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| **EC5502** | **Advanced Communication Engineering** | **L-T-P: 3-0-0; Total 42 Lectures** |

**Prerequisites:** i**)** Signal and Systems, ii) Communication Engineering.

***Objective:*** The objective of this course is to provide students with the knowledge of digital communication, various digital modulation schemes, digital transmission through AWGN channels, etc. along with the concepts of information theory and different applications of digital communications.

***Course Contents:***

**Unit I: Introduction to Digital Communications:** Introduction to Digital Communications; Block Diagram of Digital Communication System; Information Theoretic Approach to Digital Communications; Digital Communication Blocks Realized as Software-Defined Radio.(4L).

**Unit II: Digital Carrier Modulation :** Introduction to Carrier Modulation, ASK,BPSK, QPSK, BFSK, M-ary PSK, M-ary FSK, Modulations, QAM, MSK and GMSK Modulation, Differential Encoding and Decoding.(6L).

**Unit III: Digital Transmission through AWGN channel :** Geometric representation of signal waveforms, Two dimensional signal waveforms, Optimum receiver for digitally modulated signals in additive white Gaussian noise, Probability of error for signal detection in additive white Gaussian noise – PAM, MPSK, MFSK, MQAM, etc. (8L).

**Unit IV: Digital Transmission through band limited AWGN channels:** Digital transmission through band limited channels, Power spectrum of digitally modulated signals, Signal design for band limited channels – for zero ISI (Nyquist criterion) and with controlled ISI.(8L).

**Unit V: Concepts of Information Theory and** Coding: Information, Mutual Information, Measure of Information, Entropy, Information Rate, Shannon’s Theorem, Channel Capacity, Capacity of Gaussian Channel, Bandwidth-SNR Trade-off; Coding for Discrete Sources- Need for coding source letters, Introduction to source and channel coding techniques; Error Control coding.(8L).

**Unit VI: Applications of Digital communications :** Spread spectrum systems, Code division multiple access – Principle of operation, Forward and reverse channels, Processing gain, Advantage and disadvantage of CDMA, Concept of near-far problem and power control, Multicarrier modulation scheme – MC-CDMA, OFDM. (8L).

***Text & Reference Books:***

1. J. G. Prokias and M. Salehi, “Communication Systems Engineering”, 2nd Edition, Pearson, 2015.
2. S. Haykin, “Digital Communication”, 5th ed., John Wiley & Sons, Inc. .
3. B. P. Lathi and Z. Ding, “Modern Digital and Analog Communication Systems”, 4th Ed., Oxford University Press, 2009.
4. H. Taub, D. L. Schilling, and G. Saha, “Principles of communication systems”, 4th Edition, McGraw-Hill Education (India) Pvt. Ltd., 2014.
5. B. Skalar, “Digital Communications: Fundamentals & Applications”, 2nd Ed., Pearson Education India, 2009.
6. R. E. Ziemer, and W. H. Tranter, “Principles of Communications: Systems, Modulation, and Noise”, Wiley, 7th Ed., 2015.
7. Web courses: NPTEL Lectures on “Digital Communication” by Prof. SaswatChakrabarti.

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

* 1. Understand the principle of digital communication systems.
  2. Understand various approaches for digital modulation.
  3. Recognize the digital transmission through the AWGN channels

1. Understand concept of information theory & coding.
2. Understand the advanced applications of digital modulation/communication.