

RF and Microwave Engineering Roadmap (12 Weeks)

Week 1: Introduction to RF & Microwave

- Basics of RF (Radio Frequency) and Microwave ranges.
 - Applications: Radar, Satellite, Wireless Communication, Biomedical.
 - Frequency bands and their uses.
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Week 2: Electromagnetic Waves and Transmission Lines

- Maxwell's Equations recap.
 - Wave propagation in different media.
 - Types of transmission lines: Coaxial, Microstrip, Stripline.
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Week 3: Transmission Line Theory

- Reflection coefficient, VSWR.
 - Impedance matching.
 - Smith Chart introduction and usage.
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Week 4: RF Components and Circuits

- Resistors, capacitors, inductors at RF frequencies.
 - RF filters, attenuators, and couplers.
 - Decoupling and grounding techniques.
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Week 5: Microwave Network Analysis

- S-parameters (Scattering parameters).
 - 2-port network theory.
 - Measurement and interpretation of S-parameters.
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Week 6: Passive Microwave Devices

- Directional couplers, power dividers.
- Isolators and circulators.

- Design and working principles.
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Week 7: Active Microwave Devices

- Microwave diodes: Gunn, IMPATT, PIN.
 - Transistors: MESFET, HEMT, LDMOS.
 - Small signal and large signal modeling.
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Week 8: Microwave Amplifiers and Oscillators

- Low-noise amplifiers (LNA).
 - Power amplifiers (PA).
 - Oscillator design and stability criteria.
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Week 9: Microwave Antennas

- Basics of antenna parameters: Gain, Directivity, Efficiency.
 - Antenna types: Dipole, Patch, Horn, Array antennas.
 - Antenna design using simulation tools.
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Week 10: Microwave Measurement Techniques

- Vector Network Analyzer (VNA) usage.
 - Spectrum Analyzer and Power Meter.
 - Calibration and error correction methods.
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Week 11: RF and Microwave System Design

- Design of RF front-end for wireless systems.
 - Radar system basics.
 - Simulation tools: HFSS, ADS, CST overview.
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Week 12: Project / Case Study

- Design, simulate, and test a microwave filter, antenna, or amplifier.
- Document methodology, simulation results, and real-world applications.