COURSE SYLLABUS

Subject: Electrical Engineering
Course Number: 89366
EE 668: Information Theory

Course Introduction

Credit Hours: 3

Prerequisite Courses: EE 513 Stochastic Systems Theory or its equivalent

Method of Instruction: lecture

Instructor: Natalia A. Schmid, Professor

Class Meets: TR from 11 am to 12:15 pm in MRB 109

Course Description:
Mathematical description of channels and sources; entropy, information, data compression, channel capacity, Shannon's theorems, rate-distortion theory, maximum entropy principle, and large deviations theory.

Learner Support

Instructor Office Location: AERB 354

Office Hours: TBA

Instructor Email: Natalia.Schmid@mail.wvu.edu

Phone: (304) 293-9136

Method of Making Appointment: Please send an e-mail

ITS (Technical Support): If you need assistance, please call the ITS Service Desk at 304-293-4444, email ITSHelp@mail.wvu.edu or visit it.wvu.edu/help.

Instructional Materials

Required Instructional Materials:

- T. M. Cover and J.A. Thomas, Elements of Information Theory, John Wiley & Sons, New York, 2006.

Optional Instructional Materials:

- R. G. Gallager, Information Theory and Reliable Communication, John Wiley & Sons, 1968.
- R. E. Blahut, Principles and Practice of Information Theory, Addison-Wesley, 1988.

- Kullback, Information Theory and Statistics, Dover, 1997.
- D. J. C. MacKay, Information Theory, Inference, and Learning Algorithms, Cambridge University Press, 2003. Available at: http://www.inference.phy.cam.ac.uk/mackay/itila/
- J. A. Bucklew, Large Deviation Techniques in Decision, Simulation, and Estimation, New York: Wiley, 1990.

Computer Usage: Several homework problems and the final project will require computer usage. You may select any computer system and programming language to address these problems.

Course Learning Objectives

- Know the definition of measures of information and their properties
- State and prove Asymptotic Equipartition Property
- Know the limits of lossless source coding
- Know Huffman and Shannon-Fano codes
- State and prove Shannon's channel coding theorem and its converse
- Derive the capacity of channels involving Gaussian models for signals and noise
- Know Rate Distortion Theory
- Derive rate distortion results for Gaussian channels
- Know the maximum entropy principle and how to apply it to different estimation problems
- Know the major results within the theory of Large Deviations

---

Course Activities

Major Learning Activities:
This is a lecture class. We will introduce and discuss new concepts in class. However, due to small class size, this semester we can do something more exciting. We will have class discussions, presentations, and take-home projects.

Assessment

Major Assignments/Assessments:
Homeworks: There will be approximately 6 homework assignments. No late homework will be accepted. From each homework set, 3 problems will be selected at random and graded. The contribution of homework assignments towards the final grade will be based on the average of all homework grades.

Examinations: There will be a take home midterm examination and a take home final. The date of the midterm exam will be announced in advance. Alternatively, we will have a small project replacing the two exams. Expect a project assigned after we cover a chapter from Cover & Thomas.

Ethics:
Interaction among students in EE568 for the purpose of understanding concepts and developing solution strategies on homework assignments is permitted and very much encouraged but submitted homework solutions should be your own effort.

Weight/Distribution of Course Points:
The final grade for the EE568 will be based on the following factors, which will be weighted as indicated.

Homeworks	40%
Midterm Examination	30%
Project	30%

Alternative distribution:	
Homeworks	40%
Multiple projects:	60%

1st assignment: chapter 1 of Cover (pp. 1 - 12)

6 HWs

Topics and Tentative Schedule:
We will cover material in Ch. 1-3, 5, 7-10 of Cover and Thomas (Ed. 2006). Ch. 11 and 12 will be covered as the time permits. The reference material from the textbook is as follows (tentatively):

- Introduction (0.5 weeks)
- Measures of Information and Information inequalities (2 weeks)
- Convergence of sequences of random variables. AEP (1 week)
- Lagrange Multipliers (1.5 weeks)
- Lossless data compression (Huffman, Shannon-Fano codes): Kraft inequality, Shannon's source coding theorem (3 weeks)
- Channel capacity: jointly typical sequences, Fano's inequality, Shannon's channel coding theorem and its converse (2 weeks)
- Differential entropy (1 weeks)
- Gaussian channels (1.5 weeks)
- Rate distortion (2.5 weeks)
- Maximum entropy principle (as the time permits)
- Testing Hypotheses (as the time permits) 2 large deviations

priority ↑ chapter 11 and 12

Response Time and Feedback Plan:
Graded assignments and tests will be returned to students not later than one week after they were handed to the instructor.

Final Grading Scale:
A is guaranteed: 90-100 points
B is guaranteed: 80-90 points
C is guaranteed: 65-80 points

Course and Institutional Policies

Attendance Policy:
Attendance will not be taken. However, you will be responsible for all material covered in class, even if it is not in the textbook. It is your responsibility to make sure that you are present for all

tests, that all assignments are turned in on time, and that you are aware of all announcements made in class.

- Please arrive to class on time.
- Please silence your cell phones.

Late Assignment and Missed Exam Policy:
You are expected to attend the midterm and the final exams at the scheduled times and dates. If you have an unavoidable conflict, please let me know as soon as possible, but no later than one week before the exam. If you miss an exam without first having your absence approved, then you will be given the opportunity to make it up only if you have received approval from the Associate Dean of Academic Affairs.

Institutional Policies:
Students are responsible for reviewing policies on inclusivity, academic integrity, incompletes, sale of course materials, sexual misconduct, adverse weather, as well as student evaluation of instruction, and days of special concern/religious holiday statements.