1. **Course number and name**
   EE 451: Digital Communication Systems

2. **Credits and contact hours**
   3.0 (three lecture hours per week)

3. **Instructor's or course coordinator's name**
   Thomas R. Fischer

4. **Text book, title, author, and year**
   B. P. Lathi and Z. Ding. 2009. *Modern Digital and Analog Communication Systems* (4th ed.). Oxford University Press.
   Other supplemental materials
   Instructor notes will be provided for some topics.

5. **Specific course information**
   a. *Catalog description:* Digital communication techniques; performance of digital communication systems in noise; matched filter detection; quantization.
   b. *Prerequisites or co-requisites:* E E 341 with a C or better, STAT 360 with a C or better, or STAT 443 with a C or better; certified major in Electrical Engineering, Computer Science, or Computer Engineering.

6. **Specific goals for the course**
   Each student successfully completing the course will
   - Understand the relationship between entropy and lossless encoding rate, and be able to design Huffman codes (1)
   - Understand the basic concepts of linear binary block and convolutional codes, including maximum likelihood decoding and the analysis of code performance to determine probability of decoding error (1)
   - Understand basic digital signaling formats including amplitude modulation, phase shift keying, and partial response signaling, and be able to analyze the performance of such methods when used over an additive white Gaussian noise channel (1)
   - Understand the principles of matched filter and correlator receivers, orthogonal signal construction, and how pulse shape can be selected to control system bandwidth (1)
   - Understand how coding and modulation can be combined to design a coded modulation communication system (1)
   - Implement, at the simulation level, a coding or modulation system that uses Monte Carlo methods to estimate the maximum likelihood decoding performance (1, 6)

7. **Brief list of topics to be covered**
   - Review of discrete probability. Binary Symmetric Channel
   - Lossless coding: Entropy, Huffman codes, runlength codes

- Block codes, maximum likelihood decoding, probability of error analysis
- Convolutional codes, trellis diagram, and Viterbi Algorithm (VA)
- Inner product, orthogonality, basis sets
- Scalar quantization
- Equalization
- Baseband signaling: M-ary PAM, probability of error analysis
- Pulse shaping, intersymbol interference, and raised cosine pulses
- Matched filter and correlation receiver structure
- Partial response signaling: hard-decision detection; soft-decision VA detection
- Passband signaling and performance analysis; QAM, PSK, FSK
- Combined coding and modulation
- OFDM and Power allocation
- Exams and Review