Core-Course title: **Semiconductor Devices and Integrated Circuits**

Course Code*				
Credits	**4**			
Hours / Cycle	**6**			
Category	**Part III** **Core/** Theory			
Semester	**I**			
Year of Implementation	**From the academic year 2023-'24 onwards**			
Course Structure	Theory	Tutorial	Practical	Total Hours
	75	15		90
Course Objectives	On completion of the course, the student will be able to ▪ Know the physics and operating principle of basic and special semiconductor devices ▪ Understand IC fabrication technology ▪ Understand various wave shaping circuits of linear and non-linear types and memory storage devices.			

Course Outcome(s)**	PSO Addressed	Bloom's Taxonomy Levels (K1 to K6)
CO1: To remember and recall basics of semiconductor physics, IC technology, Op-Amp, timer, and storage devices	PSO1	K1
CO2: To understand the basic concepts underlying the working of semiconductor devices, principles involved in IC technology, digital gates, op-amp, timer, and memory devices	PSO1, PSO2	K2
CO3: To apply the physics of semiconductors to realize various processes and applications	PSO2, PSO3, PSO4	K3
CO4: To analyse the theoretical equations and experiments to apply to solve problems at different levels	PSO2, PSO3	K4
CO5: To evaluate concepts of semiconductor physics by learning the detailed theoretical background, processes, principles and working of devices	PSO2, PSO3	K5

* To be allotted by Examinations Office after the Approval of Academic Council
**Minimum 3 Maximum 5.

SYLLABUS: Semiconductor Devices and Integrated Circuits

UNIT	CONTENT	Hours	COs	Bloom's Taxonomy Level
I	**Physics of Semiconductor Devices:** Energy band theory of semiconductors-Density of electrons in conduction band – Density of holes in valence band – Fermi levels in intrinsic and extrinsic semiconductors – Drift and diffusion currents – Recombination and life time of minority carriers – Einstein's relation – Poisson's equation – energy band diagram of a PN junction diode – continuity equation – Application of continuity equation to junction diodes and transistors.	15	1,2,3,4,5	K1, K2, K3, K4 K5
II	**Special Semiconductor Devices:** FET: Field effect transistor – Physical interpretation of the characteristic curve – theory of JFET – FET biasing – common source and common drain amplifiers at low frequency – FET as voltage variable resistor. MOSFET: Depletion and Enhancement modes – MOSFET as switch and resistors – Dual gate MOSFET. TUNNEL DIODE: Quantum mechanical tunneling – Characteristics on the basis of energy band diagrams – Theory of tunnel diode – Applications of tunnel diode as switch amplifier and oscillator. GUNN DIODE: RWH mechanism – Explanation of RWH mechanism on the basis of electron transfer – negative relaxation time – Gunn effect – Modes of operation of Gunn diode. THYRISTORS: PNPN Diodes – construction – operation – characteristics – SCR construction and operation – characteristics – SCR as half wave and full wave rectifiers – Diac and Triac.	20	1,2,3,4,5	K1, K2, K3, K4, K5
III	**Ic Fabrication Technology** Monolithic IC Technology – Planar process – Fabrication of BJT, FET, and MOSFET – CMOS technology – monolithic diodes - Metal semiconductor contact – Integrated resistors, capacitors – Characteristics of IC components – VLSI – VHLD – Digital gates – MOSFET inverter, NOR, NAND gates – CMOS inverter, NOR, NAND gates.	10	1,2,3,4,5	K1, K2, K3, K4, K5

IV	**Linear Analog Circuits** DC Analysis of IC Op-Amp – Instrumentation amplifier – Transducer bridge – Instrumentation amplifier – Applications – Temperature indicator, Fluxmeter, ECG and weighing machine – Analog integrator, differentiator – Design of analog circuits for the solution of differential equation and simultaneous equations using Op-Amps – Sample and hold system – Analog multiplexer.	15	1,2,3,4,5	K1, K2, K3, K4, K5
V	**Non-Linear Analog Circuits** Wave shaping circuits – Precision AC/DC converts – Precision rectifiers – Precision clamp – Fast half wave, full wave rectifier – Active average detector – Active peak detector – logarithmic & exponential amplifiers – Logarithmic multiplier – Analog squaring & square root circuits. Comparators – Zero crossing detectors – Time marker generator – Multivibrators – astable (Square wave), Monostable (Pulse generator), Bistable (Schmitt trigger) circuits – Triangle wave generator – Timer 555 – Internal architecture and working – Monostable and astable operation – Voltage control oscillator (VCO) IC 566 – Active Butterworth filter - PLL concept – Phase locked loop IC 565 – Application – Frequency multiplier, FSK modulator and demodulator.	20	1,2,3,4,5	K1, K2, K3, K4, K5
VI	**Memory Circuits and Systems** Programming bipolar PROMs – AIM technique – Floating gate (FAMOS) – MOS static RAM cell – MOS dynamic RAM cell – Refreshing circuits – Charged coupled devices – Basic CCD operation – Two phase CCD – Magnetic bubble memory – Auxiliary memory storage – Magnetic disk, floppy disk and Wincester hard disk – CD –Laser R/W systems – Flash memory (memory stick)	10	1,2,3,4,5	K1, K2, K3, K4, K5

Prescribed Books/Text Books

1. S.M.Sze, Semiconductor devices Physics and Technology, John Wiley & Sons, (1985) New York.
2. Jacob Millman and Christos.C.Halkias, Integrated Electronics,TMH,(2005) NewDelhi.
3. Ramakant .A.Gayakwad, Op Amps and integrated circuits,4th Edition, EEE, (1994).
4. Taub and Shilling, Digital Integrated Electronics, Mc Graw-Hill, (1983) New Delhi,.

Reference Books

1. R.F.Coughin and F.F.Driscol, Opamp and linear integrated circuits, Prentice Hall Of India, (1996) New Delhi.
2. M.S.Tyagi, Introduction to semiconductor devices, John Wiley & Sons, New York.
3. P.Bhattacharya, Semiconductor Optoelectronic devices, 2nd edition, Prentice hall of India, (2002) New Delhi.
4. B.Somnath Nair, Digital electronics and Logic design, Prentice Hall Of India, (2002) New Delhi.

Suggested Reading

1. Malvino and Leach, Digital Principle and application 5th edition, TMH (2002) New Delhi.
2. R.L.Boylestad and L.Nashelsky, Electronic devices and circuit theory, 8th edition, Pearson Education (2003) New Delhi.

Web Resources

https://www.ti.com/seclit/ml/ssqu016/ssqu016.pdf

Semiconductor devices & Integrated circuits - Course Articulation Matrix

Course Outcomes	Programme Outcomes								Programme Specific Outcomes					Cognitive Level
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO 1	3	1	1				1		3	3	1	1		K1
CO 2	3	2	1				2		3	3	2	2		K2
CO 3	3	3	3				3				3	3		K3
CO 4	3	3	3				3				3	3		K4
CO 5	3	3	3				3				3	3		K5
Wt. Avg.														
Overall Mapping of the Course														

Identify the correlation of POs/PSOs to each CO and make a corresponding mapping table with assigning mark at the corresponding cell.