



# FUNDAMENTALS OF ELECTRONIC MATERIALS AND DEVICES

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**INTENDED AUDIENCE :** Preferable undergraduates and graduate students in Chemical, Chemistry, Computer science, Electrical, Mechanical, Metallurgy, Materials, and Physics. Working professionals in the electronics industry can also take this course.

**INDUSTRIES APPLICABLE TO :** Students aiming to join semiconductor and electronic device companies will value this course.

### COURSE OUTLINE :

This online course has been running for the last three years (since 2016). Its primary aim is to provide a basic understanding of the materials and devices used in the current semiconductor industry. The course is designed for undergraduate and graduate students from diverse backgrounds. Anyone interested in understanding how semiconductors work and how they form an integral part of today's electronic industry can take this course. The course provides the students with the basic physics of semiconductor materials. It also covers device fundamentals with emphasis on their electronic characteristics. Opto-electronic devices such as LEDs, lasers, solar cells, and their properties will also be explained.

### ABOUT INSTRUCTOR :

Prof. Parasuraman Swaminathan is an Associate Professor in the Department of Metallurgical and Materials Engineering (MME), IIT Madras. He joined the institute in 2013. He has a B. Tech and M. Tech dual degree in MME from IIT Madras, and a PhD in Materials Science from the University of Illinois at Urbana-Champaign, USA. He then did a post doc in Johns Hopkins University and National Institute of Standards and Technology (NIST), USA on microelectronics device fabrication. He also worked in Intel Corp. for two years, primarily in their development fab facility. His research group is called the Electronic Materials and Thin Films group and they work in the area of printed electronics and thin film deposition. His research page can be accessed at <https://mme.iitm.ac.in/swamnthn>. Dr. Parasuraman has been offering this online course since 2016. He has published a textbook in this topic.

### COURSE PLAN :

**Week 1:** Introduction, Energy bands in solids, Semiconductors band gap formation

**Week 2:** Problem set on week #1 and Intrinsic semiconductors.

**Week 3:** Extrinsic semiconductors, Fermi level variations, and conductivity.

**Week 4:** Problem set on week #3. Metal-semiconductor junctions and Introduction to pn junctions

**Week 5:** pn junctions under bias, Junction breakdown, and Heterojunctions. Problem set on weeks 4 & 5.

**Week 6:** Transistors, Types of transistors, MOSFETs, Problem set on week #6.

**Week 7:** Optoelectronic devices – Introduction. LEDs and Lasers.

**Week 8:** Photo detectors and solar cells. Problem set on opto electronic devices, week #7 and 8.