GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

ECE 6605
Information Theory

Assigned: Thursday, Nov. 8, 2018
Due: Thursday, Nov. 29, 2018
Due: Sections Q (Video Student): Thursday, Dec. 6, 2018

Problem Set #6

Problem 1-8: Solve the questions 7.3, 8.3, 8.10, 9.1, 9.2, 9.4, 9.5 and 9.8 from the textbook (the second edition).

Problem 9: (from previous final exam) Consider the 3×4 Discrete Memoryless Channel (DMC) characterized by the following. Find the capacity of this channel and also give the optimizing input probability distribution (i.e, the input distribution that achieves the capacity). [Hint: Observe that $P(Y = 3) = 1/3$ regardless of the distribution of X. Then start with $I(X;Y) = H(Y) - H(Y|X)$] and try to find a distribution for X (i.e., distribution of Y for the remaining three symbols in Y) that should maximize $I(X;Y)$. A second approach is to guess the input distribution and use Kohn-Tucker to validate your guess.]

Problem 10: (from previous final exam) This problem deals with differential entropy. Consider all continuous random variables X for which we have the constraint $E[|X|] = A$. In other words, the expectation of the **absolute value** of the r.v is a given constant A. There are many probability density functions that would satisfy the above constraint. Consider the probability density function

$$f_X(x) = \frac{1}{2A} e^{\frac{-|x|}{A}}$$

(a) Find $h(X)$, the resulting differential entropy (in nats) associated with $f_X(x)$.

(b) Prove that $f_X(x)$ would give the largest differential entropy among all r.v that satisfy $E[|X|] = A$.