Wendesday 11 March 2015; Time: 13h30 à 15h20
No notes allowed; no calculator allowed

Problem 1 (25 points out of 100)

A. (5 points) What is the ratio of spectral efficiency of a system using a raised cosine with rolloff .3 to a system using an ideal Nyquist pulse?

$$\eta_{RC,r=.3} \Big/ \eta_{ideal} = ?$$

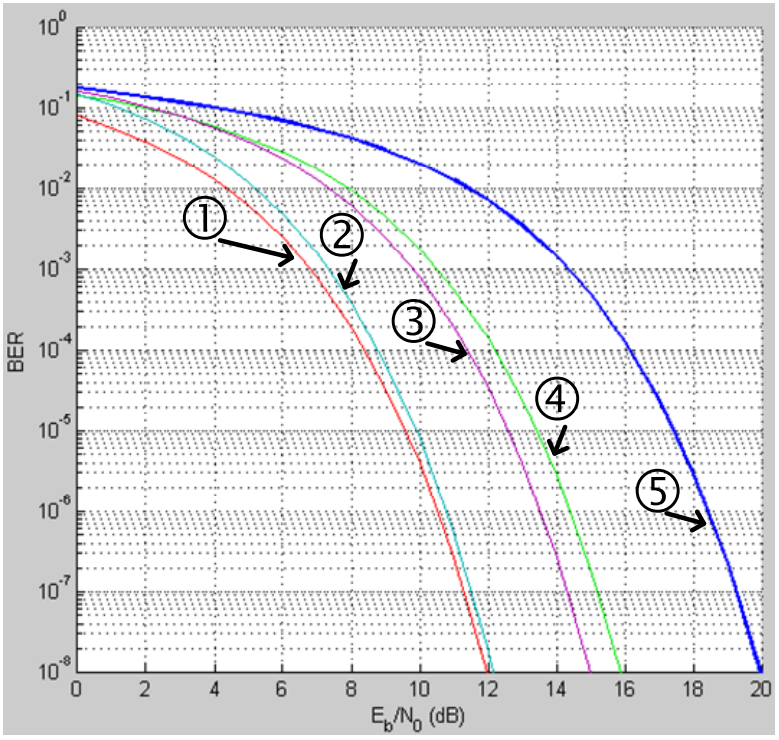
B. (5 points) Sketch an eye diagram of a PAM4 system.

C. (15 points) Define and sketch a bit error rate (BER) floor. Discuss why a BER floor is undesirable. Discuss how a bit error floor may occur.

Problem 2 (10 points out of 100)

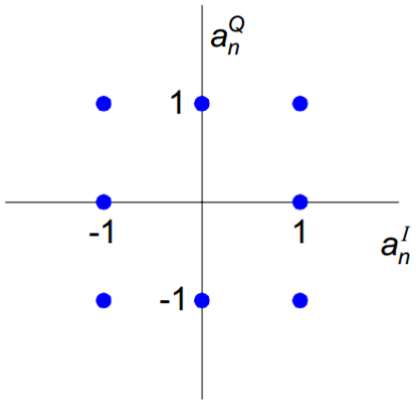
For the following plot, indicate which BER curve corresponds to each of the following modulation formats:

16PSK OOK BPSK 16QAM DPSK



Problem 3 (35 points out of 100)

Consider the following QAM constellation.



A. (10 points) What are the signal space coordinates of the symbols?

B. (15 points) What is the BER using the approximation from the union bound?

C. (10 points) Propose a grey code for the constellation.

Problem 4 (30 points out of 100)

Consider the two following communications systems

A	Point-to-point link with directional, high gain antennas E_b/N_0 = 30 dB ; required bit rate 1 Gbs Available BW = 125 MHz
B	Omni-directional link for car door lock E_b/N_0 = 0 to 10 dB (varies with distance to car) Required bit rate – code of 12 4-bit characters Available BW = 40 kHz

A. (10 points) On the following sheet trace the regions of interest for each system; indicate if the systems are bandwidth limited or power limited.

B. (10 points) Propose a modulation system for system A and discuss your choice addressing the relative importance of the following

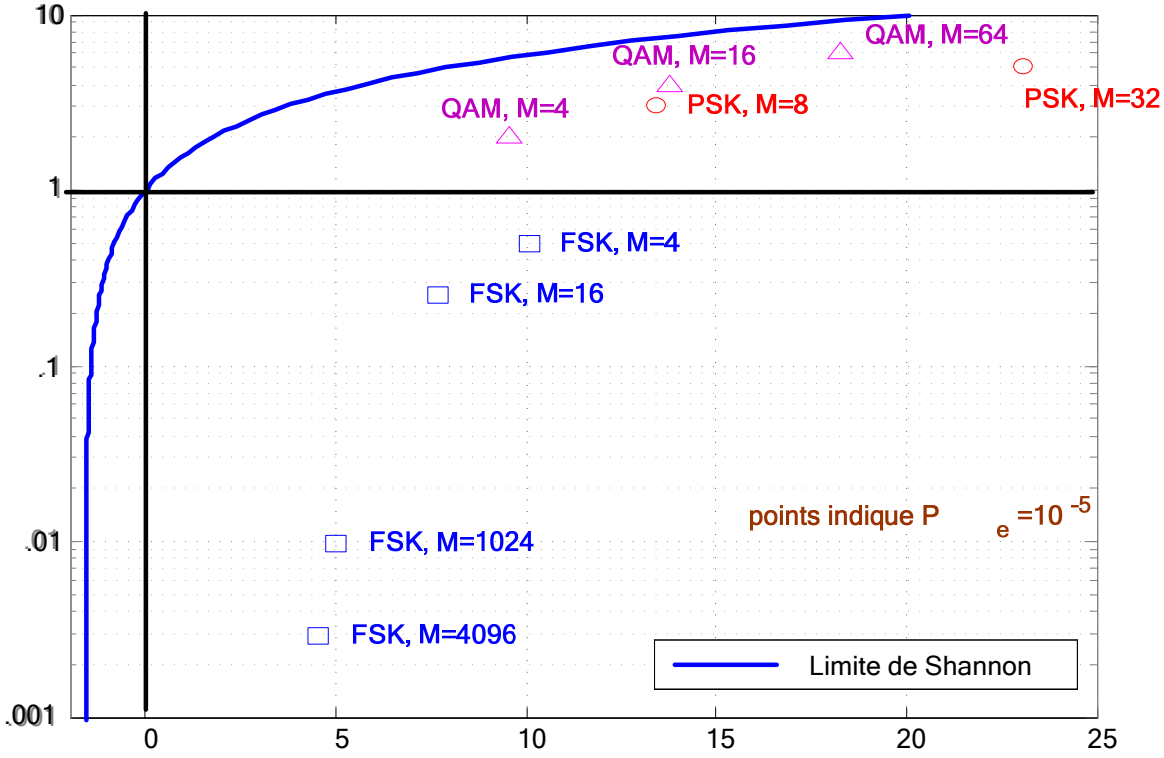
i. BER vs. Eb/N0

ii. Spectral efficiency

iii. Complexity

C. (10 points) Propose a modulation system for system B and discuss your choice addressing the same three points.

System A – point-to-point Microwave link



System B – car door key