Course Title	MOS Modeling for VLSI Circuits	Course No			
Specialization	Electronics Engineering	Structure (IPC)	3	0	3
Offered for	EDM / EVD / EDS	Status			
Pre-requisite	CoT	To take effect from			
Objectives	Explain and apply basic concepts of semiconductor physics relevant to devices, Explain, describe, and use physics-based device and circuit models for semiconductor devices of varying levels of complexity, select models appropriate to a specific need, and apply those models to analyze multi-component circuits				
Course Outcomes	Explain the equations, approximations, and techniques available for deriving a model with specified properties, for a general device characteristic with known qualitative theory, Offer clues to the the qualitative understanding of the physics of a new device and conversion of this understanding into equations, Simulate characteristics of a simple device using tools.				
Contents of the course	Intuitive analysis of MOS Transistor- Two-Terminal MOS Structure – Flatband Voltage, Surface Condition, General Analysis, Inversion, Strong Inversion, Weak Inversion, Small-Signal Capacitance, Three-Terminal MOS Structure (4) Long-Channel MOS Transistor, Introduction All-Region Models, Strong Inversion Models, Weak Inversion Models, Source Reference vs. Body Reference, Effective Mobility (5) Small-Dimension Effects- Velocity Saturation, Channel Length Modulation, Charge Sharing, Drain-Induced Barrier Lowering, Hot Carrier Effects, Velocity Overshoot and Ballistic Operation, Polysilicon Depletion (4) Small-Dimension Effects-Modeling for Circuits Simulation- Quantum-Mechanical Effects; Gate Current, Junction Leakage, Scaling and New Technologies, Approaches, and Properties of Good Models, Model Formulation Considerations, Parameter Extraction, Compact Models, Benchmark Tests (6) Large-Signal Dynamic Operation: Quasi-Static Operation, Terminal Currents in QS Operation, Charging Currents in QS Operation, Evaluation of Charges, Transit Time, Transient Response Using QS Modeling, Non-Quasi-Static Operation, Extrinsic Parasitics (6) Small-Signal Modeling- Conductance Parameter Definitions and Equivalent Circuits, Conductance Parameters Due to Gate and Body Leakage, Transconductance, Source-Drain and Output Conductance, Capacitance Definitions and Equivalent Circuits, Capacitance Evaluation and Properties, y-Parameter Model, Non-Quasi-Static Model, Model Comparison, RF Models (12) Noise – Introduction, Thermal Noise, High-Frequency Considerations, Flicker Noise, Ion Implantation – Threshold Adjust Implant, Halo Implants, Well Proximity Effect, Stress Effects (5)				
Text Books	1. Y. Tsividis and C. McAndrew, MOSFET modeling for Circuit Simulation, Oxford University Press, 2011.				
References	1. BSIM Manuals available on BSIM homepage on the internet. 2. T. A. Fjeldly, T. Ytterdal and M. Shur, Introduction to Device Modeling and Circuit Simulation, John Wiley, 1998. 3. Y. Taur and T. H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 1998. 4. Y. P. Tsividis, Mixed Analog-digital VLSI Devices and Technology, World Scientific Publishing Co Pte Ltd, 2002				