MISSISSIPPI STATE UNIVERSITY
Department of Electrical & Computer Engineering

ECE8813 — Information Theory — Spring 2011

SYLLABUS—GENERAL INFORMATION

Course: ECE8813 — Information Theory, Spring 2011, Section: 01, Credits: 3
Meeting time: 10:00am–10:50am MWF
Meeting location: Rm. 213 Simrall
Web page: `http://www.ece.msstate.edu/~fowler/Classes/ECE8813`
Email list: `ece8813@ece.msstate.edu`
Email list archive: `http://www.ece.msstate.edu/pipermail/ece8813`

Instructor: Dr. James E. Fowler
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Phone: 325-3640
Office Hours: 12–3pm MW

Prerequisite: ECE8803 (Random Signals & Systems) or permission of instructor

Text: T. M. Cover and J. A. Thomas, *Elements of Information Theory*, 2nd ed., John Wiley & Sons, Inc., 2006. ISBN: 978-0-471-24195-9.

Course Objectives: This course provides an introduction to information theory and its application to signal representation and signal communication. Attention is focused on material that is rather advanced mathematically, and a solid background in the theories of probability and random processes is assumed. The student will gain an understanding of the nature of information as well as how information is represented and communicated, all from a mathematical perspective. Although the focus is on theoretical concepts, some practical implications of information theory in the areas of signal processing and communications will be explored also.

Course Topics:

- ❑ Entropy
- ❑ The Asymptotic Equipartition Property
- ❑ Entropy rates of stochastic processes
- ❑ Data compression
- ❑ Channel capacity
- ❑ Differential entropy
- ❑ The Gaussian channel
- ❑ Rate-distortion theory

Grading: The course grades will be based upon two *midterm exams* and one *final exam*. Homework will be assigned, but it will be neither collected nor graded.

Midterm Exam I 30%
Midterm Exam II 30%
Final Exam 40%

Honor Code: Mississippi State University has an approved Honor Code that applies to all students. The code is as follows: "As a Mississippi State University student I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do." Upon accepting admission to Mississippi State University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor Code. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the MSU community from the requirements or the processes of the Honor Code. For additional information please visit: `http://www.honorcode.msstate.edu/`

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SYLLABUS—SCHEDULE

Period	Date	Topic	Sections
1	Jan. 5	Introduction to information theory	1.1
2	7	Entropy, joint entropy, & conditional entropy	2.1–2.2
	10	*no class*	
3	12	Relative entropy & mutual information	2.3–2.5
4	14	Jensen's inequality, the log-sum inequality, & the data-processing inequality	2.6–2.8
	17	*Holiday – no classes*	
5	19	Sufficient statistics & Fano's inequality	2.9–2.10
6	21	The Asymptotic Equipartition Property (AEP)	3.1
7	24	Consequences of the AEP	3.2–3.3
8	26	Random processes & the Markov chain	4.1
9	28	Entropy rate	4.2
10	31	The Kraft inequality	5.1–5.2
11	Feb. 2	Optimal codes	5.3–5.5
12	4	Optimal codes	5.3–5.5
13	7	Huffman codes	5.6–5.8
14	9	Shannon-Fano-Elias coding	5.9
15	11	Arithmetic coding	
16	14	Optimality of the Shannon code	5.10
17	16	Discrete channels & channel capacity	7.1–7.3
18	18	Channel capacity & channel codes	7.1–7.3
19	21	The Joint AEP	7.5–7.6
20	23	The channel coding theorem	7.7
21	25	The channel coding theorem & its converse	7.9–7.10
22	28	Hamming codes	7.11
23	Mar. 2	The joint source-channel coding theorem	7.12–7.13
24	4	Differential entropy	8.1–8.3
25	7	Joint & conditional differential entropy, mutual information	8.4–8.7
26	9	The Gaussian channel	9.1–9.2
27	11	Modulation, bandlimited Gaussian channels	9.3
	14	*Spring break – no classes*	
	16	*Spring break – no classes*	
	18	*Spring break – no classes*	
28	21	Quantization	10.1
29	23	Rate-distortion theory	10.2
30	25	The rate-distortion theorem	10.5
	28	*no class*	
	30	*no class*	
	Apr. 1	*no class*	
31	4	Calculation of the rate-distortion function	10.3
32	6	The maximum-entropy principle	12.1–12.2
33	8	Sequence types	11.1
34	11	Sequence types	11.1
35	13	Universal coding	11.3
36	15	Hypothesis testing	11.7
37	18	Distributed source coding	15.4
38	20	The Slepian-Wolf theorem	15.4