

# **MICROWAVE AND ANTENNA ENGINEERING (3-1-0)**

## **Module - I (15 hours)**

Overview of microwave transmission line analysis and use Smith chart in single and double stub matching. Planar transmission lines (strip line and microstrip line), Microstrip line impedance matching, quarter wave impedance transformers for broad band matching and lumped element matching, basics of design and fabrication of MMIC.

Scattering matrix representation of multiport networks (T junctions, magic TEE, circulators, directional couplers and isolators).

Semiconductor microwave devices (TEDS), negative resistance, Gunn effect, RWH theory LSA mode of operation, Avalanche transit-Time device READ diode, IMPATT, TRAPATT, BARITT diodes – principles of operation only. Solid state microwave generation and amplification (principles).

## **Module – II (12 hours)**

The vector potential for an electric and magnetic current source, solution of in homogeneous vector potential wave equation, Duality theorem, reciprocity and reaction theorem.

Principles of radiation; radiation pattern, near and far field regions. Antenna efficiency, Radiation power density, radiation intensity, radiation efficiency, Directivity, power gain, bandwidth, beam efficiency, polarization of antennas. Antenna effective length and equivalent areas. Antenna temperature, noise temperature of cascaded networks (using antenna).

Dipole and loop antennas; current distribution, radiated field. Radiation resistance, dipole arrays; planar and circular array, array factor and directivity, broadside & end-fire array, phased array, pattern multiplication.

## **Module – III (15 hours)**

Frequency independent and broad band antennas. Log periodic structure (of dipole antenna).

Reflector antenna: corner reflectors, parabolic reflectors, principle of analysis and operation, Aperture antennas (rectangular and circular apertures)  $TE_{10}$ ,  $TE_{11}$  mode and beam efficiency. Directivity and gain.

Basic characteristics of microstrip antenna, rectangular and circular patch Q. factor, band width and efficiency; feed to microstrip antenna; probe feed; microstrip line. Microstrip antenna on Ferrite substrate.

### **TEXT BOOKS:**

1. Microwave Devices and Circuits (3<sup>rd</sup> Ed.), Prentice-Hall of India Pvt. Ltd.
2. Microwave Engineering, TMH.: Annapurna Das, Sisir K. Das.
3. Antennas Theory – Analysis and Design by C. Balanis, 2<sup>nd</sup> Edition, John Willey and sons.
4. Antennas by J. D. Kraus, Tata Mc-Graw Hill Publication.

### **REFERENCE BOOKS:**

1. Microwave Circuits and Passive Devices, M. L. Sisodia, G. D. Raghu Vanshi, Willey Eastern Limited.
2. Electromagnetic Wave and Radiating Systems by E. C. Jordan and K. G. Balmain, 2<sup>nd</sup> edition, PHI Publication.
3. Antenna & Wave Propagation by K. D. Prasad.
4. Modern Antenna Handbook, John Willey & sons INC Publication.