

# GUJARAT TECHNOLOGICAL UNIVERSITY

## DIPLOMA IN ELECTRONICS & COMMUNICATION ENGINEERING

### SEMESTER: V

Subject Name: **Microwave Engineering**

Sr. No.	Course Content
1.	<b>Microwaves and Propagation:</b> 1.1 Microwaves: frequency spectrum, bands, advantages of microwave communication 1.2 Transmission line: lumped parameter representation, lossless open and short circuited line. 1.3 Standing wave pattern, standing wave ratio, reflection coefficient. 1.4 Impedance matching: single stub matching, double stub matching. 1.5 Wave propagation in guide: reflection of waves, zigzag path, phase velocity, group velocity. 1.6 Rectangular waveguides: structure, cut-off wavelength, TE and TM modes, field patterns. 1.7 Circular waveguides: structure, cut-off wavelength, TE and TM modes, field patterns, comparison with rectangular waveguide.
2.	<b>Microwave Components:</b> 2.1 S parameters of a two port network. 2.2 Waveguide Tees and bends: E-plane Tee, H-plane Tee, Magic Tee, E-plane bend, H-plane bend. 2.3 Hybrid ring 2.4 Directional couplers. 2.5 Isolators and circulators: principle, structure, operation and applications 2.6 Cavity Resonators: operation, types of cavity, applications, coupling and tuning of cavities. 2.7 Stripline and microstrip circuits.
3.	<b>Microwave Tube Oscillators and Amplifiers:</b> 3.1 Frequency limitations of vacuum tubes 3.2 Multicavity klystron: operation, klystron amplifier, oscillator and applications 3.3 Reflex klystron: operation Transit times and applications 3.4 Magnetrons: construction, field interaction, frequency pulling and pushing, applications 3.5 Traveling wave tubes : Construction, operation, applications 3.6 Backward wave oscillators
4.	<b>Semiconductor Microwave Devices:</b> 4.1 Limitations of transistor at high frequencies. 4.2 Varactor diode: construction and operation. 4.3 Parametric amplifier: principles, process of amplification. 4.4 Gunn diodes: Gunn effect, characteristic, oscillator, amplifier and applications 4.5 Construction and operation of avalanche transit time devices: PIN, IMPATT and TRAPATT diodes. 4.6 High electron mobility transistors: structure, operation and applications 4.7 Fundamentals of Masers, Ruby maser, solid state maser.

5.	<b>Microwaves Measurement:</b> 5.1 Measurement of Power: bolometer method, calorimeter method 5.2 Frequency and wavelength measurement 5.3 Attenuation Measurement 5.4 VSWR Measurement 5.5 Measurement of Q by transmission
6.	<b>Radar Systems:</b> 6.1 Basic Principles. 6.2 Radar range equation, factors influencing maximum range. 6.3 Basic pulse radar system: block diagram and its working. 6.4 Moving target indicator. 6.5 Doppler Radar. 6.6 Frequency modulated CW radar.
7.	<b>Satellite Communications Systems:</b> 7.1 Microwave link. 7.2 Synchronous and non-synchronous satellite. 7.3 Earth stations: block diagram and classification. 7.4 Satellite space craft sub-systems: Attitude and orbit control system, telemetry tracking and command, power system, transponder, space craft antennas. 7.5 Domestic satellite system.

**The sample experiments to be performed included, but are not limited to the following:**

1. To study different types of Microwave components.
2. To study the gunn power supply and V.S.W.R. meter.
3. To set the microwave bench for optimum operation.
4. To measure the guide wave length and to compute the free space wave length, microwave frequency, characteristic wave impedance of wave guide and the phase velocity.
5. To calibrate the variable attenuator and to plot the attenuation.
6. To measure VSWR for different types of load. (e. g. matched load, horn load and short load).
7. To measure the attenuation of a given attenuator.
8. To study the operation of a directional coupler.
9. To measure the coupling factor and the directivity of a directional coupler.
10. To measure the reflection co-efficient for different types of load.
11. To study the reflex klystron.
12. To measure the microwave frequency with the help of a wave meter.
13. To measure Q of cavity.
14. To study various sub-systems of space craft.

### **Reference Books:**

1. Electronics Communications System -George Kennedy, T.M.H. Pub.
2. Microwave Devices and Circuits -S. Y. Liao, Pearson Pub.
3. Electronics Communications -Sanjeev Gupta, Khann Pub.
4. Introduction to Microwaves -A.H. Wheeler, P.H.I. Pub.
5. Satellite Communications -Timothy Pratt, Johnn Wiley and Sons