Course Code	Course Title	L	T	P	C
1152EC144	SOLID STATE DEVICES	3	0	0	3

a) Course Category

Program Elective

b) Preamble

To impart knowledge on physics of semiconductors, transport of carriers in semiconductors and semiconductor based devices.

c) Prerequisite

Nil

d) Related Courses

Basic Electronics Engineering

e) Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on Revised Bloom's Taxonomy)
CO1	Understand the physics of semiconductors	K2
CO2	Understand the carrier transport mechanisms in semiconductors	K2
CO3	Gain a thorough understanding of PN junctions	K2
CO4	Analyze and understand the physics of operation of bipolar junction transistor	K2
CO5	Analyze and understand the physics of operation of MOS capacitor and MOSFET	K2

f)	Correlation of COs with POs													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														

CO4														
CO5														

g) Course Content

UNIT I Basics of Semiconductors 9

Energy bands – metals- semiconductors and insulators-direct and indirect semiconductors- Charge carriers in semiconductors: electrons and holes-intrinsic and extrinsic material-n-material and p-material- carrier concentration: fermi level- electron and hole concentrations at equilibrium-temperature dependence.

UNIT II Carrier Transport in Semiconductors 9

Conductivity and mobility- drift and resistance- effect of temperature and doping on mobility- high field effects, generation and recombination mechanisms of excess carriers: direct and indirect recombination-steady state carrier generation-quasi Fermi levels, Diffusion of carriers: diffusion processes-Einstein relations.

UNIT III PN Junctions 9

PN junctions: formation of junction, contact potential, electrical field, potential and charge density at the junction, space charge at a junction, energy band diagram, Ideal diode equation, electron and hole component of current in forward biased p-n junction, Reverse bias breakdown in p-n junctions:zener and avalanche break down.

UNIT IV Bipolar Junction Transistors 9

Bipolar transistor action: Basic principle of operation, modes of operation, amplification with bipolar transistors, minority carrier distributions: forward active mode, other modes of operation.

UNIT V Metal Insulator Semiconductor Devices and MOSFET 9

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, short channel effects.

Total 45 Hrs

h) Learning Resources

Reference Books

1. Ben G. Streetman and Sanjay Kumar Banerjee, Solid State Electronic Devices, Pearson, 6/e, 2010

2. Pierret, Semiconductor Devices Fundamentals, Pearson, 2006
3. Sze S.M., Physics of Semiconductor Devices, John Wiley, 3/e, 2005
4. Donald A. Neamen, Semiconductor Physics and Devices, McGraw Hill, 4/e, 2012
5. Achuthan, K N Bhat, Fundamentals of Semiconductor Devices, 1e, McGraw Hill,2015