

**Unit-VI: Detection of Radar Signals in Noise:** Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-Matched Filters, Matched Filter with Non-white Noise.

**Radar Receivers:** Noise Figure and Noise Temperature **(8 L)**

**Expected Outcomes:**

Students will be able to

1. Compare the working of different types of radars.
2. Analyze the statistical parameters of the Noise and Radar cross-section of targets
3. Distinguish the fixed and moving targets using different types of radar systems
4. Explain various techniques employed in Phased array and Imaging radar for target detection.
5. Explain various techniques employed in radar receivers for the detection of signals in noise.

**Text Books:**

1. Merrill Skolnik: Introduction to Radar Systems; Tata McGraw-Hill, 2007, 2/e.
2. Mark A Richards: Fundamentals of Radar signal processing; M C Graw Hill 2014, 2/e.

**Suggested Reading:**

1. Ramon Nitzberg, “Radar Signal Processing and Adaptive Systems”, Artech House, 1999.
2. Byron Edde “Radar: Principles, Technology, Applications”. Pearson Education, 2004.
3. Radar Principles – Peebles. Jr., P.Z. Wiley. New York, 1998.
4. Principles of Modern Radar: Basic Principles – Mark A. Richards, James A. Scheer, William A. Holm. Yesdee, 2013.
5. Harold Mott, “Remote Sensing with Polarimetric Radar” IEEE Press, 2007.
6. Nathanson, F E, “ Radar Design Principles” Scitech Publishing, 2002.

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| <b>ECx5149</b> | <b>Terahertz Engineering</b> | <b>L-T-P: 3-0-0; Cr: 03</b> |
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**Course Objectives:** To demonstrate the concept of THz principles and its components and design applicability for different Industrial and communication applications.

**COURSE CONTENT:**

**Unit-I: Terahertz Overview and Principles:** Electromagnetic Radiation and Propagation Fundamentals, Terahertz Principles, Towards Terahertz Communication Systems, Key Technological Issues for Terahertz Technology, Fundamental Limits, Terahertz Technology Applications and Opportunities. **(8 L)**

**Unit-II: THz Detectors:** Single-Photon Detectors, Microbolometers, Golaycells, Pyroelectric Detectors, Diode Detectors, and Focal-Plane Arrays. **(6 L)**

**Unit-III: THz Sources:** Vacuum-Electronics-based, Semiconductor-based, Photoconduction-based and Nonlinearity-based. **(6 L)**

**Unit-IV: THz Electronic Components:** Waveguides, Metamaterials, Filters and Modulators. **(8 L)**

**Unit-V: Sensing with THz Radiation:** THz Spectroscopy, Imaging and Tomography (6 L)

**Unit-VI: THz Applications:** Biology, Medicine, Space Sciences, Pharmaceutical Industry, Security and Communications. (8 L)

**Course Outcomes:**

1. To understand the concept of THz principles and components.
2. To learn the concept of THz **Electronic Components**, THz sources and THz detectors.
3. Apply the concept of THz for imaging, spectroscopy and tomography for different applications.
4. Analyse the THz systems knowledge for different Industrial and communication applications.

**Text Book(s):**

1. Terahertz Technology: Fundamentals and applications, Rostami, Ali Rasooli, Hassan Baghban, New York, Springer, 2011, ISBN 978-3-642-15793-6.
2. RE Miles, P Harisson, D Lippens "Terahertz Sources and Systems ", Springer Science+Business media, BV 2000, ISBN 978-94-010-0824-2.
3. Ho-Jin Song, Tadao Nagatsuma, "Handbook of Terahertz Technologies, Devices and applications", Pan Stanford Publishing Pte. Ltd. 2015, ISBN: 9789814613088.

**Reference Books:**

1. "Sensing with Terahertz Radiation", Daniel Mittleman, ed. (Springer, 2004)
2. "Terahertz Spectroscopy: Principles and Applications" (Optical Science and Engineering Series), Susan L. Dexheimer, ed. (CRC Press, Taylor and Francis group, 2007)
3. Terahertz Sensing Technology: Emerging Scientific Applications & Novel Device Concepts "(Selected Topics in Electronics and Systems, Vol. 32), Dwight L. Woolard, William R. Loerop, Michael Shur (Eds), (World Scientific, 2003)

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| <b>ECx5150</b> | <b>Embedded Systems Design</b> | <b>L-T-P: 3-0-0; Cr: 03</b> |
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**Pre-Requisites :** Basic of Microprocessor and Microcontroller, Computer Organization and architecture, Programming through C

**Course Objective:**

1. The goal of this course is to understand the concept of embedded system design, its fundamental requirements of embedded systems, and the interaction between hardware and software in embedded systems.
2. To expose the students to various smart sensors. Actuators, Input-output device mechanisms, Communication interface/Task Communication, embedded systems software, real-time OS, system verification, and ARM microcontroller.
3. To make the students familiar with the programming concepts of Embedded development as well as its real-time applications.