

MICROWAVE SOLID STATE DEVICES

22ECMC1T4

Credits: 4

Lecture: 4 periods/week

Internal assessment: 40 marks

Semester end examination: 60 marks

Prerequisites: Microwave Engineering

Course outcomes:

At the end of the course Student will be able to

- Understand characteristics of microwave transistors
- Apply BJTs and FETs in microwave circuits
- Apply Transferred-Electron Devices for electronic systems development
- Analyze operation of Avalanche Transit-Time Devices

UNIT-I

Microwave Transistors: Introduction, Microwave Transistors- physical structure, Transistor Configurations, principle of operation, V-I characteristics, Equivalent circuit, Amplification phenomena, Power- frequency limitations, Hetero-junction Bipolar Transistors (HBTs)- physical structure, Operational Mechanism, Applications, Microwave Tunnel Diode-principle of operation, Microwave characteristics.

UNIT-II

Microwave Field Effect Transistors: Introduction, Junction Field Effect Transistor (JFET)- structure, Principle of operation, V-I characteristics, Applications, Metal Semiconductor Field Effect Transistor (MESFET)- structure, principle of operation, Equivalent circuit, Drain current, cut-off frequency and Maximum oscillation frequency, High Electron Mobility Transistor (HEMT)- Structure, operational mechanism, performance characteristics, Applications, Metal Oxide Semiconductor Field Effect Transistor (MOSFET)- structure, principle of operation, Equivalent circuit, Drain current and Trans-conductance, Maximum operation frequency, Applications. MOS Transistors and Memory Devices.

UNIT-III

Transferred-Electron Devices: Introduction, Gunn-Effect Diodes- GaAs Diode, Ridley-Watkins-Hilsum Theory, Modes of operation, LSA Diodes, InP Diodes, CdTe Diodes, Applications (Microwave Generation and Amplification).

UNIT-IV

Avalanche Transit-Time Devices: Introduction, Read Diode- Structure, Operation, Carrier current and external current, Output power and Quality factor, IMPATT Diode- Structure, Different doping profile structures, Operation, Small-signal theory , Power output and Efficiency, applications. TRAPATT- Structure, Principle of Operation, Power output and Efficiency, BARITT- Structure, Principle of Operation, Performance and Applications. Parametric Devices - structure, Nonlinear Reactance and Manley –Rowe Power Relations, Parametric Amplifiers, and applications.

Learning Resources

Text Books

1. Samuel Y. Liao, Microwave Devices and Circuits, 3rd Ed., PHI.
2. R.E. Collin, Foundations for Microwave Engineering, 2nd Ed. Wiley

References

1. M.L. Sisodia, Vijay Lakshmi Gupta “Microwaves- Introduction to circuits, Devices and Antennas” New Age International Publishers

E-Resources

1. <https://nptel.ac.in/courses/108103141>