3. [1 + 1 + 4 = 6 marks]

$L = 5$ taps ;

(a) For QPSK, $M = 4$

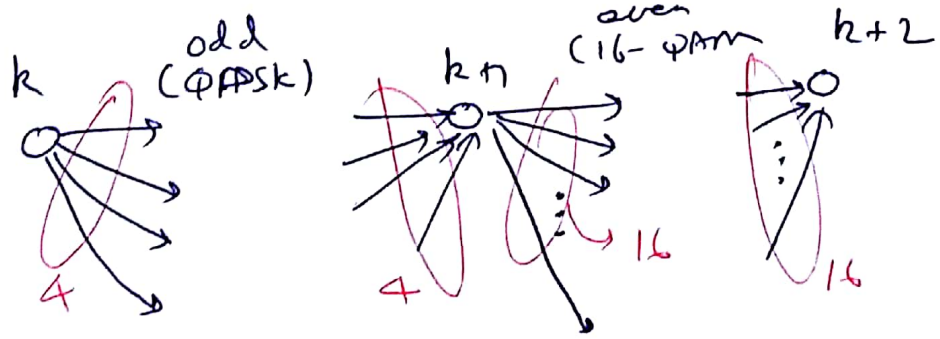
$\Rightarrow$ # of states $= 4^{5-1} = 4^4 = \boxed{256}$ states (nodes) -1-

(b) For 16-QAM, $M = 16$ not $5-1=4$

# of TM computations $= \boxed{16^5}$ -1-

$= 1,048,576$!!

(c) If alternate QPSK & 16-QAM symbols are sent



-1-

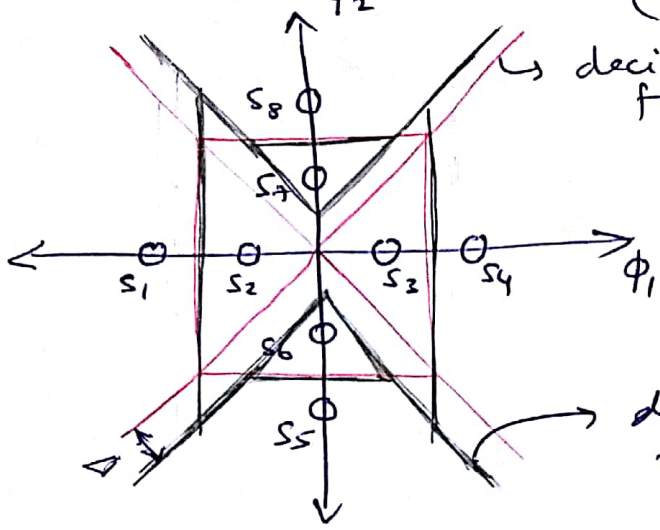
(c1) # of states (nodes) $= 4^2 \cdot 16^2 = 16^3 = \boxed{4,096}$ -1-

(c2) # of TM computations

- $\longrightarrow$ in odd symbol period (QPSK) $\Rightarrow \boxed{16^3 \times 4}$ -1-
- $\longrightarrow$ in even symbol period (16-QAM) $\Rightarrow \boxed{16^3 \times 16}$ -1-

EE 5140 Quiz 2 Solutions

1. [1 + 2·5 + 1·5 + 1 = 6]



(a) ↳ decision boundary for equal prior (-1-)

(c) decision boundary for unequal prior probability case (-2-)

(b) Assuming $s_2 - s_3$ is $(\sqrt{2}) \cdot 2d$ we have:

(*) For $s_1, s_8, s_4, \& s_5$ → only 1-nearest neighbour

$\Rightarrow \frac{4}{8} \times q$;

(*) For $s_2, s_3, s_7, \& s_6$ → 3-nearest neighbours

$\Rightarrow \frac{4}{8} \times 3q$;

$\therefore P_e \approx \frac{q}{2} + \frac{3q}{2} = \boxed{2q}$; (-2-)

OR Assuming $s_2 - s_3$ is $2d$: (i.e $s_2 - s_7 - s_3$ ($s_2 - s_3 - s_6$) is an equilateral triangle)

→ s_1, s_8, s_4, s_5 → no change from above

→ for s_2 & s_3 → 4 nearest neighbours

$\Rightarrow \frac{2}{8} \times 4q = q$;

→ for s_7 & s_6 → 3 nearest neighbours $\Rightarrow \frac{2}{8} \times 3q$ (accept this, too) (-2-)

$\therefore P_e \approx \frac{q}{2} + q + \frac{3q}{4} = \frac{9q}{4}$ (which is $> 2q$)

(d) $\Delta = \frac{N_0/2}{2d} \ln\left(\frac{p_1}{p_2}\right) = \boxed{\frac{N_0}{4d} \ln 3 = \frac{N_0}{4d} \times 1.099}$; (-1-)

EE5140 Quiz 2 Solutions

2. [1.5 + 1.5 = 3]

RF bandwidth = 5 MHz

⇒ One-sided lowpass BW = 2.5 MHz

$\therefore$ $2.5\ \text{MHz} = \frac{(1+\beta)}{2T}$, $T \rightarrow$ symbol duration, $\beta \rightarrow$ Excess BW factor

⇒ For $\beta = 0.4$, $\frac{1}{T} = \frac{5}{1.4} = 3.57$ M symbols/sec

symbol Rate

⇒ For 8-PSK Modulation,

Bit rate $= 3 \times \frac{5}{1.4} = \boxed{10.714\ \text{Mb/s}}$

-1.5-

For 10% increase in bit rate,

New Bit Rate = 11.785 Mb/s

⇒ $11.785 = 3 \times \frac{5}{(1+\beta)}$

⇒ $\beta = \frac{3.215}{11.785} = \boxed{0.2728}$

-1.5-