

CST-601
COURSE DESCRIPTION

Course code number	CST-601	Course Title	Information Theory
Semester hours	3 hours	No. of Credit Units	3
		Course Coordinator	

Course Description

This course covers introduction to information theory, the basic techniques for reasoning under uncertainty, probabilistic (stochastic) systems, entropy rates of a stochastic process, data compression and channel capacity.

Course Objectives

The objective of the course is to

- Understand the ideas of entropy and information content.
- Understand the basic classes of compression techniques
- Know how to apply compression techniques to practical situations.
- Master the basic ideas behind the Shannon Channel Capacity results
- Be able to assess the limitations for data transmission on a given channel

Assessment Plan for the Course

Class Attendance and Participation	-	10%
Quizzes	-	10%
Assignment	-	10 %
Test	-	10%
Final Exam	-	60%

Class Attendance and Participation Policy:

• **Attendance**

Class attendance is **mandatory**. Most of the material you will learn will be covered in the lectures, so it is important that you not miss any of them. You are expected to show up **on time** for class, and **stay for the whole lecture**. Students are expected to attend each class, to complete any required preparatory work (including assigned reading) and to participate actively in lectures, discussions and exercises.

- Mobile phones **must** be silenced and put away for the entire lecture unless use is specified by the instructor. You may not make or receive calls on your cell phone, or send or receive text messages during lectures.
- You are responsible for all material sent as email. Ignorance of such material is no excuse. You are responsible for all materials presented in the lectures.
- Your conduct in class should be conducive towards a positive learning environment for your class mates as well as yourself.

- **Quizzes, assignments, tests and Exam**

Your performance in this class will be evaluated using your scores for attendance, quizzes, homework assignments, two tests and one final examination. There are no planned extra credit projects or assignments to improve your grade.

We will take a short quiz for every lecture.

There will be 12 homework assignments, roughly one per week. Please show all your work and write or type your assignments neatly. Credit cannot be given for answers without work (except on true-false, always-sometimes-never, or other multiple choice questions).

Test will start after two or three chapters finished and the coordinator will announce the date for the test.

Any assignment or quiz or test is simply missed, regardless of the reason why (e.g. illness, work, traffic, car trouble, computer problems, death, etc.), and **earns a grade of zero**. You are strongly encouraged to complete all assignments and attend all quizzes so that you can check that you understand the material and can throw out bad grades, or grades for which you had to miss an assignment or quiz for a valid reason. **Late submissions will not be accepted for any graded activity for any reason.**

- **There are no extra credit opportunities.**

Students may not do additional work nor resubmit any graded activity to raise a final grade.

- **Exam**

The exam will be conducted on-campus, in a classroom. The dates/times/locations will be posted on Board as soon as possible.

For this course, the following additional requirements are specified:

All work submitted for a grade must have been prepared by the individual student. Students are expressly prohibited from sharing any work that has been or will be submitted for a grade, in progress or completed, for this course in any manner with a person other than the instructor and teaching assistant(s) assigned to this course). Specifically, students may not do the following, including but not limited to:

- Discuss questions, example problems, or example work with another person that leads to a similar solution to work submitted for a grade.
- Give to, show, or receive from another person (intentionally, or accidentally because the work was not protected) a partial, completed, or graded solution.
- Ask another person about the completion or correctness of an assignment.
- Post questions or a partial, completed, or graded solution electronically (e.g. a Web site).
- All work must be newly created by the individual student for this course. Any usage of work developed for another course, or for this course in a prior semester, is strictly prohibited without prior approval from the instructor.
- Posting or sharing course content (e.g. instructor provided lecture notes, assignment directions, assignment questions, or anything not created solely by the student), using any non-electronic or electronic medium (e.g. web site, FTP site, any location where it is accessible to someone other than the individual student, instructor and/or teaching assistant(s)) constitutes copyright infringement and is strictly prohibited without prior approval from the instructor.

Tentative Lesson

No	Chapter
I	Introduction and Preview
II	Entropy, Relative Entropy, and Mutual Information
1	Entropy
2	Joint Entropy and Conditional Entropy
3	Relative Entropy and Mutual Information
4	Relationship Between Entropy and Mutual Information
5	Chain Rules for Entropy, Relative Entropy, and Mutual Information

6	Jensen's Inequality and Its Consequences
7	Log Sum Inequality and Its Applications
8	Data-Processing Inequality
9	Problems
III	Asymptotic Equipartition Property
10	Asymptotic Equipartition Property Theorem
11	Consequences of the AEP: Data Compression
12	High-Probability Sets and the Typical Set
13	Problems
IV	Entropy Rates of a Stochastic Process
14	Markov Chains
15	Entropy Rate
16	Example: Entropy Rate of a Random Walk on a Weighted Graph
17	Problems
V	Data Compression
18	Examples of Codes
19	Kraft Inequality
20	Optimal Codes
21	Bounds on the Optimal Code Length
22	Kraft Inequality for Uniquely Decodable Codes
23	Huffman Codes
24	Optimality of Huffman Codes
25	Shannon–Fano–Elias Coding
26	Problems
VI	Channel Capacity
27	Examples of Channel Capacity
28	Symmetric Channels
29	Properties of Channel Capacity
30	Problems

Reference Book: Element of information Theory, 2nd edition, by Thomas M. Cover, Joy A. Thomas