EEL 6550 Error Control Coding

1. Catalog Description – (3 credits) Introduction to abstract algebra, block coding and decoding, convolutional coding and decoding, trellis coded modulation, and run-length-limited codes.

2. Pre-requisites - EEL 5544 or equivalent, Co-requisite - EEL 5544 or 4516.

3. Course Objectives - the student should be able to list advantages and disadvantages of ARQ and FEC, select an appropriate error control technique and/or code for a communication system, compare the performance of different error control schemes, and implement decoders for block, LDPC, convolutional, turbo, and trellis codes.

4. Contribution of course to meeting the professional component (ABET only undergraduate courses) – N/A

5. Relationship of course to program outcomes: Skills student will develop in this course (ABET only undergraduate courses) – N/A

6. Instructor – Dr. John Shea
   a. Office location: 439 NEB
   b. Telephone: 352-575-0740
   c. E-mail address: jshea@ece.ufl.edu
   d. Class Web site: https://elearning2.courses.ufl.edu/
   e. Office hours: Mon. and Tues. 10:00–11:30 AM

7. Teaching Assistant -
   a. Office location:
   b. Telephone:
   c. E-mail address:
   d. Office hours:

8. Meeting Times -

9. Class/laboratory schedule, i.e., number of sessions each week and duration of each session - 3 class periods consisting of 50 minutes each

10. Meeting Location -

11. Material and Supply Fees -

12. Textbooks and Software Required -
   a. Title: Channel Codes: Classical and Modern
   b. Author: William E. Ryan and Shu Lin
d. ISBN number:

13. Recommended Reading -

14. Course Outline –
- Introduction
  - Intro to modulation and signal spaces
  - Types of error control
  - Types of channels
  - The Hamming code
  - Optimal and suboptimal decoding algorithms
  - Intro to channel capacity and the channel coding theorem
- Block Codes
  - Abstract Algebra I
    - Groups
    - Fields
    - Binary field arithmetic
    - Vector spaces over fields
    - Matrices over fields
  - Linear Block Codes
    - Encoding
    - Decoding
    - Syndrome and error detection
    - Distance and error-detection and -correction properties
    - Array and syndrome decoding
    - Probability of error
    - Modified linear codes
  - Abstract Algebra II
    - Rings
    - Rings of polynomials
    - Quotient rings
- Cyclic codes
– Properties
– Encoding and decoding
– CRC codes
  o Reed-Muller codes (MAYBE)
    – Majority logic decoding
  o Low-Density Parity-Check Codes
    – Belief propagation/Gallagher Decoding
  o Abstract Algebra III
    – Extension fields
    – Construction of Galois Field GF(2m)
    – Properties of Galois Field GF(2m)
    – GF(2m) arithmetic
  o BCH and Reed-Solomon Codes
  o Block Code Performance Analysis

• Convolutional and Related Codes
  o Linear, Nonrecursive Convolutional Codes
    – Encoding
    – Properties
    – Graphs, state diagrams, and trellises
    – Distance properties
    – Maximum likelihood (Viterbi) decoding
    – Performance analysis
    – Punctured codes
  o Turbo Codes
    – Recursive, systematic convolutional codes
    – MAP decoding
    – Distance properties
    – Performance bounds
    – Interleaver design
  o Trellis Codes
    – M-ary signaling
    – Set partitioning
    – Distance properties
    – Multiple TCM
    – Decoding and performance

15. Attendance and Expectations - Cell phones are to be silenced. No text messaging during class or exams.

Attendance is not mandatory. However, students are expected to know all material covered in class, even if it is not in the book. Furthermore, the instructor reserves the right to give unannounced “pop” quizzes with no make-up option. Students who miss such quizzes will receive zeros for that grade.
Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at: 
https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

16. Grading – Grading will be based on two exams (40% each), homework and quizzes (10%) and participation (10%). The participation score will take into account in-class participation, e-mail or instant messaging exchanges, discussions outside of class, etc. There is no grader for this class, so homework will generally be graded on a 0 or 1 scale. No formal project is required, but, as mentioned above, students may be required to use MATLAB in solving some homework problems. When students request that a submission (test or homework) be regraded, we reserve the right to regrade the entire submission rather than just a single problem.

17. Grading Scale - A grade of > 90% is guaranteed an A, > 80% is guaranteed a B, etc.

“In order to graduate, graduate students must have an overall GPA and an upper-division GPA of 3.0 or better (B or better). Note: a B-average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:

http://gradschool.ufl.edu/catalog/current-catalog/catalog-general-regulations.html#grades

18. Make-Up Exam Policy - If you have a University-approved excuse and arrange for it in advance, or in case of documented emergency, a make-up exam will be allowed and arrangements can be made for making up missed work. University attendance policies can be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Otherwise, make-up exams will be considered only in extraordinary cases, and must be taken before the scheduled exam. The student must submit a written petition to the instructor two weeks prior to the scheduled exam and the instructor must approve the petition.

19. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

“…failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures (http://www.dso.ufl.edu/sccr/procedures/honorcode.php)
20. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. UF Counseling Services – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
   · UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
   · Career Resource Center, Reitz Union, 392-1601, career and job search services.

22. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.