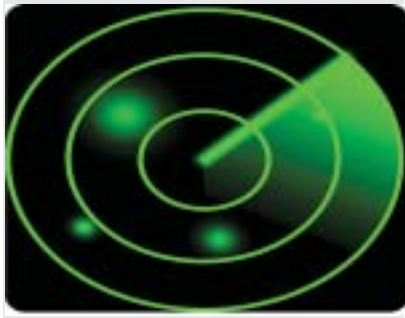
16EC402 MICROWAVE AND RADAR ENGINEERING



Hours Per Week :

L	T	P	C
3	-	2	4

Course Description and Objectives:

This course offers concepts of microwave devices, amplifiers, oscillators and radars. The objective of this course is to enable the student to understand microwave components, microwave solid-state devices, microwave tubes, microwave measurement techniques and the basic radar principles and target detection.

Course outcomes:

Upon successful completion of this course, students should be able to:

CO1: Understand and apply the concepts of scattering parameters to various microwave components.

CO2: Analyze microwave linear beam tubes.

CO3: Understand and analyze various microwavecross field devices like MAGNETRON, PIN, GUNN, IMPACTT, TRAPATT.

CO4: Perform various microwave measurements.

CO5: Evaluate the performance of different types of Radars.

CO6: Demonstrate the microwave bench setups and microwave components.

SKILLS:

- ✓ *Choose the required component for power coupling in the microwave communication systems.*
- ✓ *Select the high power amplifier/oscillator for the microwave frequency operation.*
- ✓ *Identify the required low power oscillator for receiver applications.*
- ✓ *Measure the impedance value of the given load through VSWR measurement.*
- ✓ *Simulate/Demonstrate the operating principles of CW and Pulse Radars.*

ACTIVITIES:

- *Characterize the given power coupling device.*
- *Find the mechanical tuning range of the given Reflex Klystron.*
- *Find the electronic tuning range of the given GUNN oscillator.*
- *Determine the impedance of the given Horn/ Dielectric/Dish/ Microstrip antenna.*
- *Simulate the RADAR display (PPI/Sector PPI).*
- *Design Police Radar.*

UNIT - 1 **L-9**

MICROWAVE COMPONENTS: Microwave frequencies and band designations, Microwave junctions – E-plane Tee junction, H-plane Tee junction, Magic Tee junction, Applications of magic Tee, Directional couplers; Faraday rotation In ferrite devices - Circulator, Isolator.

UNIT - 2 **L-9**

MICROWAVE LINEAR BEAM TUBES (O TYPE): Limitations of conventional tubes at microwave frequencies, Two cavity klystron amplifiers - Velocity modulation process, Bunching process, Output power and beam loading; Reflex klystron oscillator- Velocity modulation, Power output and efficiency; Operating principles of TWT.

UNIT - 3 **L-9**

MICROWAVE CROSS FIELD TUBES (M TYPE): Magnetron oscillators - Cylindrical magnetron, Cross field amplifiers; Microwave solid-state devices - Detector diode, PIN diode and its applications; Transferred electron devices - GUNN diode, LSA mode of operation, IMPATT and TRAPATT.

UNIT - 4 **L-9**

MICROWAVE MEASUREMENTS: Components of microwave bench set-up, Attenuation measurement, Microwave power measurement, Guide wavelength measurement, VSWR measurement, Impedance measurements.

UNIT - 5 **L-9**

INTRODUCTION TO RADAR ENGINEERING: Radar range equation, Pulse radar, CW radar, FM CW radar, MTI radar.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS Total hours-30

1. Verification of relationship between free space wavelength, guide wavelength and cut-off wavelength.
2. Attenuation measurement.
3. Characterization of magic Tee.
4. Characterization of circulator.
5. Measurement of coupling factor and directivity of directional coupler.
6. Mode characteristics of reflex klystron.
7. Characteristics of Gunn Oscillator.
8. Measurement of Low and High VSWR using Microwave bench.
9. Radiation pattern measurement of rectangular wave-guide.
10. Radiation pattern measurement of twisted wave-guide.

TEXT BOOKS:

1. Samuel Y Liao, "Microwave Devices and Circuits", 3rd edition, Pearson Education, 2003.
2. Merrill I Skolnik, "Introduction to Radar Systems", 3rd edition, McGraw- Hill, 2008.

REFERENCE BOOKS:

1. John Wiley and Robert E. Collin, "Foundations for Microwave Engineering", 2nd edition, John Wiley and sons, 2002.
2. Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, "Microwave Principles", CBS Publishers and Distributors, 2004.
3. David M. Pozar, "Microwave Engineering", 4th edition, John Wiley and Sons, 2012.
4. M. Kulkarni, "Micro Wave and Radar Engineering", Umesh Publications, 3rd edition, 1998.
5. Robert E. Collin, "Foundations for Microwave Engineering", 2nd edition, John Wiley and Sons, 2000.
6. Sushrut Das, "Microwave Engineering", 1st edition, Oxford Press, 2014.