Unit 13 - Week 11

Assignment 11

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-04-15, 23:59 IST.

1) The power efficiencies of 64-PSK and 64-PAM, respectively are *1 point*

- 0.6 and 0.2
- 0.06 and 0.02
- 0.05 and 0.01
- 0.5 and 0.1

No, the answer is incorrect.
Score: 0
Accepted Answers:
0.06 and 0.02

2) The bit error rate P_b in 64-PSK in terms of symbol error rate P_s is *1 point*

- $P_b \approx \frac{1}{3} P_s$
- $P_b \approx \frac{1}{5} P_s$
- $P_b \approx P_s$
- $P_b \approx \frac{1}{6} P_s$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$P_b \approx \frac{1}{6} P_s$

3) The relation between probability of bit error, P(bit error), and probability of symbol error, P(symbol error), in M- ary FSK using nearest neighbor approximation is *1 point*

- $P(bit\ error) = \frac{M/2}{M-1} P(symbol\ error)$
- $P(bit\ error) = \frac{2M}{M-1} (symbol\ error)$
- $P(bit\ error) = \frac{M}{M-1} P(symbol\ error)$
- $P(bit\ error) = \frac{M}{2} P(symbol\ error)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$P(bit\ error) = \frac{M/2}{M-1} P(symbol\ error)$

4) The ratio of power efficiencies of 16-QAM (employing standard square grid constellation) and 16-FSK is *1 point*

- 2
- 0.5
- 0.2
- 1

No, the answer is incorrect.
Score: 0
Accepted Answers:
0.2

5) The gap to Shannon limit in case of 16-ary orthogonal modulation scheme to achieve a BER of 10^{-5} is *1 point*

- 3 dB
- 6 dB
- 9.2 dB
- 10 dB

No, the answer is incorrect.
Score: 0
Accepted Answers:
9.2 dB

6) A necessary condition for an *n*-bit Gray code to exist is *1 point*

- number of nearest neighbors for any signal point should be at most *n*.
- number of nearest neighbors for any signal point should be at most *2n*
- number of nearest neighbors for any signal point should be at most *n/2*.
- number of nearest neighbors for any signal point should be at most *3n*.

No, the answer is incorrect.
Score: 0
Accepted Answers:
number of nearest neighbors for any signal point should be at most n.

7) The probability of bit error rate P_b in 4-QAM using nearest neighbor approximation is *1 point*

- $P_b \approx 2Q\left(\sqrt{\frac{4E_b}{N_0}}\right)$
- $P_b \approx 3Q\left(\sqrt{\frac{7E_b}{N_0}}\right)$
- $P_b \approx 2Q\left(\sqrt{\frac{7E_b}{N_0}}\right)$
- $P_b \approx Q\left(\sqrt{\frac{7E_b}{N_0}}\right)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$P_b \approx Q\left(\sqrt{\frac{7E_b}{N_0}}\right)$

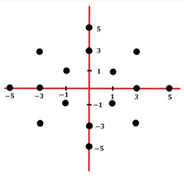
8) Using the nearest neighbor approximation, if required, find the E_b/N_0 (in dB) required for a BER of 10^{-6}, for the following modulation schemes, *2 points*

a) BPSK
b) 16-PSK
c) 64-PAM
d) Coherent 16-ary orthogonal signaling

- a) 15,b) 21,c) 36,d) 12
- a) 12,b) 30,c) 36,d) 12
- a) 12,b) 20,c) 35,d) 9
- a) 12,b) 20,c) 36,d) 15

No, the answer is incorrect.
Score: 0
Accepted Answers:
a) 12,b) 20,c) 35,d) 9

9) A 16-ary constellation is drawn below. *2 points*

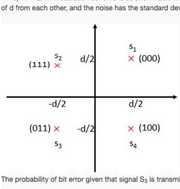


The average symbol error rate of the constellation using intelligent union bound is

- $P_s \leq Q\left(\sqrt{\frac{16E_b}{27N_0}}\right) + \frac{1}{2}Q\left(\sqrt{\frac{32E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{20E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{52E_b}{27N_0}}\right)$
- $P_s \leq Q\left(\sqrt{\frac{16E_b}{27N_0}}\right) + \frac{1}{2}Q\left(\sqrt{\frac{32E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{20E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{4E_b}{3N_0}}\right) + Q\left(\sqrt{\frac{52E_b}{27N_0}}\right)$
- $P_s \leq Q\left(\sqrt{\frac{16E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{32E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{20E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{4E_b}{3N_0}}\right) + Q\left(\sqrt{\frac{52E_b}{27N_0}}\right)$
- $P_s \leq Q\left(\sqrt{\frac{16E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{20E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{4E_b}{3N_0}}\right) + Q\left(\sqrt{\frac{52E_b}{27N_0}}\right)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$P_s \leq Q\left(\sqrt{\frac{16E_b}{27N_0}}\right) + \frac{1}{2}Q\left(\sqrt{\frac{32E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{20E_b}{27N_0}}\right) + Q\left(\sqrt{\frac{4E_b}{3N_0}}\right) + Q\left(\sqrt{\frac{52E_b}{27N_0}}\right)$

10) A 4-QAM modulation scheme is as shown below. We show the bits assigned to the symbols, where the symbols are placed at a minimum distance of d from each other, and the noise has the standard deviation of σ. *2 points*



The probability of bit error given that signal S_3 is transmitted is

- $\frac{3}{4}\left(Q(d/2\sigma)\right)$
- $\frac{3}{4}\left(Q(d/2\sigma) - Q^2(d/2\sigma)\right)$
- $\frac{1}{4}\left(Q(d/2\sigma)\right)$
- $\frac{1}{4}\left(Q(d/2\sigma) - \frac{1}{2}Q^2(d/2\sigma)\right)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{1}{4}\left(Q(d/2\sigma) - \frac{1}{2}Q^2(d/2\sigma)\right)$

11) The symbol error rate for 4-PAM and 16-QAM, respectively is *2 points*
(assume each symbol to be equal likely)

- $P_s = \frac{3}{2}Q\left(\sqrt{\frac{4E_b}{5N_0}}\right), P_s = 3Q\left(\sqrt{\frac{4E_b}{5N_0}}\right)$
- $P_s = \frac{3}{2}Q\left(\sqrt{\frac{4E_b}{5N_0}}\right), P_s = \frac{3}{2}Q\left(\sqrt{\frac{4E_b}{5N_0}}\right)$
- $P_s = \frac{3}{2}Q\left(\sqrt{\frac{2E_b}{5N_0}}\right), P_s = 3Q\left(\sqrt{\frac{E_b}{N_0}}\right)$
- $P_s = \frac{3}{2}Q\left(\sqrt{\frac{E_b}{N_0}}\right), P_s = 3Q\left(\sqrt{\frac{4E_b}{5N_0}}\right)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$P_s = \frac{3}{2}Q\left(\sqrt{\frac{4E_b}{5N_0}}\right), P_s = 3Q\left(\sqrt{\frac{4E_b}{5N_0}}\right)$