RF and Microwave Engineering

**Course Objectives:**  
The course deals with the basic understanding of 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. Standard frequency bands
   2. Behaviour of circuits at conventional and RF/microwave bands
   3. Microwave applications

1. **RF and M/W Transmission Lines (6 hours)**
   1. Types of transmission lines
   2. Transmission line theory
   3. Smith Chart analysis
   4. Impedance transformations and matching analysis

1. **RF an M/W Network Theory and Analysis(4 hours)**
   1. Scattering matrix and its properties
   2. S-Parameter derivation and analysis

1. **RF/Microwave Components and Devices(8 hours)**
   1. Coupling probes
   2. Coupling loops
   3. Waveguide
   4. Termination, E-plane Tee, H-plane Tee, Magic Tee
   5. Phase-Shifter
   6. Attenuators
   7. Directional coupler
   8. Gunn diode
   9. Microwave transistor
   10. MASER
   11. Resonator and circulators

1. **Microwave Generators (5 hours)**
   1. Transit-time effect
   2. Limitations of conventional tubes
   3. Two-cavity and multi-cavity klystrons
   4. Reflex klystron
   5. TWT and magnetrons

1. **RF Design Practices (10 hours)**
   1. RF Low pass filter
      1. Insertion loss
      2. Frequency scaling
      3. Microstrip implementation
   2. RF Amplifier
      1. Amplifier theory
      2. Design and real world consideration
   3. Oscillator and mixer
      1. Oscillator and super mixing theory
      2. Design and real world consideration

1. **Microwave Antennas and Propagation(3 hours)**
   1. Antenna types
   2. Propagation characteristics of microwave antennas
   3. RF an M/W radiation, safety practices and standards

1. **RF/Microwave Measurements (6 hours)**
   1. Power measurement
   2. Calorimeter method
   3. Bolometer bridge method
   4. Thermocouples
   5. Impedance measurement
   6. RF frequency measurement and spectrum analysis
   7. Measurement of unknown loads
   8. Measurement of reflection coefficient
   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. Microwave Principles - Herbert J. Reich and et al., Van Nostard Reinhold.
2. Microwave Electronics– K.C. Gupta, Tata McGraw Hill.
3. Microwave Engineering – A. K. Gautam, S. K. Kataria & Sons.
4. Microwave Techniques – D.C. Agrawal, Tata McGraw Hill.
5. Elements of Microwave Engineering – R. Chatterjee, Tata McGraw Hill.
6. Microwave Devices & Circuits – Samuel Y. Liao, PHI 3rd Edition, 1994.
7. Microwave Engineering - David M. Pozar, 2nd Edition, John Wiley & Sons.
8. ARRL UHF/Microwave Experimenter’s Manual, 4th Edition, Newington CT: 1997.
9. Engineering Electromagnetics – W. H. Hayt, McGraw-Hill Book Company.
10. Microwave Engineering – A. Das, 2nd Edition, Tata McGraw Hill.
11. Electronic Transmission Technology: Lines, Waves, and Antennas - William Sinnema, Prentice Hall.

**Evaluation Scheme**  
The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below.

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| --- | --- | --- |
| **Chapters** | **Hours** | **Marks Distribution\*** |
| 1 | 3 | 8 |
| 2 | 6 | 8 |
| 3 | 4 | 8 |
| 4 | 8 | 10 |
| 5 | 5 | 8 |
| 6 | 10 | 20 |
| 7 | 3 | 8 |
| 8 | 6 | 10 |
| **Total** | **45** | **80** |

**\*Note: There may be minor deviation in marks distribution.**