BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI- HYDERABAD CAMPUS
SECOND SEMESTER 2021-2022
COURSE HANDOUT PART II

Date: 15/01/2022

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 : **Dr. Parikshit Sahatiya**
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 under graduate level course is intended to offer a design-level understanding of the basic electronic devices which is an essential requirement for engineers working in different abstraction level of VLSI design. The laboratory based course will guide the students in developing hands-on exposure and 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, emphasize will be given on 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 industry-level numerical device simulation package like Sentarus TCAD. A brief project component would be introduced at the final stage of this course to encourage students to apply their understanding for real world device design problems. Finally, visits and familiarization in clean room environment should develop an overall understanding and exposure for present day device design scenario.

2. Course description:

The laboratory classes will be conducted in the VLSI CAD Lab. The experiments are intended to provide hands-on experience on 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:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Laboratory Practical Regular class work	4 hours/ week	30%	Regular lab Performance	Open Book
Project/Assignment		25%		
Lab Quiz		20%		
Lab Exam		25%		

3. **Notices**: Notices concerning this course will be on CMS.
4. **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Dr. Sayan Kanungo
Instructor-in-Charge