Assignment 1

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

1) Consider a linear block code with the parity check matrix

\[
\begin{bmatrix}
1 & 1 & 0 & 0 & 1 \\
1 & 1 & 0 & 1 & 0 \\
1 & 0 & 1 & 0 & 0
\end{bmatrix}
\]

The number of edges in the corresponding Tanner Graph is _______________.

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Numeric) 8

2) Consider a linear block code with the parity check matrix

\[
\begin{bmatrix}
0 & 0 & 0 & 1 & 1 & 1 \\
0 & 1 & 1 & 0 & 0 & 1 \\
1 & 0 & 1 & 0 & 1 & 0
\end{bmatrix}
\]

The maximum bit node degree in the corresponding tanner graph is ______________.

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Numeric) 3

3) If the expansion factor of a base matrix is 20, then the maximum value of an entry in the base matrix is ______________.

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Numeric) 19

4) Consider a protograph LDPC code with a base matrix of dimension 42 \times 52. Let the expansion factor be 12. Then, the number of message bits in any codeword of this code is ______________.

20 \times 12 = 240 bits

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Numeric) 240
The number of 1s in a parity check matrix given by the base matrix with expansion factor 5 is ______________.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 55

6) The number of -1s in the E part of a 46 x 68 base matrix in the 5G standard is _____________.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 7

7) Consider a protograph LDPC code with an expansion factor of 6. The vector \([1 \ 1 \ 0 \ 0 \ 0 \ 0]\) acted on by the base matrix entry 2 will transform to:

- [1 0 0 0 1]
- [0 1 0 1 0]
- [0 1 0 1 1]
- [0 0 1 0 1]

No, the answer is incorrect.
Score: 0
Accepted Answers:
[0 1 0 1 1]

8) Consider a protograph LDPC code with expansion factor 6. Say that two vectors \(p_1\) and \(q_1\) are related as \(q_1 = I_2 p_1\). Then, which of the following relations must also hold true:

- \(p_1 = I q_1\)
- \(p_1 = I_4 q_1\)
- \(p_1 = I_5 q_1\)
- \(p_1 = I_2 q_1\)

No, the answer is incorrect.
Score: 0
Accepted Answers:
\(p_1 = I_4 q_1\)

9) You are encoding a protograph LDPC code with expansion factor 5 and the following base matrix, (the notation is same as that used in the lectures)

\[
\begin{bmatrix}
I_1 & 0 & I_1 & I_2 & I & 0 & 0 \\
I_2 & I & 0 & I_3 & I_2 & I & I & 0 \\
0 & I_4 & I_2 & I & I_1 & 0 & I & 0 \\
I_4 & I_3 & I & 0 & 0 & 0 & 0 & I
\end{bmatrix}
\]

Let the codeword be represented by \([m_1 \ m_2 \ m_3 \ m_4 \ p_1 \ p_2 \ p_3 \ p_4]\), where \(m_i's\) are the message blocks and \(p_j's\) are the parity blocks. Given that you are first computing \(p_1\) given a particular message \([m_1 \ m_2 \ m_3 \ m_4]\), the equation you need to solve is:

\[
\begin{align*}
I_1 p_1 &= I_1 m_1 + I_2 m_1 + I_4 m_3 + I_2 m_2 + I_3 m_1 + I_3 m_2 + I_1 m_2 + I_3 m_3 + I_2 m_4 + I_1 m_4 + I_3 m_4 + I_4 m_4 \\
I_5 p_1 &= I_1 m_1 + I_2 m_1 + I_4 m_2 + I_4 m_4 + I_3 m_1 + I_2 m_3 + I_1 m_3 + I_1 m_4 + I_3 m_4 + I_4 m_4
\end{align*}
\]
Consider the $x$ base matrix in the 5G standard for the expansion factor 384. Any codeword in this code consists of 52 blocks with each block having 384 bits. Let $[m_1, m_2, m_3, \ldots, m_{10}, p_1, p_2, p_3, \ldots, p_{12}]$ denote a codeword belonging to this code where $m_1, m_2, m_3, \ldots, m_{10}$ are the message blocks and $p_1, p_2, p_3, \ldots, p_{12}$ are the parity blocks. In encoding $[m_1, m_2, m_3, \ldots, m_{10}]$ to $[m_1, m_2, m_3, \ldots, m_{10}, p_1, p_2, p_3, \ldots, p_{12}]$, the sufficient information to compute $p_9$ is

$$I_{1}p_{1} = I_{4}m_{2} + I_{2}m_{3} + I_{3}m_{4} + I_{9}p_{3}$$

$$I_{p_{1}} = I_{4}m_{1} + I_{5}m_{2} + I_{3}m_{3}$$

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

$I_{1}p_{1} = I_{4}m_{2} + I_{2}m_{3} + I_{3}m_{4} + I_{9}p_{3}$

$m_1, m_2, m_3, m_4, \ldots, m_{10}, p_1, p_2, p_3, \ldots, p_8$

$m_1, m_2, m_3, m_4, \ldots, m_{10}, p_1, p_2, p_3, p_7$

$m_1, m_2, m_3, m_4, \ldots, m_{10}, p_1, p_2, p_3, p_4$

$m_1, m_2, m_3, m_4, \ldots, m_{10}, p_2, p_3, p_6, p_8$

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

$m_1, m_2, m_3, m_4, \ldots, m_{10}, p_1, p_2, p_3, p_4$