COURSE CONTENT

ELECTRONIC DEVICES AND CIRCUITS								
I Semester: CSD / CSM **II Semester: ECE /CSE /EEE**								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
25X0401	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes:45**		
Prerequisites: Knowledge on Basic Electrical Engineering and Semiconductor Device Physics								

Course Overview:

This course introduces fundamental semiconductor devices and their behavior, including diodes, BJTs, and FETs. It covers their characteristics, applications, and the analysis of basic electronic circuits. The course also explores rectifiers, voltage regulation, amplifier design, and advanced semiconductor technologies like FinFETs and CNTFETs. Emphasis is placed on developing a strong foundation for analog circuit design and understanding modern device technologies in electronics.

Course Objectives:

The students will try to learn

- Characteristics of semiconductor diodes, their models, and applications
- Structure, operation, and characteristics of Bipolar Junction Transistors (BJT) in various Configurations, along with the determination of h-parameters
- Need for transistor biasing, load line analysis, operating point selection, and various biasing Techniques with emphasis on stabilization and prevention of thermal runaway
- The design and analysis of transistor-based small-signal amplifiers using h-parameters in CE, CB, and CC configurations with approximate models
- Principles, operation, and characteristics of special-purpose diodes, FET devices, and advanced Transistors like FinFETs and CNTFETs

Course Outcomes: After successful completion of the course, students should be able to

- Analyze the electrical characteristics and models of semiconductor diodes and apply them in rectifier and clipping circuits
- Evaluate the operation and configurations of Bipolar Junction Transistors (BJTs) and analyze their input and output characteristics
- Design appropriate biasing networks for BJTs and determine the operating point for amplifier applications
- Analyze transistor amplifier circuits using h-parameter models and assess performance for various configurations
- Analyze the structure, working, and characteristics of JFETs, MOSFETs, and advanced devices like FinFETs and CNTFETs, and compare modern device technologies.

Module–I: Diode Characteristics and Applications
PN junction diode – I-V characteristics, Diode resistance and capacitance, Diode models (Ideal, Simplified, Piecewise Linear), Rectifiers – Half-wave, Fullwave (Center-tap and bridge), Capacitor filter for rectifiers, Clippers and clampers, Zener diode – I-V characteristics and voltage regulation.

Module–II: Bipolar Junction Transistor (BJT)
Structure and working principle of BJT, Current components and transistor action, Configurations: Common Base (CB), Common Emitter (CE), Common Collector (CC), Input and output characteristics, Determination of h-parameters from transistor characteristics.

Module–III: BJT Biasing
Need for biasing and stabilization, Load line and operating point, Biasing techniques: Fixed bias, Collector-to-base bias, Voltage divider bias, Stability factors and thermal runaway.

Module – IV: Transistor Amplifiers
Transistor as a small-signal amplifier, h-parameter equivalent circuit, CE, CB, CC amplifier analysis using h-parameters, Approximate CE model – with and without emitter bypass capacitor.

Module –V: Special Purpose Diodes, Field Effect Transistors and Advanced Devices
Special Purpose Diodes: Principle of Operation of – SCR, Tunnel Diode, Varactor Diode, Photo Diode, Solar Cell, LED and Schottky Diode. Field Effect Transistors and Advanced Devices: JFET: Structure, operation, and characteristics, MOSFET: Enhancement and Depletion modes – Structure, operation, and characteristics, Advanced Devices: FinFETs - 3D structure, Scaling advantages, CNTFETs - Structure, ballistic transport, fabrication, Comparison: CMOS vs. FinFET vs. CNTFET.

TEXTBOOKS:

1. Millman, Jacob, and Christos C. Halkias. Electronic Devices and Circuits. 3rd edition, Tata McGraw-Hill,2010.

2.Boylestad, Robert L., and Louis Nashelsky. Electronic Devices and Circuit Theory, 11th edition, Pearson, 2013.

REFERENCEBOOKS:

1. Bell, David A. Electronic Devices and Circuits. Oxford University Press, 5th ed., 2008.
2. Neamen, Donald A. Electronic Circuit Analysis and Design. McGraw-Hill, 2nd ed., 2001.
3. Salivahanan, S., and N. Suresh Kumar. Electronic Devices and Circuits. McGraw-Hill Education, 4th ed., 2017..

ELECTRONIC RESOURCES:

1. https://www.tutorialspoint.com/electronic_circuits/index.htm
2. https://elearn.psgcas.ac.in/nptel/courses/video/117103063
3. https://nptel.ac.in/courses/117106086
4. https://nptel.ac.in/courses/117/106/117106086
5. https://nptel.ac.in/courses/117102008
6. https://nptel.ac.in/courses/117101002
7. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-3/special-purpose- diodes/

MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Tech talk and Concept Video topics
4. Open-endedexperiments
5. Definitions and terminology
6. Assignments
7. Model questionpaper–I
8. Model questionpaper–II
9. Lecture notes
10. Drshya Siksha Sangrah Videos (DSSV)