SEMICONDUCTOR DEVICES AND CIRCUITS

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PRE-REQUISITES : A background in electrical engineering helps to some extent, but this is not required

INTENDED AUDIENCE : Graduate and Senior Undergraduate Students pursuing studies in Electrical/Electronic Engineering, Electronic Materials, Physics

INDUSTRIES APPLICABLE TO : Companies working in semiconductors and integrated circuits: Intel, AMD, Samsung, Texas Instruments, Analog Devices etc.

COURSE OUTLINE :

This course is intended to equip any students interested in electronic materials and devices with the fundamentals of semiconductor devices. The materials covered in the course begins with fundamentals and accelerates to advanced topics in semiconductor physics. The course connects circuit performance to material and device behavior.

At the end of the course, the students would learn to:

1.) Learn the important concepts related to semiconductor technology.

2.) Perform the analysis and design of semiconductor devices (electrostatics and current-voltage characteristics) from fundamental principles.

3.) Learn how to extract device parameters by suitable experiments.

4.) Engineer and innovate on device design and even construct new devices intended for special applications in circuits. There is special emphasize placed on this aspect.

5.) Learn the fundamentals of circuit design and observe how device properties and device design impact circuit behaviour (eg. dc and ac response, noise)

6.) Extend the concepts and analysis to advanced topics such as: devices based on disordered semiconductors (eg. organic semiconductors, amorphous metal oxides), flexible and printed electronics, etc.

ABOUT INSTRUCTOR :

Prof. Sanjiv Sambandan is an Associate Professor at the Department of Instrumentation and Applied Physics, Indian Institute of Science Bangalore, India. He is also cross-appointed at the Department of Engineering, University of Cambridge, Cambridge, UK. Prior to taking up academic positions, he was with the Electronic Materials and Device Lab, Xerox Palo Alto Research Centre (PARC), Palo Alto, California, USA. He is also the founder and director of openwater, a clean water startup from his lab (www.openwater.in).

COURSE PLAN :

Week 1 : Excursion in Quantum Mechanics

Week 2 : Excursion in Solid State Physics

Week 3 : Density of States, Fermi Function and Doping

Week 4 : Recombination-Generation, Charge Transport and Continuity Equation

Week 5 : Metal-Semiconductor (MS) Junctions

Week 6 : PN Junctions

Week 7 : Bipolar Junction Transistors (BJT)

Week 8 : Metal Oxide Semiconductor Capacitors (MOSCAP) and CV Characteristics

Week 9 : Metal Oxide Semiconductor Field Effect Transistors (MOSFET)

Week 10 : MOSFET Continued

Week 11 : Connections: Circuit Design to Device Physics

Week 12 : Thin Film Transistors