

Microwave Engineering

Code : EI 605B(ECE)

Contacts : 3L

Credits : 3

Module 1

Introduction

RF & Microwave Spectrum, Typical applications of RF and Microwave, Safety considerations. [1]

Microwave Waveguide and Waveguide Resonator

Rectangular Waveguide- Design consideration, TE & TM modes, TE₁₀ mode analysis, cut-off frequency, propagation constant, intrinsic wave impedance, phase and group velocity, power transmission, attenuation, waveguide excitation, wall current; Introduction of circular waveguide; Rectangular waveguide resonator- Design consideration, resonant frequency, Q-factor, excitation. [6]

Planar Transmission line

Micro-strip lines, Coplanar waveguide, Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the above mentioned lines. [3]

Module 2

High frequency Circuit Elements:

Difference in High frequency and relatively low frequency behavior of Lumped circuit components. Miniaturization and Design of Lumped components at High RF. Realization of reactive elements as Waveguide and Planar Circuit components. [4]

Waveguide Passive Components and their S-matrix Representation

N-port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magic tee, hybrid ring, Circulators, Isolators; Design procedure of filter (maximally flat and equal ripple) using insertion loss method-specification, low-pass prototype design, scaling and conversion, implementation. [8]

Module 3

Microwave Tubes

Electron beam & Field interaction for energy exchange in resonant (two cavity klystron, Reflex Klystron, Magnetron) and non-resonant (TWT & BWO) microwave active devices: Typical characteristics & applications (only physical explanation is required, no mathematical derivation required). [4]

Semiconductor Microwave devices

TED (Gunn diode) & Avalanche Transit Time (IMPATT) device, Schottky diode, PIN diode- characteristics & applications; Microwave bipolar transistor, Microwave field effect transistor(MESFET). [5]

Microwave Amplifier Design

Basic consideration in the design of RF amplifier- Transistor S-parameter, Stability, matching network, noise figure; Matching network design using lumped elements and L-Section. Brief introduction to NBA, LNA. [4]

Module 4

Typical Microwave Test Bench & measurement

VSWR meter, Tunable detector, Slotted line and Probe detector, Frequency meter, Network analyzer, Measurement of VSWR – low, medium and high, Measurement of power: low, medium and high, Frequency measurement. [4]

Text Books:

1. *Microwave Engineering*, 3Rd Ed David M. Pozar, Willey & Sons Inc.
2. *Microwaves*, K C Gupta, New Age Publishers.
3. *Microwave Engineering*, A Das & S Das, TMH.
4. *Microwave Devices & Circuits*, SY Liao , Pearson Education /PHI

References Books:

1. *Microwave Engineering-Passive Circuits*, PA Rizzi , Pearson Education.
2. *Foundation of Microwave Engineering*, 2ed edition, Robert E Collin, McGraw Hill, Inc.
3. *Microwave Devices & Circuit Design* , GP Srivastava & VL Gupta, PHI