COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Graduate Studies

Electronics & Communications Engineering

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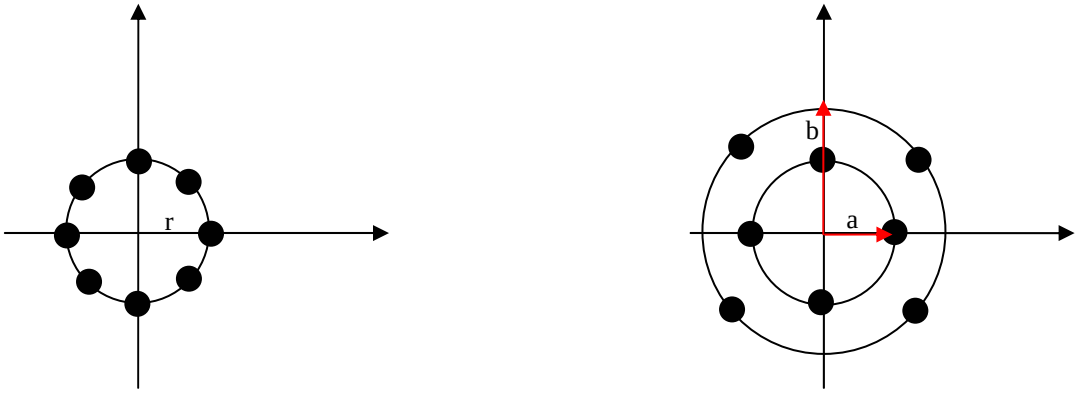
Course : Satellite Communications

Course Code : EC 723

Final Exam (Take home). Only lecture slides and textbooks, No Internet is allowed

I. Consider the octal signal point constellations in the following figure
   a- The nearest neighbour signal points in the signal constellations are separated in distance by A unites, Determine the radii r of the first circle and a and b of the inner and outer circles.
   b- Determine the average transmitted powers of the two signal constellations and compare the two powers.
   c- Sketch the decision boundaries for both constellations
   d- Find the average probability of error of both constellations.



II. A convolutional encoder is sown in figure one:
   a. What is the rate of this encoder? What is the constraint length of this encoder?
   b. How many states the state diagram will have? How many transitions per state?
   c. Draw the state diagram of the encoder.
   d. Determine the encoder output produced by the message sequence 10111
   e. Flip the third and eighth bit of the output of part d and show the process of decoding using the trellis diagram

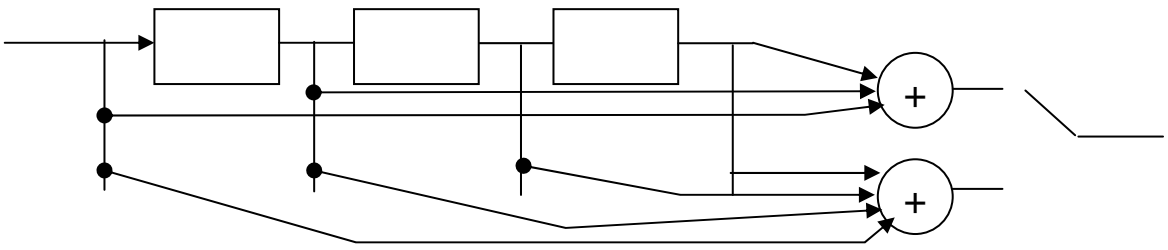


Figure one

III. A convolutional encoder having the rate R=1/5, constraint length K=4 and a generator matrix G= [17 17 13 15 15].

a- How many shift registers are used in the encoder? Draw the encoder.
b- How many states the state diagram will have? Sketch the state diagram.
Draw one stage of the trellis diagram.

IV. A linear block code has the following parity matrix

P=[1 1 0 1
0 1 1 1
1 1 1 0]

a- Express the generating matrix G in the form of [P:I] form.
b- Determine the parity check matrix H
c- Construct the table of syndromes
d- Determine the minimum distance of the code.
e- Show that the codeword corresponding to the information sequence 101 is perpendicular on H

V. A 10 Mbit/s data source is encoded by a rate 5/6 encoder, 8PSK modulated and filtered by a raised cosine filter with rolloff 1.0.

f. What is the satellite bandwidth occupied by this signal?
g. How does this change if rate 3/4 16QAM is used instead of the rate 5/6 8PSK option?
h. What other implications are there if we choose from the above two modulations the one which occupies the smallest bandwidth?

VI. A digital satellite system operates using a 48 MHz-wide satellite transponder capable of delivering 20 Watts (saturated).

a) FDMA System

Assuming individual BPSK channels are used, each with Rb/Bw=1/1.5 and a data rate of 500kbits/sec:

1) Find the number of FDMA channels which can be fit into the available bandwidth.

K =_____ Channels

2) Find the power available from the transponder for each channel. Assume that the power is equally divided among all channels and a 3 dB backoff is employed.

Pr = _____ watts/channel

b) TDMA System

A single –carrier high data rate TDMA system uses the same transponder employing QPSK with Rb/BW =1. A preamble overhead of 5% is used.

1) What will be the number of 500kbit/sec data channels (each from a different earth station) which may be multiplexed onto this system?

N = _____ channels

2) What will be the overall system data transmission rate?

Rsys, data = _____ Mbits/second

3) Assuming frame duration of 1 ms, what will be the number of preamble bits sent during a frame?

# of preamble bits in frame Pframe = _____ bits

VII. Give the name and a brief description of the six classical orbital elements. The description should include:
a. whether the element is a shape, orientation, or location factor.
b. what the element is measuring and, if it is an angle, what it is measured with respect to.