ECMC2T1: Solid State Microwave Devices & Circuits

Unit I Review of Microwave Tubes

Classification of Microwave Bands and applications, Limitations of Conventional Tubes, Multi-cavity Klystron (Two-cavity), Reflex Klystron, Magnetron, Traveling-wave Tube-Construction, Physics of operation, Performance limitations, Applications.

Unit II Microwave Semiconductor Diodes

Varactor diode, Tunnel Diode, PIN Diode, Schottkey-barrier Diode, Point-contact Diode-Structure, Physics of operation, Equivalent circuit, V-I characteristics, Performance limitations, Applications, Josephston junctions.

Unit III Avalanche Transit-Time Devices

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 of IMPATT device impedance, Power conversion, Efficiency, Performance and Applications. TRAPATT- Structure, Principle of Operation, Oscillation condition and Oscillation frequency, Power output and Efficiency, BARITT- Structure, Principle of Operation, Performance and Applications.

Unit IV Transferred-Electron Devices

Gunn-Effect Diodes- GaAs Diode, Ridley-Watkins-Hilsum Theory, Modes of operation, LSA Diodes, InP Diodes, CaTe Diodes, Applications (Microwave Generation and Amplification).

Unit V Microwave Transistors-I

Bipolar Transistor- physical structure, Transistor Configurations, principle of operation, V-I characteristics, Equivalent circuit, Amplification phenomena, Power- frequency limitations, Noise performance, Applications. Hetero-junction Bipolar Transistors (HBTs)- physical structure, Operational Mechanism, V-I characteristics, Equivalent circuit and cut-off frequency, Applications. Junction Field Effect Transistor (JFET)- structure, Principle of operation, V-I characteristics, Applications.

Unit VI Microwave Transistors-II

Metal Semiconductor Field Effect Transistor (MESFET)- structure, principle of operation, Equivalent circuit, Drain current, cut-off frequency and Maximum oscillation frequency. Metal-Oxide semiconductor Field Effect Transistor (MOSFET)- structure, principle of operation, Equivalent circuit, Drain current and Trans-conductance, Maximum operation frequency,

Applications. High Electron Mobility Transistor (HEMT)- Structure, operational mechanism, Equivalent circuit, performance characteristics, Applications.

Unit VII Amplifiers

Amplifier Characterization- Power gain, Noise Characterization, Stability, Non-linear behavior, Dynamic range. Biasing Networks, Small-signal Amplifier Design-Low noise design, Maximum-gain design, and Broadband design.

Unit VIII Oscillators

Active devices for Microwave Oscillators, Concept of Negative Resistance, Three-port S-parameter characterization of Transistors, Oscillation and Stability conditions, Transistor oscillator types and configurations, Fixed- frequency oscillators, Wide-band tunable oscillators, Oscillator Characterization and measurements.

Text Books:

1. "Microwave Solid State Circuit Design", Inder Bahl and Prakash Bhartia, John-Wiley and Sons, Ltd.
2. "Microwave Devices, Circuits and Subsystems for communications Engineering", I.A. Glover, S.R. Pennock and P.R. Shepherd, John-Wiley and Sons, Ltd.
3. "Microwave Devices and Circuits", Samuel L. Liao, PHI.
4. "Microwave Active Devices Vacuum and Solid-State" M.L. Sisodia, New Age Publishers.
5. "Microwave Solid State Devices and their Circuit Applications", H.A. Watson.