

**2. Course Description:**

The laboratory classes will be conducted in the VLSI CAD Lab. The experiments are intended to provide hands-on experience with the concepts learned in the Electronic Devices Course. Details of the experiments will be available in the "Laboratory Manual." Laboratory marks mentioned includes marks for record and attendance in lab practical and Project. The Students are expected to do a course project which would strengthen the analytical thinking ability of the student in Electronic Devices.

**List of Experiments**

**Part 1- Theoretical Characterization of Materials**

1. Structural Properties of Semiconductors (X-ray Diffraction and Transmission Electron Microscopy basics)
2. Calculating the E-K diagram and Density of States of Semiconductors using Burai

**Part 2 - Introduction and Design of Basic Electronic Devices**

3. Understanding the Electrostatics of p-n Junction
4. Forward and Reverse Bias I-V Characteristics of p-n Junction
5. Design Optimization of p-n Junction
6. Electrostatics of MOS Capacitor
7. C-V Characteristics of MOS Capacitor
8. Design Optimization of MOS Capacitor
9. Electrostatics of MOSFET- Effects of Source/Drain Terminals
10. I-V characteristics of MOSFET

11. Extraction of relevant performance matrices (trans-conductance, threshold-voltage, sub-threshold swing, leakage current, and drain-induced barrier lowering)
11. Design Optimization of MOSFET

### **Part 3 - Present Scenario and Challenges in Device Design**

13. Characterization of the Effects of MOSFET Downscaling
14. SOI and Multi-gate MOSFET architectures
15. Project

#### **Evaluation Scheme:**

<b>Component</b>	<b>Duration</b>	<b>Weightage (%)</b>	<b>Date &amp; Time</b>	<b>Nature of Component</b>
Laboratory Practical Regular classwork	4 hours/ week	30%	Regular lab Performance	Open Book
Project/Assignment		20%	TBA	Open Book
Lab Quiz		10%	TBA	Closed Book
Lab Exam (Mid-Sem and Comprehensive)		40%	TBA	Closed Book

3. **Notices:** Notices concerning this course will be on CMS.

**Dr. Sayan Kanungo**  
**Instructor-in-Charge**