

1. *Course number and name*

ENGR 449: Communication Systems

2. *Credits and contact hours*

3 credit hours; three 50-minute lecture sessions/week, or two 1-hr-15-minute lecture sessions/week, depending on semester

3. *Instructor's or course coordinator's name*

Instructor: Prof. Murthy

Course coordinator: Tom Holton, Ph.D.

4. *Text book, title, author, and year*

Lathi, B. P. *Modern Digital and Analog Communication Systems*. 3rd ed. Oxford University Press, 1998.

a. Other supplemental materials

1. Carlson, A. B. *Communication Systems*, 3rd ed. McGraw Hill, 1986.

2. Couch, L. W. *Digital and Analog Communication Systems*. Macmillan, 1987.

3. Sklar, B. *Digital Communications: Fundamentals and Applications*. Prentice Hall, 1988.

5. *Specific course information*

a. Brief description of the content of the course (catalog description)

Review of analog signal and system analysis in the time and frequency domains. AM, FM, and PM modulation and demodulation techniques. Pulse modulation techniques. Digital modulation systems. Error-correcting coding: Block and convolutional codes. Advanced communications technologies.

b. Prerequisites or co-requisites

A grade of C- or better in ENGR 305

c. Indicate whether a required, elective, or selected elective course in the program

Required for Electrical Engineering

Elective for Computer Engineering

6. *Specific goals for the course*

a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.

- The student can sketch signal waveforms before and after amplitude modulation both in the time and frequency domains.
- The student can design a demodulator given a modulator.
- The student understands SSB, VSB, and QAM.
- The student is able to compare modulation schemes regarding their power and bandwidth efficiencies.
- The student demonstrates an understanding of mathematics associated with frequency and phase modulation and demodulation.
- The student can sketch signal waveforms before and after frequency modulation both in the time and frequency domains.
- The student can design an FM demodulator.
- The student demonstrates an understanding of how sampling rate is related to aliasing in converting analog signals to discrete samples.
- The student understands the advantages of digital communications over analog communications.
- The student understands how PCM is encoded and the reasons behind the resulting bit rate.
- The student understands why digital data are line coded and pulse shaped before transmission.
- The student understands why ISI is caused by pulse shaping and what the Nyquist filter is. The student can perform scrambling and is able to design a descrambler given the scrambler.
- The student understands equalization and is able to design a linear equalizer. The student understands digital modulation.
- The student can sketch the waveforms of digitally modulated signals for ASK, PSK, FSK, and digital QAM.
- The student is able to draw the constellation diagrams for BPSK, 8PSK, 16 PSK, 4QAM, 16 QAM.
- The student knows cumulative distribution function and probability density function and their properties.
- The student can analyze the performance of the binary symmetric channel.
- The student can analyze the performance of digital modulation (e.g. BPSK) in an AWGN channel.
- The student can perform block coding and decoding.
- The student can obtain the parity-check matrix given the generator matrix and vice-versa. The student can construct the trellis diagram of a convolutional code
- The student can perform decoding of convolutional codes using the Viterbi algorithm.
- The student demonstrates an understanding of mathematics associated with amplitude modulation and demodulation.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

Course addresses ABET Student Outcome(s): a, b, c, e

7. Brief list of topics to be covered

- Amplitude modulation and demodulation
- Frequency modulation and demodulation
- Sampling theorem, PAM and PCM
- Line coding and pulse shaping
- Digital modulation techniques: BPSK, QPSK and FSK
- Probability and random processes. Gaussian and uniform distributions.

- Error-correcting coding. Linear and convolutional codes
- Advanced communications technologies