National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Master of Technology in VLSI and Embedded Systems**	Year of Regulation	**2018-19**
Department	**Electronics and Communication Engineering**	Semester	**I**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EC 511	**Physics of Semiconductor**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes	
To develop the student's ability to understand the concepts of energy band, charge carriers and current conduction in semiconductors.	CO1	Able to understand the basic principles of semiconductor physics
To understand the basic concepts of PN junction, metal–semiconductor junction and hetero junctions and their current-voltage characteristics.	CO2	Able to analyze carrier densities and carrier transport in semiconductors
To understand the concepts of MOS (metal–oxide–semiconductor) structures, concepts of surface depletion, threshold and inversion using energy band diagrams and MOS capacitor-voltage characteristics.	CO3	Able to understand the working and utilize the basic governing equations to analyze semiconductor devices

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1	CO1	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**0**
2	CO2	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**0**
3	CO3	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**1**	**0**	**0**

SYLLABUS

No.	Content	Hours	COs
I	Recapitulation from previous studies: Atomic bonding, covalent bonding, concept of holes, intrinsic and extrinsic semiconductors, silicon crystal structure, Review of quantum mechanics, Band formation of silicon and band gap energy, semiconductors, insulators and metals, E-k diagrams, direct and in-direct band gap semiconductors, Electrons and holes in semiconductors, Density of states, Fermi-Dirac density function, carrier concentrations, energy band diagrams	10	CO1
II	Transport of carriers: Mobility and scattering, drift, diffusion, generation and recombination in semiconductors, Excess carriers, carrier life time. Quasi energy levels, continuity equation, steady state carrier injection and diffusion length	8	CO2
III	PN junction under zero bias, formation of depletion region, contact potential, equilibrium Fermi levels, built-in electric field and space-charge width, forward and reverse bias, drift and diffusion currents in biased junction, current expression of a diode, reverse bias breakdown, capacitance of pn junction, switching characteristics of a semiconductor diode.	8	CO3
IV	Metal-Semiconductor contacts, Schottky diode and ohmic contact, hetero-junctions, energy band diagrams and current voltage characteristics	4	CO3
V	Introduction to two terminal MOS capacitor, Basic operation without gate voltage and with positive and negative gate voltage, energy band diagrams, Accumulation , depletion and inversion regions, flat band voltage, charges in the oxide, interface traps, threshold voltage, capacitance-voltage characteristics of MOS structure.	6	CO3
	Total Hours	36	

Essential Readings

1. Hu C. C., "Modern Semiconductor Devices for Integrated Circuits", Pearson, Education, 1st Edition, 2010.
2. Donald A. Neamen, "Semiconductor Physics and Devices, Irwin publishers, 3rd Edition 2002.
3. Streetman and Banerjee, "Solid State Electronic Devices", Pearson Education, 6th Edition, 2007