Course Mechanics:

Pre-requisites: MTH 201/ECE 270 (Undergraduate course in probability) and ECE 242 (Communication Systems), or instructor permission.
Credit Hours: 4
Lectures: Tue, Thu 4:50-6:05 p.m, CSB 523

Course Objective:

The course aims at providing students a foundation in information theory – the theory that provides quantitative measures of information and allows us to analyze and characterize the fundamental limits of communication systems.

Tentative Course Outline:

1. Introduction: Motivation, applications and related areas, key results related to compression and communications.
2. Measuring Information: Entropy as a unique measure of information, joint and conditional entropy, mutual information, Jensen’s inequality.
3. Asymptotic Equipartition Property (AEP): Strongly and weak typicality, consequences of AEP.
4. Data Compression (discrete sources): Coding for discrete memoryless sources, prefix codes, Kraft inequality, optimal codes, Huffman and Arithmetic coding.
5. Channel Capacity: Examples of channels, jointly typical sequences, the channel coding theorem, converse, error correction codes.
6. Differential Entropy and Rate-Distortion: Continuous random variables, AEP for continuous random variables, relative entropy and mutual information, rate-distortion theory and lossy coding.
7. Selected Topics (subject to time and availability of guest lecturers): Quantum Information Theory, multi-user information theory, distributed source coding.

Note: The course emphasis is on foundational material and latter topics may be dropped if time is a limitation.

Text (required):


References

2. Relevant papers in the development of information theory (some will be made available on-line on the course website).

The text and the reference book are available on reserve at the library for the duration of this semester.
Grading:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Midterm</td>
<td>30%</td>
</tr>
<tr>
<td>Final</td>
<td>40%</td>
</tr>
<tr>
<td>Term Paper</td>
<td>20%</td>
</tr>
</tbody>
</table>

Tentative Exam Schedule:

- **Mid-term Exam**: Thursday, October 18, 2018, in class (subject to change).
- **Final Exam**: Thursday, December 20, 2018, 12:30pm (subject to change)

Instructor:

Prof. Gaurav Sharma  
Office hours: 9:00-10:00am, Thu. Additional times by appointment.  
Office: Hopeman 417  
Homepage: [http://www.ece.rochester.edu/~gsharma](http://www.ece.rochester.edu/~gsharma)

Course Web Sites:

Homework assignments and announcements relating to the class will be posted on the Blackboard course web-site accessible from:  
[http://learn.rochester.edu/](http://learn.rochester.edu/)  
You will need your UR NETID to access the Blackboard course content.  
The course sheet and general information on the class is also available at the ECE course website:  
[http://www.ece.rochester.edu/courses/ECE450](http://www.ece.rochester.edu/courses/ECE450)

Academic Honesty Policy:

The University of Rochester academic honesty policy applies to all assignments and exams for this class. The full-text of the academic honesty policy can be found at:  
[http://www.rochester.edu/College/CCAS/AdviserHandbook/AcadHonesty.html](http://www.rochester.edu/College/CCAS/AdviserHandbook/AcadHonesty.html)  
In addition to the general guidelines mentioned in the above policy, for this course I require that:

- In examinations, you must work individually with no communication with others and use only materials/tools that have been explicitly allowed.
- For homework, you may discuss problems with your colleagues but final solutions need to be worked out, written and submitted individually.
- **Any external material used should be clearly cited.** This applies to all work you submit for the class. It is inappropriate to use any resources that you would not be willing to publicly acknowledge or those that you are explicitly forbidden from using.
- In your own writings (for example, term papers, homework solutions, proposals etc), **no more than one or two sentences may be used verbatim from any source** (even with citation and clear demarcation as quotations).
- Online tutoring and homework help sites such as [chegg.com](http://www.chegg.com) should be clearly acknowledged if these are used for any work. Problems, lab assignments, quizzes, etc that are assigned in the class **should not** be posted on such sites (to seek solutions or tutoring help).

**READ THESE INSTRUCTIONS CAREFULLY!** If any aspect of the academic honesty policy and guidelines for this course are unclear, please ask me for clarifications. Lack of awareness or understanding of this policy will not be an acceptable excuse or defense against disciplinary action.
Term Paper:

You are required to complete a term paper if you are taking the course for credit. By the second week of October, you must independently identify a key paper in information theory and obtaining my approval of your selection. For this purpose, you may find it helpful to look at articles published in IEEE Transactions on Information Theory, IEEE Communications Magazine and IEEE Transactions on Communications. NOTE: Conference papers will not be acceptable as primary references for your term paper.

For your term paper, you must read, understand, and critique your selected paper and, by week 12 of the class, submit a brief report of no more than 5 pages. In addition, (time permitting) you will also be required to make a brief 15-20 min presentation on the paper to the class in the final week of class. The grade for the term paper will be determined by your report and presentation. Note that it is your responsibility to present your work clearly. **Unclear reports will not receive a satisfactory grade for the term paper.**

The term paper should be under 5 single-spaced pages (additional pages may be allowed for figures/citations). It should be readable and understandable at the general level of the class. Explain and outline the key results and outline the methodology used for establishing these results. Indicate your assessment of the significance of the results and their impact. Cite references for all material that is not original to you (ideas/algorithms/software/papers/reports) that you use in preparing your term paper. Sentences/phrases quoted verbatim from other sources should be enclosed in quotation marks and there should be no more than two/three such sentences in your report. Please read the Academic Honesty policy section of this document carefully. Any plagiarism will be reported and be subject to disciplinary action by the University.

Your term paper should be typeset using a word-processing or desktop publishing package. In addition to a printed copy of the report, you should turn in an electronic copy of your term paper. Acceptable formats for electronic submission are PDF (portable document format), Microsoft Word™, RTF (rich text format), and postscript.

Note that if term paper presentations are scheduled, you are required to attend all presentations. If you are absent when one of your colleagues is presenting, you will incur a penalty equal to 20% of your term paper grade.