

AIMS

To provide the students with an opportunity to develop knowledge, skills and attitude in the area of microwave & antenna with special emphasis on:

- Microwave components
- Wave guides
- Microwave tubes
- Microwave measurements
- Semiconductor microwave devices
- Propagation models
- Microwave & GSM antenna

SHORT DESCRIPTION

Concept of Microwave, Microwave components; Wave guide; Microwave tubes; Microwave measurements; Semiconductor microwave devices; Propagation models: Microwave antenna.

DETAIL DESCRIPTION**Theory:****1 Understand the concept of microwave.**

- 1.1 Define the term microwave.
- 1.2 Mention the application of microwave with frequency range.
- 1.3 List the characteristics of microwave.
- 1.4 List the problems associated with conventional tubes at UHF.
- 1.5 Discuss the characteristics of tubes for ultra high frequency.
- 1.6 Describe the basic principle of acron and disk seal tube.

2 Understand the concept of microwave components.

- 2.1 Describe the construction and function of basic microwave components, wave guide tees, magic tee, isolating device, adjustable phase shifter, hybrid ring (rat-race), coupling probes, coupling loops, wave guide flanges, rotating joints, travelling detector, mode suppressors, irises, tuning posts and screws.
- 2.2 Describe the working principle of wave meters.
- 2.3 Describe the working principle of directional couplers (DC).
- 2.4 Describe the constructions of isolators and circulators.
- 2.5 Describe the principle of isolators and circulators.
- 2.6 Describe the principle of operation of cavity resonator.

3 Understand the features of waveguide guide.

- 3.1 Define the term waveguide.
- 3.2 List the advantages of wave guide over coaxial line.
- 3.3 Mention different modes of a wave guide.
- 3.4 Describe phase velocity and group velocity in a wave guide.
- 3.5 Describe the field pattern of TE_{10} , TE_{20} , TM_{11} and TEM modes.
- 3.6 Solve the cut-off frequency, phase and group velocity in a wave guide.

- 3.7 Explain the methods of mode excitation in rectangular wave guide.
- 3.8 Describe behavior, field pattern and disadvantages of circular waveguide.
- 4 Understand the features of different microwave tube.**
 - 4.1 Describe the construction and operation of two cavity klystron tube.
 - 4.2 Describe schematic diagram for klystron amplifier.
 - 4.3 Describe the construction and operation of multi cavity klystron.
 - 4.4 Describe the construction and operation of reflex klystron tube.
 - 4.5 Describe constructional features of cavity magnetron.
 - 4.6 Describe the mechanism of oscillations in a magnetron.
 - 4.7 Describe the construction and operation of travelling wave tube.
 - 4.8 Mention performance, properties and applications of cavity klystron, reflex klystron tube and travelling wave tube.
- 5 Understand the basic concept of microwave measurements.**
 - 5.1 Describe the method of measurement of low microwave power by bolometer and microwave thermocouple.
 - 5.2 Describe the method of measurement of medium and high microwave power by calorimeter wattmeter measuring system.
 - 5.3 Describe the method of measurement of microwave frequency and wavelength.
 - 5.4 Describe the method of measurement of standing wave ratio (SWR).
 - 5.5 Describe the method of measurement of impedance.
 - 5.6 Describe the method of measurement of attenuation.
- 6 Understand the concept of semi conductor microwave devices.**
 - 6.1 Describe the construction, performance and application of microwave transistor.
 - 6.2 Describe the construction and operation of varactor diode.
 - 6.3 Describe the characteristic of varactor diode.
 - 6.4 Describe the basic principle of parametric amplifiers.
 - 6.5 Describe the constructional features and applications of gun diode.
 - 6.6 Describe the theory of microwave amplification by stimulated emission of radiation (Maser).
 - 6.7 Describe the construction and performance of IMPATT (impact avalanche and transit time) diode.
- 7 Understand the construction, operation & features of antenna.**
 - 7.1 Describe the physical idea of radiation of electromagnetic energy from antenna.
 - 7.2 Define point source, power gain, directivity, aperture, effective area, radiation pattern, beam angle, radiation angle, beam and radiation distance related to antenna.
 - 7.3 Describe the construction of dipole, folded dipole, yagi, Marconi and whip antenna
 - 7.4 Describe the radiation pattern of dipole, folded dipole, yagi, Marconi and whip antenna.
 - 7.5 Describe the parasitic arrays and Linear, planar and circular arrays
 - 7.6 Describe End-Fire and Broad- Side array.
 - 7.7 Describe the effective resistance and effective height of antenna.
- 8 Understand the features of microwave antennas.**
 - 8.1 Mention the characteristics of microwave antennas.
 - 8.2 State reciprocity theorem of antenna.
 - 8.3 Describe the constructions of Vee, Rhombic, Turnstile and Helical antenna.
 - 8.4 Describe the constructions of horn antennas.
 - 8.5 Describe the operation of antennas with parabolic reflectors.
 - 8.6 Describe the function of feed antennas.
 - 8.7 Describe the operation of dielectric lens antenna.

- 8.8 Describe the construction and application of loop, modified loop and a dock antenna.
- 8.9 Describe the operation of horizontal and vertical log periodic aerials.
- 8.10 Describe the modern trends in aerial design and practice.

9 Understand wide range of GSM antenna.

- 9.1 Define GSM antenna.
- 9.2 Mention the type of GSM antenna.
- 9.3 Describe principle of Micro-strip patch, and on-chip, RFID antenna.
- 9.4 Describe the principle of operation ceramic chip LTE antenna.
- 9.5 Describe the construction of operation, Magnetic, Trucke, on-glass antenna, window clip antenna, wall mount antenna, base station antenna.
- 9.6 Calculate the distance coverage and Power in dBW of GSM antenna.
- 9.7 Mention the limitation of Microwave GSM antenna.
- 9.8 Mention the procedure of installation GSM antenna.

10 Understand Radio MASTs & Towers

- 10.1 Define Radio MASTs & Towers.
- 10.2 Describe the construction of mast radiator.
- 10.3 Describe the principle of operation reinforced concrete Towers.
- 10.4 State the difference between numerous concrete Towers and lattice towers
- 10.5 Describe the construction of a Felsenegg-Girstel TV-tower.
- 10.6 Mention the use of Towers for outside broadcasting.

PRACTICAL:

1 Perform the measurement of the tuning range of a reflex klystron.

- 1.1 Select reflex klystron, power supply, klystron mounts detector & necessary meters, equipment and materials.
- 1.2 Connect the klystron tube and associated components properly.
- 1.3 Set up the signal detector.
- 1.4 Connect the power supply.
- 1.5 Set the tuning control at minimum.
- 1.6 Measure the frequency.
- 1.7 Measure the frequency for the maximum control.
- 1.8 Determine the tuning range.

2 Perform the measurement of the VSWR of a microwave signal for a given load.

- 2.1 Select a micro wave tube (klystron) and require apparatus & materials.
- 2.2 Connect the klystron, wave guide/slotted line, load and necessary equipment.
- 2.3 Switch on the power supply.
- 2.4 **Adjust** the controls properly.
- 2.5 Measure the VSWR.

3 Study the operation of two cavity klystron amplifier.

- 3.1 Select a klystron tube and required apparatus & materials.
- 3.2 Set up the apparatus and connect the circuit properly.
- 3.3 Switch on the power supply.
- 3.4 Apply known signal to the input.
- 3.5 Make necessary adjustment.

- 3.6 Measure the signal from output.
- 3.7 Determine amplification.

4 Study the operation of magnetron travelling wave tube amplifier.

- 4.1 Select the tube and required tools & materials.
- 4.2 Connect the circuit and equipment properly.
- 4.3 Switch on the power supply.
- 4.4 Apply known signal to the input.
- 4.5 Make proper adjustment.
- 4.6 Observe the output.
- 4.7 Determine the amplification.

5 Study the operation of magnetron tube oscillator.

- 5.1 Select the tube, required apparatus and materials.
- 5.2 Set up the equipment and connect the circuit.
- 5.3 Switch on the power supply.
- 5.4 Make proper adjustment.
- 5.5 Observe the output frequencies.
- 5.6 Determine the modes of the tube.

6 Perform the measurement of the directivity and coupling of a directional coupler (DC).

- 6.1 Select klystron supply, mount, isolator, directional coupler and required equipment & materials.
- 6.2 Set up the apparatus and connect the circuit.
- 6.3 Switch on the power supply.
- 6.4 Make proper adjustment.
- 6.5 Measure the coupling.
- 6.6 Measure the directivity.

7 Perform the drawing of radiation pattern of horn antenna in horizontal and vertical plane.

- 7.1 Select klystron supply, klystron mount, isolator two horn antenna, waveguide to coaxial adapter, etc.
- 7.2 Set up the apparatus and connect the circuits.
- 7.3 Switch on the power supplies.
- 7.4 Make proper adjustment.
- 7.5 Obtain data for horizontal and vertical plane.
- 7.6 Plot the radiation pattern.

8 Perform the verification of the properties of magic tee.

- 8.1 Select magic tee and required apparatus.
- 8.2 Set up the equipment and connect the circuit.
- 8.3 Switch on the power supply.
- 8.4 Make proper adjustment.
- 8.5 Observe the properties of magic tee.

9 Study the characteristics of GSM Antenna.

- 9.1 Select a GSM antenna and required apparatus.
- 9.2 Set up the equipment and connect the circuit.
- 9.3 Switch on the power supply.
- 9.4 Make proper adjustment.
- 9.5 Observe the characteristics of **GSM Antenna**

10 Study the characteristics of parabolic dish antenna.

- 10.1 Select a dish antenna and required apparatus.
- 10.2 Select low noise block down (LNB) converter.
- 10.3 Set up the LNB and parabolic dish antenna.
- 10.4 Observe the characteristics of parabolic antenna.

11 Study the operation of varactor diode, gunn diode and IMPATT diode.

- 11.1 Select the necessary diode, required apparatus and materials.
- 11.2 Setup the equipment and connect the circuits.
- 11.3 Switch on the power supply.
- 11.4 Observe the input and output signals.

12 Perform the measurement of the microwave power.

- 12.1 Select required equipment, tools and materials.
- 12.2 Construct the circuit.
- 12.3 Switch on the power.
- 12.4 Make power adjustment.
- 12.5 Measure the microwave power.

*** Visit a microwave station and prepare a report.**

REFERENCE BOOKS

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 - Kennedy
 - Anokh singh.
- 2. Microwave Engineering
 - Sanyeeva Gupta
- 3. Radio Engineering
 - M. L. Gupta.
- 4. Field's and Waves in Communication Electronics
 - SIMON RAM
- 5. Radio Engineering
 - G. K Mithal