ET680 Communications and Fields – 4 sem. hrs. Fall 2017 RevA

University of New Hampshire @ Manchester – Electrical Engineering Technology

Catalog Data: Topics include Fourier series analysis; Fourier Transform and its properties; convolution; correlation, including PN sequences; modulation theory; encoding and decoding of digital data (NRZ-M, NRZ-S, RZ, Bi-phase-L and Manchester encoding); antennas and antenna patterns; Radar Range Equation and an introduction to Information Theory. Prerequisites: Differential and Integral calculus. Lab. 4cr.

Room Assignment: P142 – Lecture; P146/P114 - Laboratory

Recommended References / Not required: *Modern Digital and Analog Communications Systems*: B.P. Lathi & Ding; 4th edition; Oxford; Note 3rd edition is fine if you can find one for much less $$; Schaums Outline – *Signals and System*

Faculty: David A. Forest – Associate Professor Emeritus - Electrical Engineering Technology

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Course Outcomes: The student will receive a solid foundation in signal analysis that will serve as a baseline for analysis of modulation techniques and other communication topics. This course will provide the necessary background required and is a prerequisite for ET 788 "Introduction to DSP".

- **Topics: Fourier series analysis –Trigonometric and Exponential**
- **Fourier transform and its properties**
- **Convolution techniques**
- **Correlation of signals**
- **Pseudo Random (PN) sequences and their correlation**
- **Modulation Theory: Normal AM, AM suppressed carrier (AMSC)**
  - **Phase Modulation, Frequency Modulation (Wide**
  - **Band), Digital techniques**
- **Digital sampling of Analog signals and their associated spectrums**
- ***Noise Figure; derivation of the noise figure of cascaded amplifiers; placement of amplifiers based on its noise figure and gain.***
- ***Measure of relative amplifier linearity using 1db compression point***
- **Encoding of digital data -- NRZ-M, NRZ-S, RZ and bi-phase signals; *this material will be covered in a prelab session.***
- **Bit Error Rate (BER) analysis over a noisy RF link**
- **Antennas and antenna patterns**
- **Radar range equation**
- **Introduction to Information Theory**

Notes: **(a) The above topics that are *italicized* are new this academic year as a results of input from BAE Systems at our recent Industrial Advisory Board meeting. (b) Some topics may be discussed in a different order than shown.**

- **Labs: Generation of Pseudo Noise (PN) sequences**
- **Correlation of PN sequences with and without bit errors in the codes**
- **Encoding of digital data listed above; NRZ-M etc. *usually two lab sessions***
- **Spectral analysis of base band signals**
- **Spectral analysis of sampled continuous signals**
- **AM and AMSC spectral analysis**
- **FM modulation and verification of Bessel function tables for various modulation indexes**

Lab reports are due two weeks after the lab session, with no exception.
"*Timeliness is a virtue*"

Grading:

Midterm 1 ---- 100 pts.
Midterm 2 ---- 100 pts.
Quizzes four --- 20 pts = 80 pts.
Final Exam ----- 160 pts.
Labs - 7 labs @ 20 pts/lab = 140pts; *Teamwork is essential while performing in the laboratory.*

Total = 580 pts.

Homework: Homework is not given a letter grade but must be submitted when due for review. *Late homework will not be accepted.*

Student Outcomes: ETAC – ABET Criterion #3 (a – k)

Student Outcome (b) an ability to apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies

Description of data for assessment: Two graded homework sets and associated lab reports. The students are required to do Fourier analysis for two ensemble sets of pulse trains; a) the pulse width is held constant and the frequency is changed and b) the frequency is held constant and pulse width is changed. The technical understanding and mathematical facility required is extensive involving the use of

integral calculus. The analysis is then verified in the laboratory and a report is written. This data is provided to ETAC – ABET for assessment in the accreditation process.

Other Notes: Please be on time for class as it sometimes disruptive to the class in general. I will do my best to start the class on time.

Attendance Policy: Students are expected to attend scheduled classes and labs. There is a lot of information conveyed in class that does not appear on exams and quizzes. Missing classes will affect your grade as listed below. At discretion of the instructor the following grade deductions will be implemented.

- **6 classes – 1/3rd grade**
- **9 classes – 2/3rd grade**
- **12 classes – 1 full grade**

Prepared by: David A. Forest

Date: August 27, 2017