

1.

Advanced Digital Communication

Course Code: EE-851

Course Description:

The objective of this course is to introduce graduate students to the advanced concepts in digital communications. The course will start with an introduction to digital communication as applied to communication systems. This introduction will be followed by in-depth lectures on discrete and continuous-time modulation techniques and their working with standard communication channels in the presence of noise. Students would be introduced to mathematical tools for analysis of capacity of the communication channels and analyze end-to-end performance of a communication system. Starting from a basic communication system foundation, we would gradually increase student's comfort level culminating with latest advances in digital communications arena. The course will conclude with coverage of advanced topics digital modulations, equalization and new technologies. This course will also include an introduction to information and coding theory. The concepts learnt in this course will allow the students to identify and employ appropriate analytical tools for design of complex communication systems for their MS and PhD theses.

Text Book:

1. John G. Proakis, Digital Communications, 4th Edition.
2. Bernard Sklar, Digital Communications: Fundamentals and Applications, 2nd Edition.
3. B.P. Lathi, Modern Digital and Analog Communication Systems, 3rd Edition.
4. Simon S. Haykin, Digital Communications, 4th Edition, Wiley.

Reference Book:

1. Robert G. Gallager, Principles of Digital Communication, Cambridge University Press
2. 2. Robert Gallager, Digital Communications-I Text Notes, Massachusetts Institute of Technology (MIT)
3. 3. David Forney, Digital Communications-II Text Notes, Massachusetts Institute of Technology (MIT)
4. 4. Andrea Goldsmith, Digital Communications Undergraduate Text Notes, Stanford University

Prerequisites

ASSESSMENT SYSTEM

Quizzes	10%
Assignments	10%
Mid Terms	30%
ESE	50%

Teaching Plan

Week No.	Topics to be covered
1	Introduction: Digital Communications (Review of Typical Undergraduate Digital Communications concepts)
2	Basic Communication System: Components
3	Quantization
4	Source and Channel Waveforms
5	Vector Spaces and Signal Space
6	Channels, Modulation, Demodulation
7	Random Processes and Noise
8	Detection in the Presence of Noise Eye Diagrams
9	Mid Semester Exam
10	Equalization Linear & non linear Zero forcing, MMSE, DFE, MLSE, Adaptive
11	BER performance of BPSK, QPSK, M-QAM
12	Multiuser Communications
13	Advanced Topics in Modulations: Adaptive Modulation and Hierarchical Modulation
14	Gap between Uncoded Performance & Shannon Limit
15	Introduction to Information Theory & coding (if time permits)
16-17	Advanced Topics: Diversity (Time, frequency & space) Combining Techniques (SC, TC, EGC & MRC) Multi Access Interference, Multi User Detection Interference Cancellation techniques (SIC, PIC) Cooperative Communications (DF, AF, SF & CF) Cognitive Radios
18	End Semester Exam