25ECMJ204: Electronics Devices and Semiconductor Technology

w. e. f. Academic Year:	**2026-27**
Semester:	**3**
Category of the Course:	**Program Core Course** (PCC).
Prerequisite:	Basic knowledge of Physics especially electricity and magnetism, fundamental concepts of electronic components, and an understanding of basic mathematics used in engineering analysis.
Rationale:	This course provides a foundational understanding of semiconductor physics and electronic devices such as diodes, transistors, and MOSFETs. It enables students to analyze the behavior and characteristics of these devices and understand their applications in circuits like rectifiers, amplifiers, and switching systems. The course also introduces modern semiconductor technology and CMOS design concepts, which are essential for VLSI and low-power electronics. This knowledge forms the basis for advanced studies in electronics, communication, and embedded systems.

Course Outcomes:
After Completion of the Course, Student will able to:

	Course Outcome (CO)	**RBT Level (Cognitive Domain)**	**Marks% Weightage (Approx.)**
CO1	Explain the fundamental concepts of semiconductor physics and charge transport mechanisms.	Understand (L2)	15%
CO2	Analyze the characteristics and applications of PN junction diodes and related devices.	Analyze (L4)	15%
CO3	Apply diode concepts in designing rectifiers, clipping, clamping, and power supply circuits.	Apply (L3)	20%
CO4	Analyze the construction, working principle, configurations (CB, CE, and CC), characteristics, biasing methods, and applications of junction transistors including amplifier and switching operations.	Analyze (L4)	25%
CO5	Understand MOSFET operation, CMOS technology, and their applications in VLSI systems.	Understand (L2)	25%

Teaching and Evaluation Scheme:

Teaching Scheme					**Examination Scheme**				
L	**T**	**P**	**C**	**Hrs/Week**	**IE**	**Theory**	**CIA**	**Practical**	**Total Marks**
3	0	2	4	5	40	60	30	20	150

IE: Internal Evaluation
CIA: Continuous Internal Assessment
Theory: Theory Exam (End Semester)
Practical: Practical Exam (End Semester)

Detailed Syllabus:

Topic		Hrs.	% of Weightage (Approx.)
UNIT: 1	**Semiconductor Fundamentals**:	**06**	**15%**
The Energy Band Theory of Crystals, Insulators, Semiconductors and Metals, Mobility, Charge Densities and Conductivity, Electrons and Holes in an Intrinsic Semiconductor, Donor and Acceptor Impurities, Hall Effect Sensors and their Applications, Conductivity Modulation.			
UNIT: 2	**PN Junction and Diode Basics:**	**05**	**15%**
Open-Circuited PN Junction, P-N Junction Diode with Volt-Ampere Characteristics, Transition Capacitance (CT) and Diffusion Capacitance, Rectifiers.			
UNIT: 3	**Diode Applications:**	**08**	**20%**
Clipping and Clamping Circuits, Light Emitting Diode (LED), Zener Diode, Photodiode, Solar Cell, Power Supply Design using Rectifiers and Filters.			
UNIT: 4	**Transistor Characteristics and Biasing:**	**14**	**25%**
Junction Transistor: Construction and Working Principle, Transistor Action and Current Components (IE, IB, IC), Transistor Configurations: CB, CE, and CC with Input and Output Characteristics, Transistor as an Amplifier and as a Switch, DC Load Line and Operating Point (Q-point), Transistor Biasing Methods (Fixed Bias, Voltage Divider Bias, etc.), Bias Stabilization Techniques, Thermal Runaway and Bias Compensation, Transistor-based Amplifier Circuits for Audio Applications.			
UNIT: 5	**MOSFET and CMOS Technology:**	**12**	**25%**
MOSFET: Depletion-type and Enhancement-type – Construction, Operation and Characteristics, MOS Structure with Energy Band Diagram, MOS System under External Bias, Photolithography Process Steps for MOSFET Design, CMOS: Basic Concept and Applications, CMOS Logic Gates Design and Low-Power VLSI Applications.			
		45	**100%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks in Percentage					
Remember	Understand	Apply	Analyze	Evaluate	Create
-	40	20	40	-	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

TEXT/REFERENCE BOOKS:

TEXT BOOKS:

1. S. Salivahanan, N. Suresh Kumar, and A. Vallavaraj, Electronic Devices and Circuits, Tata McGraw-Hill.
2. Sanjeev Gupta, Electronic Devices and Circuits, Dhanpat Rai Publications.
3. J. B. Gupta, Electronic Devices and Circuits, S. K. Kataria & Sons.
4. V. K. Mehta and Rohit Mehta, Principles of Electronics, S. Chand & Company.

REFERENCE BOOKS:

1. Boylestad, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education.
2.Millman, J. and Halkias, C. C., Integrated Electronics, McGraw-Hill Education..

List of Practical:

Topic	Hrs.
1. To Study of V–I characteristics of PN junction diode (forward and reverse bias).	02
2. To Study of V–I characteristics of Zener diode (forward and reverse bias).	02
3. To Study of V–I characteristics of Light Emitting diode (forward and reverse bias).	02
4. To Design and Testing Half wave rectifier circuit.	02
5. To Design and Testing Full wave rectifier circuit.	02
6. To Design and Testing Clipping circuit.	02
7. To Design and Testing Clamping circuit.	02
8. To Study of V–I characteristics of Photo diode (forward and reverse bias).	02
9. To Study of Input and Output characteristics of Common Base Configuration.	02
10. To Study of Input and Output characteristics of Common Emitter Configuration.	02
11. To Study of Input and Output characteristics of Common Collector Configuration.	02
12. To Design and Test Transistor application as an Amplifier.	02
13. To Design and Test Transistor application as a Switch.	02
14. To Study of drain and transfer characteristics of MOSFET.	02
15. Mini Project	02
TOTAL	**30**

Teaching Learning Method

- **Chalk & Talk with ICT Support**
  → used to explain core concepts like energy band theory, PN junction, BJT, and MOSFET with diagrams and presentations.
- **Demonstration & Laboratory Experiments**
  → Practical verification of concepts such as V-I characteristics of diodes, transistor configurations, and MOSFET behavior.
- **Simulation-Based Learning**
  → Use of tools like LTspice or Multisim to analyze electronic circuits virtually.

- **Problem-Based Learning (PBL)**
  → Students design and solve real-world circuit problems like rectifiers, amplifiers, and switching circuits.
- **Mini Projects / Application-Based Learning**
  → Development of small projects such as power supply circuits, LED drivers, or solar-based systems.

Course Outcomes Mapping:

CO No.	Course Outcome (CO)	POs/ PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Class Sessions (Lecture)
CO1	Explain the fundamental concepts of semiconductor physics and charge transport mechanisms.	PO1, PO2, PO11,PSO1	Understand (L2)	Conceptual	06
CO2	Analyze the characteristics and applications of PN junction diodes and related devices.	PO1, PO2, PO3, PO11,PSO1	Analyze (L4)	Analytical	05
CO3	Apply diode concepts in designing rectifiers, clipping, clamping, and power supply circuits.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1,PSO2	Apply (L3)	Procedural	08
CO4	Analyze the construction, working principle, configurations (CB, CE, and CC), characteristics, biasing methods, and applications of junction transistors including amplifier and switching operations.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1,PSO2	Analyze (L4)	Analytical	14
CO5	Understand MOSFET operation, CMOS technology, and their applications in VLSI systems.	PO1, PO2, PO3, PO5, PO11, PSO1,PSO2	Understand (L2)	Conceptual	12

Mapping of Cos with Pos& PSOs:

CO	PO											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3	0	0	0	0	0	0	0	0	3	3	0
CO2	3	3	3	0	0	0	0	0	0	0	3	3	0
CO3	3	3	3	3	3	0	0	0	0	0	3	3	3
CO4	3	3	3	3	3	0	0	0	0	0	3	3	3
CO5	3	3	3	0	3	0	0	0	0	0	3	3	3

3: High, 2: Medium, 1: Low

Sustainable Development Goals (SDG) Integration:

This course aligns with several Sustainable Development Goals (SDGs) by promoting knowledge and skills essential for modern electronics and sustainable technologies. It supports SDG 4 (Quality Education) by building strong technical foundations in semiconductor and electronic systems. The focus on low-power CMOS and efficient circuit design contributes to SDG 7 (Affordable and Clean Energy) and SDG 12 (Responsible Consumption and Production) by encouraging energy-efficient solutions. Additionally, applications in VLSI and embedded systems foster innovation aligned with SDG 9 (Industry, Innovation, and Infrastructure).

SDG Mapping with Course Outcomes:

CO	Course Outcome	Relevant SDGs	Justification
CO1	Explain the fundamental concepts of semiconductor physics and charge transport mechanisms.	SDG 4	Builds strong foundational knowledge in semiconductor physics, enabling students to understand modern electronic systems and pursue advanced learning.
CO2	Analyze the characteristics and applications of PN junction diodes and related devices.	SDG 4, SDG 9	Enhances analytical skills and understanding of core electronic components used in industrial and technological applications.
CO3	Apply diode concepts in designing rectifiers, clipping, clamping, and power supply circuits.	SDG 7, SDG 9	Supports development of efficient power supply systems, contributing to energy conversion and utilization in sustainable technologies.
CO4	Analyze the construction, working principle, configurations (CB, CE, and CC), characteristics, biasing methods, and applications of junction transistors including amplifier and switching operations.	SDG 9, SDG 12	Promotes efficient circuit design and optimization, reducing energy waste and supporting innovation in electronic systems.
CO5	Understand MOSFET operation, CMOS technology, and their applications in VLSI systems.	SDG 7, SDG 9, SDG 12	Encourages low-power CMOS design and VLSI technology, which are essential for energy-efficient electronics and sustainable manufacturing practices.