Electrical and Computer Engineering Course Syllabus

Instructor:	Prof. Henry Pfister	**E-mail:**	hpfister@tamu.edu
Office / Hour:	WERC 235A / W 2-3 pm	**Phone:**	(979) 862-3198
Class Room:	ZEC 223D	**Class Time:**	T-TH 3:55-5:10 PM

Course Name: **ECEN 647**

Course Title: **Information Theory**

Prerequisite(s): ECEN 646

Required Text(s): Elements of Information Theory by Thomas Cover and Joy Thomas, Wiley 2006.

Other Text(s): Information Theory and Reliable Communication by Robert Gallager, Wiley 1968.

Course Objectives:

1. Explore Shannon's mathematical approach to communication. Explore fundamental approaches to quantifying the amount of information contained in a message or transmitted by a signal.
2. Introduce mathematical models for discrete information sources and derive fundamental limits on data compression. Discuss source codes, entropy, Kraft's inequality, Huffman codes, typical sequences, the AEP, and Fano's inequality. State and prove the source coding theorem.
3. Describe the main tools of information theory: joint entropy, conditional entropy, mutual information. State and prove standard identities and bounds.
4. Introduce mathematical models for noisy channels and derive fundamental limits on rates of communication. Discuss DMCs, joint typicality, ans the data processing inequality. State and prove the channel coding theorem.
5. Extend previous result to continuous random variables. Discuss differential entropy, the continuous AEP, and the channel coding theorem for Gaussian channels.
6. Explore advanced topics in information theory such as rate-distortion theory, Slepian-Wolf Coding, multiple-access channels, and error exponents.
7. Engage the student in an active learning experience. Expose the student to search engines, scholastic resources, research tools, indexes and databases. Prepare the student to become an active contributor to the common body of knowledge.

Course Topics and Hours:

Unit	Topics	Hours
1	Source Coding	4.5
2	Entropy and Mutual Information	4.5
3	Typical Sequences and the AEP	3
4	Channel Coding	6
5	Differential Entropy and the Gaussian Channel	6
6	Slepian-Wolf, Rate-Distortion, and Multiple Access	6
7	Stochastic Processes	3
8	Chernoff Bounds, Types, and Error Exponents	6
9	Advanced Topics	3
	Total Hours	42

Lecture Schedule: 2 meetings / week, 125 minutes total

Student Evaluation:

Homework	20%	Roughly 12 assignments throughout the semester
Midterm Exams	40%	Two equally weighted midterm exams
Final Exam	30%	Comprehensive final exam
Project	10%	Use the tools acquired in this class to solve an engineering problem

Final Exam: Tuesday, May 10, 1:00 - 3:00 PM

Rules and Guidelines:

The class shall follow all established policies of TAMU. This includes the Aggie Honor Code and the Americans with Disabilities Act (ADA). The honor code is "An Aggie does not lie, cheat, or steal or tolerate those who do." and more information is available from `http://www.tamu.edu/aggiehonor`. The ADA is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities and more information is available from `http://disability.tamu.edu`. Links to these and other policies can be found at `http://www.ece.tamu.edu/~hpfister/courses.html`.

Tentative Schedule:

Week	Date	Tuesday	Thursday	Notes
1	1/17	1	2	
2	1/24	3	4	
3	1/31	5	6	
4	2/7	7	8	Guest
5	2/14	9	10	
6	2/21	11	12	
7	2/28	13	14	
8	3/7	15	16	
9	3/14	X	X	Spring Break
10	3/21	17	18	
11	3/28	19	20	
12	4/4	21	22	Mon. Last Q-Drop
13	4/11	23	24	
14	4/18	25	26	
15	4/25	27	28	Thur. Last Class

Lecture Topics:

(1-3) Source Coding (Ch. 5)

(4-7) Entropy & Mutual Information (Ch. 2)

(8-9) Typical Sequences & AEP (Ch. 5)

(10-13) Channel Coding (Ch. 7)

(14-15) Differential Entropy (Ch. 8)

(16-17) The Gaussian Channel (Ch. 9)

(18-19) Rate-Distortion (Ch. 10)

(20-22) Network Problems (Ch. 15)

(23-24) Stochastic Processes (Ch. 4)

(25-28) Chernoff Bound & Types (Ch. 11)