Advanced Microwave & Antenna Setup

Facility Spotlight: Advanced Microwave & Antenna Engineering Lab Experiments

Overview

The Microwave Engineering Laboratory is a specialized facility dedicated to the study of high-frequency electromagnetic waves (X-Band). Equipped with precision waveguide components and a comprehensive suite of antennas, this lab enables students to visualize wave phenomena, measure radiation patterns, and understand the critical parameters governing modern wireless communication systems.

Core Microwave Test Bench Setup

Our lab utilizes a standardized X-band waveguide setup for characterizing microwave sources and passive components. Key modules include:

- **Klystron Power Source (KM-203):** The primary source for generating microwave energy.
- **Frequency Measurement (FM-205):** A precision cavity-type frequency meter for identifying operating resonance.
- **Signal Detection & Analysis:**
  - **Detector Mount (DM-209):** Converts microwave power into measurable DC voltage using a crystal diode.
  - **Slotted Section (SBW-241 / SNW-242):** Allows for the measurement of Standing Wave Ratio (VSWR) and impedance matching.
- **Terminations & Matching:**
  - **Matched Termination (MT-212):** Used to absorb all incident power without reflection.
  - **Fixed (FS-224) & Movable Shorts (MS-210 / PMS-235):** Essential for phase shifting and creating standing wave patterns for impedance studies.

Advanced Antenna Training Facility

The lab features an extensive array of antenna geometries, allowing students to plot 2D/3D radiation patterns and calculate parameters like **Gain, Directivity, and Beamwidth**.

Antenna Type	Model	Educational Use Case

Pyramidal Horn	PH-246	Standard reference for gain measurements.
E-Plane & H-Plane Horns	EPSH-244 / HPSH-245	Studying aperture field distributions and polarization.
Parabolic Dish	Ph-247	High-gain, narrow-beamwidth studies for satellite communications.
Standard Gain Horn	SGHA-239	Calibration of unknown antennas in the lab.
Pick-up Horn	PHA-240	Used as a secondary receiver for field strength measurements.

Integrated Microwave Components

For advanced network analysis, the lab provides specialized waveguide junctions:

- **E-Plane Tee (EPT-221) & H-Plane Tee (HPT-222):** 3-port junctions used for power division and impedance matching.
- **Magic Tee:** (If used with the above) For phase-shifting and duplexing applications.

Learning Objectives

By engaging with this setup, students master the following industry-relevant skills:

1. **V-I Characteristics:** Plotting the characteristics of Reflex Klystron tubes.
2. **VSWR Measurement:** Identifying the degree of mismatch between a source and a load.
3. **Radiation Pattern Plotting:** Measuring the E-plane and H-plane patterns for various horn and dish antennas.
4. **Impedance Matching:** Using movable shorts and stubs to optimize power transfer in a waveguide system.
5. **Attenuation & Power:** Measuring the loss in microwave components using the substitution method.

> **Lab Safety Note:** Microwaves are non-ionizing but can cause thermal damage. Never look directly into an open waveguide or a powered antenna. Ensure all terminations are secure before powering the Klystron.

Quick Resource Access

- **Manuals:** Download the *Microwave Component Data Sheets* from the department portal.

- **Software:** Use our PC-based Antenna Plotting Software to automatically generate polar plots from lab data.