



# MICROELECTRONICS: DEVICES TO CIRCUITS

**PROF.SUDEB DASGUPTA**

Department of Electronics & Communication Engineering  
IIT Roorkee

**TYPE OF COURSE** : Rerun | Core\_Elective | PG/UG

**COURSE DURATION** : 12 weeks (2<sup>nd</sup> Jul'2F - F<sup>irst</sup> Oct'2F)

**EXAM DATE** : G I Oct 202F

**INTENDED AUDIENCE** : Undergraduate students in Electronics and Communication Engineering

**REQUIREMENTS** : Basic knowledge of Semiconductor Devices and Digital Electronics. A course on Computer Organization will be also helpful (though not strictly required).

**INDUSTRIES APPLICABLE TO** : Cadence; Synopsys; ST Microelectronics; NXP Semiconductors; Semiconductor Complex Limited; Design House in general

### COURSE OUTLINE :

This course aligns with the core courses in Electronics Circuits taught to undergraduates in Electrical and Computer Engineering. The objective of this course is to develop the ability to analyse and design electronic circuits both analog and digital, discrete and integrated. The course starts with the basics of the device most seldom encountered in mixed designs and then go on to do circuit analysis in the later parts.

### ABOUT INSTRUCTOR :

Prof. S. Dasgupta is presently working as an Associate Professor, in Microelectronics and VLSI Group of the Department of Electronics and Communication Engineering at Indian Institute of Technology, Roorkee. He received his PhD degree in Electronics Engineering from Institute of Technology-Banaras Hindu University (currently IIT-BHU), Varanasi in 2000.

### COURSE PLAN :

**Week 1** : Introduction to Semiconductor Devices, Basic Semiconductor Physics, Carrier Transport, PN Junction Diode, Bipolar Junction Transistor (BJT) and MOSFET.

**Week 2** : Small Signal Model of BJT and MOSFET, Frequency Response of BJT and MOSFET.

**Week 3** : Frequency Response of BJT and MOSFET (continued), Frequency Response of BJT and MOSFET (continued).

**Week 4** : Biasing of MOS Amplifier and its behavior as an analog switch, CMOS CS/CG/SF Amplifier Configuration, Internal cap models and high frequency modelling, JFET, structure and operation.

**Week 5** : Multistage and Differential Amplifier, Small Signal Operation and Differential Amplifier, MOS Differential Amplifier, BiCMOS Amplifier with Active Load, Multistage Amplifier with SPICE Simulation

**Week 6** : s-domain analysis, transfer function, poles and zeros, High Frequency Response of CS and CE Amplifier, Frequency Response of CC and SF Configuration, Frequency Response of the Differential Amplifier.

### Cascode Connection and its Operation

**Week 7**: General Feedback structure and properties of negative feedback, Basic Feedback Topologies, Design of Feedback Amplifier for all configuration, Stability and Amplifier poles, Bode Plots and Frequency Compensation

**Week 8** : Ideal Operational Amplifier and its terminals, Inverting and Non- Inverting Configuration, As an integrator and Differentiator, Introduction to Analog Computer, Large Signal Operation of Op Amp and Second order offsets.

**Week 9** : Butterworth and Chebyshev Filters, First and Second Order Filter Functions, Switched Capacitor based filters, Single-Amplifier Biquadratic Filters, Second Order LCR Resonator.

**Week 10** : Combinational Logic Design-I,II,III & IV

**Week 11** : Sequential Logic Design

**Week 12** : Clock Strategies for Sequential Design