ELECTRICAL AND COMPUTER ENGINEERING 3614

INTRODUCTION TO COMMUNICATION SYSTEMS

PART I.

- Catalog Description:

  Analysis and design of analog and digital communication systems based on Fourier analysis. Topics include linear systems and filtering, power and energy spectral density, basic analog modulation techniques, quantization of analog signals, line coding, pulse shaping, and transmitter and receiver design concepts. Applications include AM and FM radio, television, digital communications, and frequency-division and time-division multiplexing. (3C, 3H).

  Pre: ECE 2704

- Course Number: 3614

- Transcript Title: INTRO COMM SYSTEMS

PART II.

- Major, Measurable Learning Objectives

  Having successfully completed this course, the student will be able to:

  a. Compute the Fourier transform and the energy/power spectral density of communications signals.
  b. Calculate the bandwidth and signal-to-noise ratio of a signal at the output of a linear time-invariant system given the signal and the power spectral density of the noise at the input of the system.
  c. Explain the operation of amplitude and angle modulation systems in both the time and frequency domains including plotting the magnitude spectra and computing the power and bandwidth requirements of each type of signal.
  d. Design a basic analog or digital communications system including: (1) the selection of a digital or analog modulation format, (2) the block-diagram design of a transmitter for the system, (3) the block-diagram design of a superheterodyne receiver for the system, (4) the design of a time or frequency division multiplexing scheme, as appropriate, and (5) the choice of an appropriate pulse shape and analog to digital converter (if needed) to meet performance requirements.
  e. Evaluate a given analog or digital communications system in terms of the complexity of the required transmitters and receivers and the power and bandwidth requirements of the system.

PART III. Justification

- Reason for Teaching the Course:

  Communication is a major and growing discipline in electrical engineering and impacts every major area of electrical engineering. This course provides the basic concepts for analyzing communication systems including an introduction to spectral analysis, modulation, and multiplexing. These concepts are utilized throughout electrical engineering.

- Level Justification:

  To comprehend the mathematics and concepts used in the analysis, the students must have a basic class in signals and systems that covers transform theory and its application to filtering. This mathematical background requirement, the needed conceptual sophistication, and the prerequisites require the class to be taught at the junior level.

- Modification:

  Syllabus has been modified to provide more time on digital communication to reflect the fact that virtually all modern communication systems are digital. Probability and stochastic processes have been largely eliminated from this course. This topic is covered more completely in ECE 4634. Consequently, the co-requisite for STAT 4714 has been removed; STAT 4714 is already a prerequisite for ECE 4634.

- Graduate Credit:

  None.

PART IV. Prerequisites and Co-requisites

This course assumes that students have had an introduction to system analysis using convolution, Fourier transforms and series, Laplace transforms, and frequency response. This material is covered in the course ECE 2704 and its prerequisites.

PART V. Texts and Special Teaching Aids

- Required Texts:

  B. P. Lathi. *Modern Digital and Analog Communication Systems*, third edition. Oxford University Press: New York, 1998, 781 pages.

- Required Course Materials:

  The Mathworks. *MATLAB and Simulink Student Version*, release 14.

  Optional:

PART VI. Syllabus

	Percent of Course
1. Signals: Fourier Series and Fourier Transform	20%
2. Systems: Linear Systems and Filtering, Energy and Power Spectral Density, Bandwidth and Rise Time	15%
3. Amplitude Modulation: AM Radio, TV, Superheterodyne Receivers, FDM	15%
4. Angle Modulation: FM Radio, Stereo, Bandwidth	10%
5. Sampling and PCM: Sampling Theorem, Pulse-Code Modulation, Quantization	20%
6. Basic Digital Communications: Line Coding, Pulse Shaping, TDM	20%

PART VII. Old (Current) Syllabus

	Percent of Course
1. Review of Fourier series and Fourier transforms, properties of the Fourier transform	20%
2. Linear systems and filtering: bandwidth and rise time	10%
3. Random variables: binomial, Poisson, exponential	10%
4. Random processes, noise, power spectral density, signal-to-noise ratio, matched filter	10%
5. Sampling theorem, pulse amplitude modulation, time division multiplexing, intersymbol interference and raised cosine channel shaping	12%
6. Analog-to-digital conversion, pulse-code-modulation, quantization noise, uniform and non-uniform quantizers, T1 transmission system	18%
7. Amplitude Modulation: Am radio, TV, heterodyne receivers	10%
8. Frequency Modulation: FM radio, stereo, bandwidth	10%

PART VIII. Core Curriculum

PART IX. Design Justification

Form ABET-1

Course : __ECE 3614____ Prepared by : __A. B. MacKenzie_ Date : _11 Feb 2005__

	Course Learning Objective	Overall Educational Objective (Enter level number defined below)										
		A	B	C	D	E	F	G	H	I	J	K
1	Compute the Fourier transform and the energy/power spectral density of communications signals.	1	3	4	4	3	4	4	4	4	4	2
What will be measured to demonstrate that this learning objective has been achieved? Homework, Tests												
2	Calculate the bandwidth and signal-to-noise ratio of a signal at the output of a linear time-invariant system given the signal and the power spectral density of the noise at the input of the system.	1	4	4	4	2	4	4	4	4	4	2
What will be measured to demonstrate that this learning objective has been achieved? Homework, Tests												
3	Explain the operation of amplitude and angle modulation systems in both the time and frequency domains including plotting the magnitude spectra and computing the power and bandwidth requirements of each type of signal.	2	4	3	4	1	4	4	4	2	4	1
What will be measured to demonstrate that this learning objective has been achieved? Homework, Tests												
4	Design a basic analog or digital communications system including: (1) the selection of a digital or analog modulation format, (2) the block-diagram design of a transmitter for the system, (3) the block-diagram design of a superheterodyne receiver for the system, (4) the design of a time or frequency division multiplexing scheme, as appropriate, and (5) the choice of an appropriate pulse shape and analog to digital converter (if needed) to meet performance requirements.	2	4	1	3	2	4	2	3	2	4	1
What will be measured to demonstrate that this learning objective has been achieved? Homework, Tests, Project												
5	Evaluate a given analog or digital communications system in terms of the complexity of the required transmitters and receivers and the power and bandwidth requirements of the system.	2	4	2	4	1	4	3	4	3	4	1
What will be measured to demonstrate that this learning objective has been achieved? Homework, Tests, Project												

Overall Educational Objectives

A. To develop the ability to apply knowledge of mathematics, science, and engineering
B. To develop the ability to design and conduct experiments, as well as to analyze and interpret data
C. To develop the ability to design a system, component, or process to meet desired needs
D. To develop the ability to function on multi-disciplinary teams
E. To develop the ability to identify, formulate, and solve engineering problems
F. To provide an education on professional and ethical responsibility
G. To develop the ability to communicate effectively
H. To provide an education on the impact of engineering solutions in a global and societal context
I. To develop the ability to engage in life-long learning
J. To provide an education on contemporary issues
K. To develop the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Level

1. Major emphasis of the course.
2. Discussed in the course and covered in homework or quiz.
3. Mentioned in the course but not covered in homework or quiz.
4. Not mentioned in the course.

Form ABET-1