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**  
   
   **a. Other supplemental materials**  

5. **Specific course information**  
   **a. Brief description of the content of the course (catalog description)**  

   **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