

SOLUTIONS # 6
EE 6391 - Prof. Torlak
Coding and Interleaving

6.1

a)
$$G = \left[\begin{array}{cccc|cccc} 1 & 0 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 0 & 1 \end{array} \right]$$

I P

b)
$$H = \left[\begin{array}{cccc|ccc} I_{n-k} & P^T \end{array} \right]$$

$$H = \left[\begin{array}{cccc|ccc} 1 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{array} \right]$$

$HG^T = 0$

c) $s = eHT$

Syndrome

0	0	0	0
1	1	0	1
0	1	1	1
1	1	1	0
0	0	0	1
0	0	1	0
0	1	0	0
1	0	0	0

Error Pattern (e)

0	0	0	0	0	0	0
0	0	0	0	0	0	1
						⋮
						⋮
						⋮
						⋮
						⋮
						⋮
1	0	0	0	0	0	0

d) The minimum distance can be found by applying 3 bits inputs of all combinations to generate corresponding codewords

$$d_{min} = 4$$

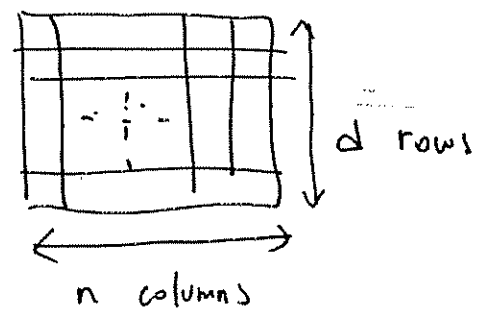
$$e) 101 \rightarrow [1010011] = c$$

$$H \cdot c^T = 0$$

6.2. $f_d = 80 \text{ Hz}$ $n = 5 \text{ bits}$

$$\bar{\gamma} = 15 \text{ dB}$$

$$T_c = \frac{0.423}{f_m} = \frac{0.423}{80} \approx 0.0053$$



$$(d-1) T_b > T_c$$

$$T_b = \frac{1}{30.10^3} = 0.33 \cdot 10^{-4}$$

Interleave matrix

$$\frac{T_c}{T_b} + 1 < d$$

$$d \approx 16 \text{ bits}$$

$$\text{Interleave depth} = n * d = 810 \text{ bits}$$

$$\text{Delay} = 810 * T_b = 0.0267 \text{ sec}$$

BPSK In Rayleigh fading

$$P = \frac{1}{2} \left[1 - \sqrt{\frac{\gamma}{1+\gamma}} \right] \approx 0.0077$$

Majority Leading

$$P_e = P^5 + 5P^4(1-P) + 10P^3(1-P)^2$$

$$= 4.55 \times 10^{-6}$$

It will work fine for voice since delay is less than 80 msec (which is considered the limit).

