Programme	BS Solid State Physics	Course Code	SSP-403	Credit Hours	3 (3-0)
Course Title	**Introduction to Solid State Devices**				

Course Introduction

This course provides an introduction to the fundamental principles and applications of solid state devices. It covers the physical concepts underlying the operation of semiconductor devices, including diodes, transistors, and other key components in modern electronics. The course combines theoretical concepts with practical applications, preparing students for further studies in electronics, materials science, and engineering.

Learning Outcomes

By the end of this course, students will be able to:

1. Understand the Basics of Solid-State Physics
2. Comprehend Semiconductor Properties
3. Understand diodes and Their Applications
4. Transistor Fundamentals
5. Device Fabrication Techniques
6. Analyze Device Performance
7. Explore Advanced Devices
8. Gain laboratory Skills
9. Apply knowledge in Circuits and Systems
10. Problem-Solving and Critical Thinking
11. Stay Informed About Current Trends

These outcomes collectively ensure that students completing the course will have a solid grounding in the theory and practical aspects of solid-state devices, preparing them for further study or careers in electronics and related fields.

	Course Content	Assignments/Readings
Week 1	**Unit-I** 1.1 Introduction to Solid State Devices 1.1.1 Overview of solid state devices and their importance in modern technology 1.1.2 Review of basic concepts: charge carriers, electric fields, and current flow 1.1.3 Introduction to semiconductors: intrinsic and extrinsic materials 1.1.4 Energy bands in solids: conduction band, valence band, and bandgap	What are semiconductors?

Week 2	**Unit-II** 2.1 Semiconductor Physics 2.1.1 Carrier concentration and the role of doping 2.1.2 Carrier transport mechanisms: drift, diffusion, and recombination	Discussion about carrier transport mechanism
Week 3	**Unit-III** 3.1 The concept of Fermi level and its significance in semiconductors 3.1.1 Generation-recombination processes and minority carrier dynamics 3.1.2 Temperature dependence of carrier concentration and mobility	What is fermi level?
Week 4	**Unit-IV** 4.1 The p-n Junction 4.1.1 Formation of the p-n junction and depletion region 4.1.2 Built-in potential and electric field in a p-n junction	
Week 5	**Unit-V** 5.1 Current-voltage (I-V) characteristics of p-n junction diodes 5.1.1 Capacitance and transient behavior of p-n junctions 5.1.2 Applications of p-n junctions: rectifiers, Zener diodes, photodiodes, and LEDs	Practice
Week 6	**Unit-VI** 6.1 Bipolar Junction Transistors (BJTs) 6.1.1 Structure and operation of BJTs (NPN and PNP transistors) 6.1.2 Current flow in BJTs: injection and recombination of carriers	What is the significance of BJTs?
Week 7	**Unit-VII** 7.1 BJT operating regions: active, cutoff, and saturation 7.1.1 The Ebers-Moll model and transistor characteristics 7.1.2 Applications of BJTs in amplification and switching circuits	Quiz
Week 8	Mid Term Exams	
Week 9	**Unit-VIII** 8.1 Field-Effect Transistors (FETs) 8.1.1 Introduction to FETs: JFETs and	What is the physical significance of FETs?

	MOSFETs 8.1.2 Structure and operation of MOSFETs: enhancement and depletion modes	
Week 10	**Unit-IX** 9.1 Threshold voltage and channel formation in MOSFETs 9.1.1 Current-voltage (I-V) characteristics of MOSFETs 9.1.2 Scaling of MOSFETs and short-channel effects 9.1.3 Applications of MOSFETs in digital and analog circuits	What are MOSFETs?
Week 11	**Unit-X** 10.1 Advanced Solid State Devices 10.1.1 Metal-Semiconductor Junctions: Schottky diodes and Ohmic contacts 10.1.2 Heterojunction devices and their advantages	Define Schottky and Ohmic contacts
Week 12	**Unit-XI** 11.1 High-electron-mobility transistors (HEMTs) 11.1.1 Optoelectronic devices: solar cells, photodetectors, and lasers 11.1.2 Power devices: thyristors, IGBTs, and power MOSFETs	Review
Week 13	**Unit-XII** 12.1 Fabrication and Characterization of Solid State Devices 12.1.1 Introduction to semiconductor fabrication processes: doping, lithography, etching 12.1.2 Thin-film deposition and epitaxy	What are doping processes?
Week 14	**Unit-XIII** 13.1 Device characterization techniques: I-V, C-V measurements, and impedance spectroscopy 13.1.1 Reliability and failure mechanisms in solid state devices	Practice
Week 15	**Unit-XIV** 14.1 Applications and Future Trends 14.1.1 Solid state devices in integrated circuits (ICs) and microelectronics 14.1.2 Emerging technologies: organic semiconductors, flexible electronics, and	What is the future of ICs?

	nanoelectronics 14.1.3 Introduction to quantum devices and the future of solid state electronics	
Week 16	Final Term Exams	

Textbooks and Reading Material

1. "Semiconductor Physics and Devices: Basic Principles" by Donald A. Neamen
2. "Solid State Electronic Devices" by Ben G. Streetman and Sanjay Banerjee
3. "Fundamentals of Semiconductor Devices" by Anderson R. Jacob and Richard C. Jaeger
4. "Physics of Semiconductor Devices" by Simon M. Sze and Kwok K. Ng
5. "Microelectronic Circuits" by Adel S. Sedra and Kenneth C. Smith
6. "Introduction to Microelectronics" by Jacob Millman
7. "Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky

Teaching Learning Strategies

1. Course Teaching
2. Presentations
3. Quiz

Assignments: Types and Number with Calendar

1.
2.
3.
4.

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.