

COURSE CODE	COURSE NAME	L-T-P-C	YEAR OF INTRODUCTION
EC203	SOLID STATE DEVICES	3-1-0-4	2016
Prerequisite: Nil			
Course objectives:			
<ul style="list-style-type: none"> To provide an insight into the basic semiconductor concepts To provide a sound understanding of current semiconductor devices and technology to appreciate its applications to electronics circuits and systems 			
Syllabus: Elemental and compound semiconductors, Fermi-Dirac distribution, Equilibrium and steady state conditions: Equilibrium concentration of electrons and holes, Temperature dependence of carrier concentration, Carrier transport in semiconductors, High field effects, Hall effect, Excess carriers in semiconductors, PN junctions, contact potential, electrical field, potential and charge density at the junction, energy band diagram, minority carrier distribution, ideal diode equation, electron and hole component of current in forward biased pn junction, piecewise linear model of a diode, effect of temperature on VI characteristics, Diode capacitances, electrical breakdown in pn junctions, Tunnel Diode, Metal semiconductor contacts, bipolar junction transistor, metal insulator semiconductor devices, MOSFET, FinFET			
Expected outcome:			
The students should have a good knowledge in semiconductor theory and electronic devices.			
Text Books:			
<ol style="list-style-type: none"> Ben G. Streetman and Sanjay Kumar Banerjee, Solid State Electronic Devices, Pearson, 6/e, 2010 Achuthan, K N Bhat, Fundamentals of Semiconductor Devices, 1e, McGraw Hill, 2015 			
References:			
<ol style="list-style-type: none"> Tyagi M.S., Introduction to Semiconductor Materials and Devices, Wiley India, 5/e, 2008 Sze S.M., Physics of Semiconductor Devices, John Wiley, 3/e, 2005 Neamen, Semiconductor Physics and Devices, McGraw Hill, 4/e, 2012 Pierret, Semiconductor Devices Fundamentals, Pearson, 2006 Rita John, Solid State Devices, McGraw-Hill, 2014 Bhattacharya .Sharma, Solid State Electronic Devices, Oxford University Press, 2012 Dasgupta and Dasgupta, Semiconductor Devices : Modelling and Technology (PHI) 			
Course Plan			
Module	Course content (48hrs)	Hours	Sem. Exam Marks
I	Elemental and compound semiconductors, Fermi-Dirac distribution, Equilibrium and steady state conditions, Equilibrium concentration of electrons and holes, Temperature dependence of carrier concentration	4	15
	Carrier transport in semiconductors, drift, conductivity and mobility, variation of mobility with temperature and doping, High Field Effects, Hall effect	5	
II	Excess carriers in semiconductors: Generation and recombination mechanisms of excess carriers, quasi Fermi levels, diffusion, Einstein relations, Continuity equations, Diffusion length, Gradient of quasi Fermi level	9	15
FIRST INTERNAL EXAM			

III	PN junctions : Contact potential, Electrical Field, Potential and Charge density at the junction, Energy band diagram, Minority carrier distribution, Ideal diode equation, Electron and hole component of current in forward biased p-n junction, piecewise linear model of a diode effect of temperature on V-I characteristics	9	15
IV	Diode capacitances, switching transients, Electrical Breakdown in PN junctions, Zener and avalanche break down (abrupt PN junctions only), Tunnel Diode basics only, Metal Semiconductor contacts, Ohmic and Rectifying Contacts, current voltage characteristics	9	15
SECOND INTERNAL EXAM			
V	Bipolar junction transistor , current components, Minority carrier distributions, basic parameters, Evaluation of terminal currents (based on physical dimensions), Transistor action, Base width modulation	9	20
VI	Metal Insulator semiconductor devices: The ideal MOS capacitor, band diagrams at equilibrium, accumulation, depletion and inversion, surface potential, CV characteristics, effects of real surfaces, work function difference, interface charge, threshold voltage MOSFET: Output characteristics, transfer characteristics, sub threshold characteristics, MOSFET scaling (basic concepts)	9	20
	FinFET- structure and operation	1	
END SEMESTER EXAM			

Question Paper Pattern (End Sem Exam)

Maximum Marks: 100

Time : 3 hours

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark pattern is according to the syllabus with maximum 70 % for theory, derivation, proof and 30% for logical/numerical problems.