GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. Semester: I

Signal Processing and VLSI Technology(EC)

Subject Name: **Physics of MOS Transistor (Major Elective – I)**

Sr.No	Course content
1.	**Semiconductors, Junctions, and MOSFET Overview:** Semiconductors, Conduction, Contact Potentials, *pn* junction, Overview of MOS Transistor
2.	**Two-Terminal MOS Structure:** Introduction, Flat-band voltage, Potential and Charge balance, Effect of Gate-Substrate Voltage on Surface Condition, Regions of Inversion and Analysis, Small-Signal Capacitances
3.	**Three-Terminal MOS Structure:** Introduction, Contacting the Inversion layer, Body effect, Regions of Inversion and Mathematical Analysis, Study of MOS Structure from "VCB" Control Point of View
4.	**Four-Terminal MOS Structure:** Transistor Regions of Operation, General Charge Sheet Models, Strong Inversion, Weak Inversion, Moderate Inversion, Interpolation Models, Source Referenced versus Body Referenced Modeling, Effective Mobility, Temperature Effects, Breakdown, p-channel MOS Transistor, Enhancement-Mode and Depletion-Mode Transistors, Model Parameter Values, Model Accuracy, Model Comparison
5.	**Small-Dimension Effects:** Introduction, Channel Length Modulation, Barrier Lowering, Two-Dimensional Charge Sharing, Threshold Voltage, Punch-through, Carrier Velocity Saturation, Hot Carrier Effects, Scaling, Effects of Surface and Drain Series Resistances, Effects due to Thin Oxides and High Doping
6.	**The MOS Transistor in Dynamic Operation – Large-signal Modeling:** Introduction, Quasi-static Operation, Terminal Currents in Quasi-static Operation, Evaluation of Charges in Quasi-static Operation, Transit Time under DC Conditions, Limitations of the Quasi-static Modeling, Non-Quasi-Static Modeling
7.	**MOSFET Modeling for Circuit Simulation:** Introduction, Types of Models, Combining Several Effects into One Physical Model, Parameter Extraction, Accuracy, Properties of Good Models, General Considerations, Benchmark Tests, Nontechnical Considerations

Reference Books:

1. Operation and Modeling of The MOS Transistor, Y. Tsividis
2. S. M. Sze, Physics of Semiconductor Devices, (2e), Wiley Eastern
3. N. D. Arora, MOSFET Models for VLSI Circuit Simulation, Springer-Verlag