

RF AND MICROWAVE ENGINEERING

EX 752

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : IV
Part : II

Course Objectives:

To understand the fundamentals of Radio Frequency (RF) and Microwave (M/W) theory and applications, design and analysis practices, and measurement techniques.

- 1. Introduction (3 hours)**
 - 1.1 Standard frequency bands
 - 1.2 Behaviour of circuits at conventional and RF/microwave bands
 - 1.3 Microwave applications
- 2. RF and M/W Transmission Lines (6 hours)**
 - 2.1 Types of transmission lines
 - 2.2 Transmission line theory
 - 2.3 Smith Chart analysis
 - 2.4 Impedance transformations and matching analysis
- 3. RF and M/W Network Theory and Analysis (4 hours)**
 - 3.1 Scattering matrix and its properties
 - 3.2 S-Parameter derivation and analysis
- 4. RF/Microwave Components and Devices (8 hours)**
 - 4.1 Coupling probes
 - 4.2 Coupling loops
 - 4.3 Waveguide
 - 4.4 Termination, E-plane Tee, H-plane Tee, Magic Tee
 - 4.5 Phase-Shifter
 - 4.6 Attenuators
 - 4.7 Directional coupler
 - 4.8 Gunn diode
 - 4.9 Microwave transistor
 - 4.10 MASER
 - 4.11 Resonator and circulators
- 5. Microwave Generators (5 hours)**
 - 5.1 Transit-time effect
 - 5.2 Limitations of conventional tubes

- 5.3 Two-cavity and multi-cavity klystrons
- 5.4 Reflex klystron
- 5.5 TWT and magnetrons

6. RF Design Practices (10 hours)

- 6.1 RF Low pass filter
 - 6.1.1 Insertion loss
 - 6.1.2 Frequency scaling
 - 6.1.3 Microstrip implementation
- 6.2 RF Amplifier
 - 6.2.1 Amplifier theory
 - 6.2.2 Design and real world consideration
- 6.3 Oscillator and mixer
 - 6.3.1 Oscillator and super mixing theory
 - 6.3.2 Design and real world consideration

7. Microwave Antennas and Propagation (3 hours)

- 7.1 Antenna types
- 7.2 Propagation characteristics of microwave antennas
- 7.3 RF an M/W radiation, safety practices and standards

8. RF/Microwave Measurements (6 hours)

- 8.1 Power measurement
- 8.2 Calorimeter method
- 8.3 Bolometer bridge method
- 8.4 Thermocouples
- 8.5 Impedance measurement
- 8.6 RF frequency measurement and spectrum analysis
- 8.7 Measurement of unknown loads
- 8.8 Measurement of reflection coefficient
- 8.9 VSWR and Noise

Practicals:

1. Illustration of Smith Chart and load analysis
2. Introduction to RF and M/W signal and circuits, measuring techniques, instrumentations, and practices
3. Designing and analysis of simple strip-line and two-port circuits using network and spectrum analysers
4. Software-based (ADS-like) RF signal & circuit simulation practices

References:

1. Herbert J. Reich and et al., Van Nostard Reinhold, " Microwave Principles",
2. K.C. Gupta, "Microwave Electronics", Tata McGraw Hill.

3. A. K. Gautam, "Microwave Engineering" , S. K. Kataria & Sons.
4. D.C. Agrawal, "Microwave Techniques" , Tata McGraw Hill.
5. R. Chatterjee, "Elements of Microwave Engineering" ,Tata McGraw Hill.
6. Samuel Y. Liao, "Microwave Devices & Circuits", PHI.
7. David M. Pozar, "Microwave Engineering", John Wiley & Sons.
8. Newington "ARRL UHF/Microwave Experimenter's Manual", CT.
9. W. H. Hayt, "Engineering Electromagnetics" , McGraw-Hill Book Company.
10. A. Das, "Microwave Engineering", Tata McGraw Hill.
11. William Sinnema, "Electronic Transmission Technology: Lines, Waves, and Antennas", Prentice Hall.