EEE2040 : Communications & Networks Spring 2017	Final Summative Assignment **Submission date: TBD**

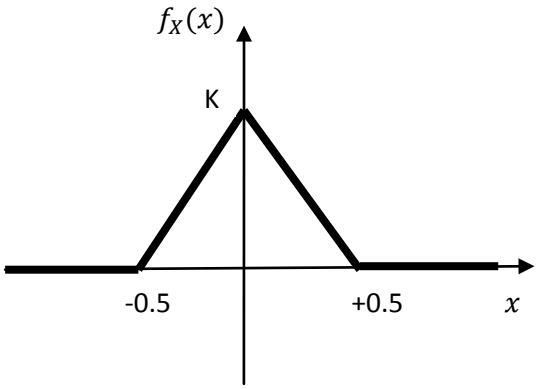
Please note that your submission should be a single report (handwritten is fine, but please make sure that it is readable). All submissions must be uploaded on SurreyLearn.

[5%]Q1. In a certain city, three car brands A, B, and C have 20%, 30%, and 50% of the market share, respectively. The probabilities that a car will need a major repair during its first year of purchase are 0.05, 0.10 and 0.15, respectively.

a) What is the probability that a car in this city will need a major repair during its first year of purchase?

b) If a car in this city needs a major repair during its first year of purchase, what is the probability that it is made by manufacturer A?

[15%]Q2. A random variable X is defined by the following PDF:

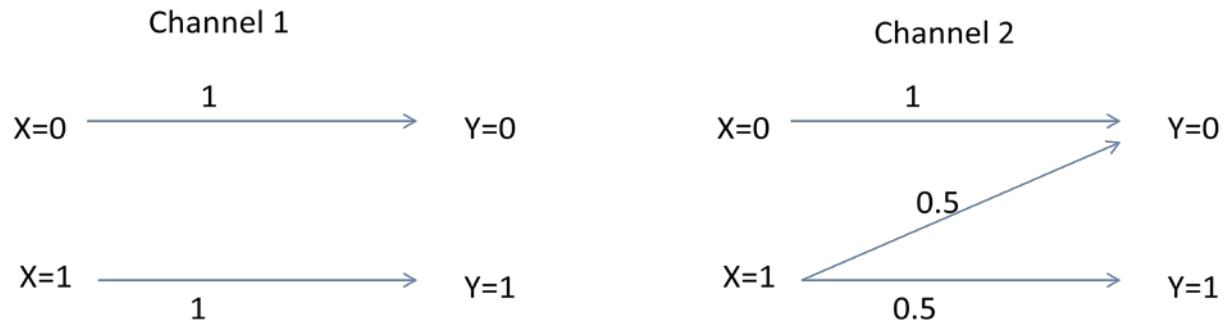


a) Find the value of K.
b) Determine P(X>0.25).
c) Determine P(X>0 | X<0.25).
d) What is $f_X(x|X > 0)$?
e) Determine E(X|X>0).

[10%] Q3. Find the Lempel-Ziv source code for the binary source sequence
000101010010011010100001010111100011011000011101011
Symbol alphabet is {0, 1}.
Please show all steps of your work clearly.

[5%] Q4. Show that {01, 100, 101, 1110, 1111, 0011, 0001} cannot be a Huffman Code for any source probability distribution.

[15%] Q5. Channels 1 and 2 are shown in the following. The source is characterised by P(X=0)=q.



Find the capacity of Channel 1 and 2 as a function of q. What values of q will maximise *I(X;Y)* of Channel 1 and Channel 2.

[10%] Q6. A binary PAM communication system employs rectangular pulses of duration Tb and amplitudes $\pm A$ to transmit digital information at rate R $= 10^5$ bits/sec. If the power spectral density of the additive white Gaussian noise is $N_0/2$, where $N_0 = 10^{-2}$ W/Hz, determine the value of A that is required to achieve an error probability of $P_b = 10^{-6}$.

[15%] Q7. In a binary antipodal signalling scheme, the signals are given by

$$s_1(t) = -s_2(t) = \begin{cases} \frac{2A}{T}t, & 0 \le t < T/2 \\ 2A\left(1 - \frac{t}{T}\right), & \frac{T}{2} \le t < T \\ 0, & otherwise. \end{cases}$$

The channel is AWGN and the power spectral density of the noise is $N_0/2$. The two signals have prior probabilities of p and 1-p.

a) Determine the energy consumed for transmission of a single bit, ε_b.
b) Plot the constellation diagram for this system.
c) Determine the **matched-filter based** structure of the optimal receiver.
d) Determine the detection threshold $\tau_h$as a function of A, T, N_0, and p.
e) Determine an expression for the error probability.

[15%]Q8.

(a) Consider a transposition encryption system with the encryption key of "KARMA". Let assume that the input plaintext to this system is the following text:

"TRANSPOSTION CIPHER CHANGES THE ORDER OF THE LETTERS"

Determine the equivalent cipher text for the above plaintext, neglecting the spaces between subsequent words in the plaintext. You will need to produce the transposition table and the cipher-text in your answer, all in capital letters.

[20%]

(b) Briefly describe the 3 main pieces of information that an adversary needs to carry out a brute force

attack against a symmetric encryption system.

(c) Consider a brute force attack scenario, where the adversary uses a computer that can examine 10^{12} key combinations every second. How many hours will be required to break a DES encryption system with a 56-bit key and a 3DES encryption system with a 112-bit key?

[5%] Q9. Consider a CSMA/CD network running at 1 Gbps over a 1-km cable. The signal speed in the cable is 200,000 km/sec. Determine the minimum frame size for this system.

[5%] Q10. A router has the following CIDR entries in its routing table:

Address/mask	Next hop
135.46.56.0/22	Interface 0
135.46.60.0/22	Interface 1
192.53.40.0/23	Router 1
Default	Router 2
…	…

For each of the following IP addresses, what does the router do if a packet with that address arrives at the router?

a)135.46.63.10
b)135.46.57.14
c)135.46.52.2
d)192.53.40.7
e)191.53.56.7