Aims and Objectives: Today’s (modern) communication device — be it the cellphone, the computer connected to Internet, or the satellite TV — is an intelligent machine. The smartphone is “smart” not only because it offers many Apps, but more fundamentally because it actively helps its owner — without the owner’s awareness — in the process of communication. The messages (audio, video, images, etc.) are “understood” by the communication device and are compressed before the transmission (similar to how the essence of a lengthy speech by a politician is often summarized by a journalist before it is succinctly published in a newspaper). The smartphone also intelligently overcomes the effect of noise and interference during the message transmission (similar to how your brain can infer the message even though it hears only a few of the words spoken by your friend because he/she is talking to you while standing near a Navaratri Garba loudspeaker) so that its owner can hear clean, uninterrupted, speech or watch videos that do not buffer.

The course CT11 introduces the students to the various machine intelligence (MI) and machine learning (ML) techniques that empower the modern communication systems. The course demonstrates application of elegant mathematical principles — which generally apply to the Artificial Intelligence (AI) techniques — to practical engineering design of the communication systems. The students gain hands-on skills on these topics by performing software laboratory experiments throughout the semester and by completing one project in the semester.

Course Description:

- **Information Theoretic Limits and Power versus Bandwidth Tradeoff.** Power and bandwidth efficiencies, and trade-off between them, channel capacity, entropy
- **Introduction to Signals and Systems.** Fourier Transformation, Fourier Series, Discrete Time Fourier Transform, Linear Shift Invariant (LSI) systems, impulse response, frequency response
- **Digital Modulation Schemes.** Base band and bandpass communication, PSK and QAM modulation, spectral characteristics of digitally modulated signals
- **Design of Receivers and Demodulators.** Elements of probability and estimation theories, Bayes’ rule, application of Bayes’ rule in binary PSK demodulation, probability of demodulation error
- **Analog Communication Schemes.** Double Side Band and Single Side Band Amplitude Modulation, Frequency and Phase Modulation, Spectral characteristics of digitally modulated signals
• *Channel Coding Schemes.* Linear block codes, convolution codes, LDPC Codes, decoding of block codes, Viterbi algorithm, Message Passing algorithm

• *Organization of Communications Systems.* wired and wireless communication system organization, seven layer OSI model, satellite communication systems, fiber optic communication systems

References:


Homework and Projects:

• Five to six ungraded homework assignments, more frequent at the start of the semester, and becoming less frequent as the semester progresses.

• Six to eight laboratory exercises (one to two weeks per exercise, a three-hour lab session per week)

• An end-of-the-semester project

Exams: Two mid-semester and one end-of-the-semester examination.

Honor Policy: The students may confer with the classmates on interpretation and approach to solving homework, lab exercises and the project, however, the final submission should entirely be the student’s own work. All outside sources of information should be clearly referenced.

Grading Policy:

• Two mid-term exams: 20% each

• Final Exam: 30%

• Project: 15%

• Laboratory Work: 15%

• Ungraded Homework and Interactivity in the Class: 5%

Credit Structure: L-T-P-Cr: 3-0-3-4.5

Course Type: BTech First Year Core Course