

Course Code	ECE 518			
Course Name	Solid State Devices			
Credits	4			
Course Offered to	UG/PG			
Course Description	This course provides fundamental knowledge required for many other courses in Analog, digital and Mixed signal IC design (Analog CMOS Circuit Design, Mixed Signal Design, Low Power Design and Digital VLSI Design). The course starts with an overview of semiconductors and their conduction mechanism. Then explains PN junction formation and operation of various types of two terminal semiconductor devices and BJTs. The discussion will be extended to MOSCAP and MOSFETs, which are very important elements in the modern IC design. In addition MOSFET short channel effects will also be explained as they are becoming highly significant with technology scaling. Fabrication process will also be covered.			
Pre-requisites				
Pre-requisite (Mandatory)	Pre-requisite (Desirable)	Pre-requisite (Other)		
Basic Knowledge on semiconductors	None			
Post Conditions				
CO1	CO2	CO3	CO4	CO5
Students are able to understand the relation between terminal characteristics and process parameters	Students are able to analyze current-voltage characteristics of the pn-junction diode	Students are able to understand working principles of various types of two terminal devices and BJT	Students are able to understand the MOSCAP operation. Determine small signal parameters, analyze current-voltage characteristics of the MOSFET and able to implement passive elements (resistor and capacitor) with MOSFETs.	Students are able to understand device fabrication and short channel effects of the MOSFETs
Weekly Lecture Plan				
Week Number	Lecture Topic	COs Met	Assignment/Labs/Tutorial	
Week 1, 2	Introduction to Semiconductors, Energy bands, intrinsic and extrinsic Silicon Carrier transport in Silicon: Diffusion current, drift current, mobility, Resistivity, Generations and recombination of carriers, excess carriers (6)	CO1	Assignment - Problems	
Week 3, 4	PN junction diode ideal and non-ideal characteristics Forward bias, reverse bias, breakdown, tunneling, ohmic contacts, near ohmic contacts (6)	CO2	Assignment - Problems	
Week 5, 6	Schottky diode, Light emitting diode, photo diode BJTs: IV characteristics, small signal model, high frequency models, breakdown (6)	CO3		
Week 7, 8, 9, 10	MOS capacitors, MOSFET ideal and non-ideal characteristics, inversion, accumulation, threshold voltage, small signal models, triode and saturation, sub-threshold conduction (12)	CO4	Assignment - Problems	
Week 11,12, 13	Device fabrication, Short channel effects: Charge sharing, DIBL, velocity saturation, hot carriers (9)	CO5		
Assessment Plan				
Type of Evaluation	% Contribution in Grade			
Mid-Sem	20			
Assignment	10			
Quiz	10			
Group Seminar	20			
End-sem	40			
Resource Material				
Type	Title			
Textbook	1. Ben Streetman and Sanjay Bannerjee, Solid State Electronic Devices, Prentice-Hall			
Textbook	2. J. Singh, Physics of Semiconductors and their Heterostructures, John Wiley & Sons			
Textbook	3. Yannis Tsidis and Colin McAndrew , "Operation and Modeling of the MOS Transistor", Third edition			
Textbook	4. M. S. Tyagi, "Introduction to Semiconductor Materials and Devices". Wiley Student Edition.			