EE321A: Communication Systems

Class Hours:	Mon./Wed./Fri. 9.00 a.m.- 10.00 a.m.
Credits:	9
Instructor:	Adrish Banerjee
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Office Hours:	By appointment

Objectives:

This is a second course in communications, mainly dealing with digital communications. The course will cover three main areas of digital communications, namely information theory, coding theory and modulation, signal design, receiver design for digital communications.

Prerequisites:

EE320A. Students are expected to have a very good background in probability theory and linear algebra.

Topics Overview:

Information Theory:
- Introduction: Entropy, Relative Entropy, Mutual Information
- Information Inequalities
- Block to variable length coding: Huffman coding
- Variable to variable length coding: Lempel-Ziv codes
- Asymptotic Equipartition Property
- Channel capacity
- Differential Entropy
- Gaussian Channel

Coding Theory:
- Introduction
- Linear Block Codes
- Examples of some linear block codes
- Bounds on codes
- Convolutional codes
- Decoding of convolutional codes: Viterbi algorithm, BCJR algorithm.
- Turbo codes
- Low-Density Parity Check Codes

Digital Communications:
- Digital modulation techniques
- Optimum receivers for AWGN channels
- Non coherent receivers
- Signal design for bandlimited channels
- Receivers for AWGN channels with ISI
- Equalization
- Synchronization
- An introduction to wireless communications
- Multiple access technologies

Grading Scheme:

S.No.	Grading Component	Marks
1.	Quizzes (best 2 out of 3)	20
2.	Mid-semester examination	30
3.	End-semester examination	50

Class Policies:

- You are expected to attend all the classes.
- You should report for the class on time.
- You are expected to actively participate in class discussions.
- Homeworks will be assigned periodically.
- Makeup examination (missed quizzes/midsem/endsem) will be allowed only for those students who have SUGC approved leave. Request for makeup examination should be made within a week for missed exam.
- All exams will be closed book, closed notes exams.
- Lecture notes will be posted at Brihaspati.
- Class announcements will be sent by e-mail. You are expected to regularly check your e-mails.

Books:

- Information Theory:
    - James L. Massey, Lecture notes on "Applied Digital Information Theory-I" (http://www.isiweb.ee.ethz.ch/archive/massey_scr/).
    - Thomas M. Cover, "Elements of Information Theory", 2nd Edition, John Wiley & Sons (available in cheap edition).
    - Robert G. Gallager, "Information Theory and Reliable Communication", 1st Edition, John Wiley.
    - David MacKay, "Information Theory, Inference & Learning Algorithms", 1st Edition, Cambridge University Press (available in cheap edition).
    - Raymond Yeung, "A First Course in Information Theory", 1st Edition, Springer.
    - Richard B. Wells, "Applied Coding & Information Theory for Engineers", 1st Edition, Pearson Education Limited (available in cheap edition).
- Coding Theory:
    - Shu Lin & Daniel J. Costello, Jr., "Error Control Coding", 2nd Edition, Prentice Hall (available in cheap edition).
    - Todd Moon, "Error Correction Coding: Mathematical Methods and Algorithms", 1st Edition, Wiley India Pvt. Ltd. (available in cheap edition).
    - Huffman & Pless, "Fundamentals of Error Correcting Codes", 1st Edition Cambridge Publishing Co. Pvt. Ltd. (available in cheap edition).
    - Steve Wicker, "Error Control Systems for Digital Communication and Storage", 1st Edition, Prentice Hall.
    - MacWilliams & Sloane, "The Theory of Error-Correcting Codes", 1st Edition, North-Holland Mathematical Library.
    - Johannesson & Zigangirov, "Fundamentals of Convolutional Coding", 1st Edition, Universities Press (India) Limited (available in cheap edition).
    - Richard Blahut, "Algebraic Codes for Data Transmission", 1st Edition, Cambridge University Press.

- Digital Communications:
  - Proakis & Salehi, "Communication Systems Engineering", 5th Edition, Pearson Education Limited (available in cheap edition).
  - Bernard Sklar, "Digital Communications: Fundamentals and Applications", 2nd Edition, Prentice Hall (available in cheap edition).
  - John G. Proakis, "Digital Communications", 4th Edition, Tata-McGraw Hill (available in cheap edition).
  - Edward A. Lee, David G. Messerschmitt and John R. Barry, "Digital Communication", 3rd Edition, Springer-Verlag (available in cheap edition).
  - Stephen G. Wilson, "Digital Modulation and Coding", 1st Edition, Pearson Education (available in cheap edition).
  - Michael Fitz, "Fundamentals of Communications Systems", 1st Edition, Tata-McGraw Hill (available in cheap edition).
  - Ziemer & Tranter, "Principles of Communication: Systems, Modulation and Noise", 5th Edition, John Wiley & Sons (available in cheap edition).
  - Simon & Hinedi & Lindsey, "Digital Communication Techniques: Signal Design and Detection", 1st Edition, Prentice Hall, India (available in cheap edition).
  - Simon Haykin, "Digital Communications", 1st Edition, John Wiley & Sons (available in cheap edition).
  - Taub & Schilling & Saha, "Principles of Communication Systems", 3rd Edition, Tata McGraw Hill (available in cheap edition).
  - Wozencraft & Jacobs, "Principles of Communication Engineering", 1st Edition, Waveland Press.
  - Proakis & Salehi, & Bauch, "Contemporary Communication Systems Using MATLAB and Simulink", 2nd Edition, Thomson Learning (available in cheap edition).