Blockwise Repeated Burst Error Correcting Linear Codes

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Abstract

This paper presents a lower and an upper bound on the number of parity check digits required for a linear code that corrects a single sub-block containing errors which are in the form of 2-repeated bursts of length b or less. An illustration of such kind of codes has been provided. Further, the codes that correct m-repeated bursts of length b or less have also been studied.

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I   Introduction

Error detecting codes and Error correcting codes have been the traditional areas of study in the field of coding techniques on error control in digital data transmission. Wolf and Elspas [12] introduced a coding technique, *error-locating codes* (EL Codes), lying midway between error detection and error correction. In an error locating code, each block of received digits is regarded as being subdivided into mutually exclusive sub-blocks, and codes have been devised that permit the detection of errors occurring within a single sub-block, the sub-block containing errors being identified. In ordinary decision feedback systems using error detection the receiver tests each block of received digits for the presence of errors. If errors are detected, the receiver requests the retransmission of the corrupted block of digits alone and this process is repeated for each incoming block. One drawback of the conventional system is that long block lengths (which are desirable for increased coding efficiency) can result in a low data rate when the reception of large amount of data is called for. However, the use of EL codes can soften this conflict between short and long block lengths by providing an additional design parameter. The overall constraint block length can be long to provide efficient coding while the length of the sub-blocks can be relatively short in order to keep the data rate up.

Codes developed at the early stages were meant mainly to detect and correct random errors. However, it was observed later that in many channels the likelihood of the occurrence of errors is more in adjacent positions rather than their occurrence in a random manner. In this spirit, Abramson[1] developed codes correcting single and double adjacent errors. The concept of clustered errors, commonly called burst errors, was generalized further in the work due to Fire [7]. A burst, also known as an open loop burst, of length b may be defined as follows:

Definition 1. A burst of length b is a vector whose all non-zero components are among some b consecutive components, the first and the last of which is non-zero.

It was observed that in very busy communication channels, errors repeat themselves. Similar is a situation when errors occur in the form of a burst. The development of codes for such kind of repeated burst errors is useful for

improving upon the efficiency of some communication channels. Not only do repeated bursts emerge as a natural generalization of bursts, but considering a recent study by Srinivas, Jain, Saurav and Sikdar [11], where the changes in the neuronal network properties during epileptiform activity *in vitro* in planar two-dimensional neuronal networks cultured on a multielectrode array using the *in vitro* model of stroke-induced epilepsy have been explored, we observe that the study of these codes is significant.

The study of codes that detect repeated open-loop bursts was initiated by Berardi, Dass and Verma [2] and for correction of such errors by Dass and Verma [6] . An m-repeated burst (open-loop) of length b is defined as follows:

Definition 2. An m-repeated burst of length b is a vector of length n whose only non-zero components are confined to m distinct sets of b consecutive components, the first and the last component of each set being non-zero.

For example, (00103200002031000313200) is a 3-repeated burst of length 4 over $GF(4)$.

In particular, a 2-repeated burst (open-loop) of length b is defined as:

Definition 3. A 2-repeated burst of length b is a vector of length n whose only non-zero components are confined to two distinct sets of b consecutive components, the first and the last component of each set being non-zero.

Wolf and Elspas [12] obtained results in the form of bounds over the number of parity-check digits required for binary codes capable of detecting and locating a single sub-block containing random errors. A study of such error locating codes in which errors occur in the form of bursts was made by Dass [3]. Further, these results were extended to the codes correcting burst errors occurring within a sub-block (refer Dass and Tyagi [5]). In our earlier paper [4] the authors obtained bounds over the number of parity-check digits required for codes detecting 2-repeated and m-repeated bursts of length b or less occurring within a single sub-block, the sub-block containing errors being identified. In this paper we extend our study to the correction of repeated bursts occurring within a sub-block. The development of codes correcting repeated burst errors within a sub-block improves the efficiency of the communication channel as it reduces the number of parity

check digits required. The results that follow have been described in terms of the following parameters: the block of n digits, consisting of r check digits, and $k = n - r$ information digits, is subdivided into s mutually exclusive sub-blocks, each sub-block containing $t = n/s$ digits.

II Bounds for codes correcting 2-repeated bursts

In this section, we obtain bounds on the number of parity check digits of a code capable of correcting 2-repeated bursts of length b or less occurring within a single sub-block.

We note that an (n, k) linear EL code over $GF(q)$ capable of detecting and locating a single sub-block containing 2-repeated burst of length b or less must satisfy the following two conditions:

(i) The syndrome resulting from the occurrence of any 2-repeated burst of length b or less within any one sub-block must be non-zero.

(ii) The syndrome resulting from the occurrence of any 2-repeated burst of length b or less within a single sub-block must be distinct from the syndrome resulting likewise from any 2-repeated burst of length b or less within *any other* sub-block.

Further, an (n, k) linear code over $GF(q)$ capable of correcting an error requires the syndromes of any two vectors to be distinct irrespective of whether they belong to the same sub-block or different sub-blocks. So, in order to correct 2-repeated bursts of length b or less lying within a sub-block the following conditions need to be satisfied:

(iii) The syndrome resulting from the occurrence of any 2-repeated burst of length b or less within a single sub-block must be distinct from the syndrome resulting from any other 2-repeated burst of length b or less within the same sub-block.

(iv) The syndrome resulting from the occurrence of any 2-repeated burst of length b or less within a single sub-block must be distinct from the syndrome resulting likewise from any 2-repeated burst of length b or less within *any other* sub-block.

Remark 1. We observe that condition (ii) is the same as condition (iv). Also, for computational purposes condition (i) is taken care of by condition (iii). From this we infer that correction of errors requires more strict conditions than location of

errors. So we need to consider conditions (iii) and (iv) or equivalently conditions (ii) and (iii) for correction of the said type of errors.

We first obtain a lower bound over the number of parity check digits required for such a code.

Theorem 1. *The number of check digits r required for an (n, k) linear code over $GF(q)$, subdivided into s sub-blocks of length t each, that corrects 2-repeated bursts of length b or less lying within a single corrupted sub-block is atleast*

$$log_q \left\{ 1 + s \left[q^{2b-2} \left\{ q + (q-1)^2 \binom{t-2b+2}{2} + (q-1) \binom{t-2b+1}{1} \right\} - 1 \right] \right\}. \quad (1)$$

Proof. Let V be an (n, k) linear code over $GF(q)$ that corrects 2-repeated burst of length b or less within a single corrupted sub-block. The maximum number of distinct syndromes available using r check digits is q^r. The proof proceeds by first counting the number of syndromes that are required to be distinct by the two conditions and then setting this number less than or equal to q^r.

Since the code is capable of correcting all errors which are 2-repeated bursts of length b or less within any single sub-block, any syndrome produced by a 2-repeated burst of length b or less in a given sub-block must be distinct from any such syndrome likewise resulting from another 2-repeated burst of length b or less in the same sub-block(refer to condition (iii)). Moreover, syndromes produced by 2-repeated bursts of length b or less in different sub-blocks must also be distinct by condition (iv).

Thus, the syndromes of vectors which are 2-repeated bursts, whether in the same sub-block or in different sub-blocks, must be distinct.
Since there are

$$q^{2b-2} \left\{ q + (q-1)^2 \binom{t-2b+2}{2} + (q-1) \binom{t-2b+1}{1} \right\} - 1$$

2-repeated bursts of length b or less within one sub-block of length t, excluding the vector of all zeros(refer Dass and Verma (2008)) and there are s sub-blocks

in all, we must have at least

$$1 + s\left[q^{2b-2}\left\{q + (q-1)^2\binom{t-2b+2}{2} + (q-1)\binom{t-2b+1}{1}\right\} - 1\right]$$

distinct syndromes, including the all zeros syndrome.

Therefore, we must have

$$q^r \geq 1 + s\left[q^{2b-2}\left\{q + (q-1)^2\binom{t-2b+2}{2} + (q-1)\binom{t-2b+1}{1}\right\} - 1\right]$$

i.e.

$$r \geq log_q\left\{1 + s\left[q^{2b-2}\left\{q + (q-1)^2\binom{t-2b+2}{2} + (q-1)\binom{t-2b+1}{1}\right\} - 1\right]\right\}.$$

$\square$

Remark 2. By taking $s = 1$ the bound obtained in (1) reduces to

$$log_q\left(q^{2b-2}\left[q + (q-1)^2\binom{t-2b+2}{2} + (q-1)\binom{t-2b+1}{1}\right]\right)$$

which coincides with the result for correction of 2-repeated bursts obtained by Dass and Verma(2008).

In the following result, we derive another bound on the number of check digits required for the existence of such a code. The proof is based on the technique used to establish Varshamov-Gilbert-Sacks bound by constructing a parity check matrix for such a code (refer Sacks (1958) also Theorem 4.7, Peterson and Weldon (1972)). This technique not only ensures the existence of such a code but also gives a method for the construction of the code.

Theorem 2. *An (n, k) linear code over $GF(q)$ capable of correcting 2-repeated burst of length b or less occurring within a single sub-block of length t $(4b < t)$ can always be constructed using r check digits, where r is the smallest integer*

satisfying the inequality

$$q^r > q^{2(b-1)}\left\{q^{2(b-1)}\left\{(q-1)^3\binom{t-4b+3}{3} + (q-1)^2\binom{t-4b+2}{2} + q(q-1)\binom{t-4b+1}{1} + q^2\right\}\right.$$

$$+\left\{(s-1)\Big[(t-2b+1)(q-1)+1\Big]\times\right.$$

$$\left.\left.\Big[q^{2(b-1)}\Big\{q+(q-1)^2\binom{t-2b+2}{2} + (q-1)\binom{t-2b+1}{1}\Big\} - 1\Big]\right\}\right\}. \qquad (2)$$

Proof. We shall prove the result by constructing an appropriate $(n-k)\times n$ parity check matrix H for the desired code. Suppose that the columns of the first $s-1$ sub-blocks of H and the first $j-1$ columns $h_1, h_2, \cdots, h_{j-1}$ of the sth sub-block have been appropriately added. We now lay down conditions to add the jth column h_j to the sth sub-block as follows:

Since the code is to correct 2-repeated bursts of length b or less within a single sub-block, therefore, by condition (iii), the syndrome of any 2-repeated burst in any sub-block must be different from the syndrome resulting from any other such burst within the same sub-block. Therefore the jth column h_j can be added provided that h_j is not a linear combination of the immediately preceding $b-1$ or fewer columns $h_{j-b+1}, \cdots, h_{j-1}$ of the sth sub-block together with any three distinct sets of b or fewer consecutive columns each from amongst the first $j-b$ columns $h_1, h_2, \cdots, h_{j-b}$. In other words,

$$h_j \neq (\alpha_1 h_{j-b+1} + \alpha_2 h_{j-b+2} + \cdots + \alpha_{b-1} h_{j-1}) +$$

$$\sum_{l=1}^{3}(\beta_{l_1} h_{l_1} + \beta_{l_2} h_{l_2} + \cdots + \beta_{l_b} h_{l_b}), \qquad (3)$$

where $\alpha_i, \beta_{l_i} \in GF(q)$ and $l_b \leq j-b$.

The number of ways in which the coefficients α_i can be selected is clearly q^{b-1}. To enumerate the coefficients β_i is equivalent to enumerate the number of 3-repeated bursts of length b or less in a vector of length $j-b$ which is (refer Dass and Verma(2008))

$$q^{3(b-1)}\left\{(q-1)^3\binom{j-4b+3}{3} + (q-1)^2\binom{j-4b+2}{2} + q(q-1)\binom{j-4b+1}{1} + q^2\right\}.$$

Therefore, the total number of possible choices for α_i and β_i on the R.H.S of (3) is

$$q^{4(b-1)}\left\{(q-1)^3\binom{j-4b+3}{3}+(q-1)^2\binom{j-4b+2}{2}+q(q-1)\binom{j-4b+1}{1}+q^2\right\}. \quad (4)$$

Further, by condition (iv), h_j can be added to the sth sub-block provided h_j is not a linear combination of the immediately preceding $b-1$ or fewer columns together with one set of b or fewer columns from amongst the first $j-b$ columns together with linear combination of any two sets of b or less consecutive columns within *any other* sub-block. i.e.

$$\begin{aligned}
h_j \neq \, &(\alpha_1 h_{j-b+1} + \alpha_2 h_{j-b+2} + \cdots + \alpha_{b-1} h_{j-1}) + \\
&(\beta_1 h_i + \beta_2 h_{i+1} + \cdots + \beta_b h_{i+b-1}) + \\
&(\gamma_1 h_{i_1} + \gamma_2 h_{i_1+1} + \cdots + \gamma_b h_{i_1+b-1}) + \\
&(\delta_1 h_{i_2} + \delta_2 h_{i_2+1} + \cdots + \delta_b h_{i_2+b-1})
\end{aligned} \quad (5)$$

where $\alpha_p, \beta_p, \gamma_p, \delta_p \in GF(q), i+b-1 \leq j-b$ and not all γ_p and δ_p are zero. (The last two terms in the above sum correspond to any two sets of b or less consecutive columns within any one of the other sub-block.)

The number of ways in which the coefficients α_p can be selected is clearly q^{b-1}. To enumerate the coefficients β_p is equivalent to enumerate the number of bursts of length b or less in a vector of length $j-b$ which is $q^{b-1}[(j-2b+1)(q-1)+1]$ (refer Fire [7]). Therefore, the total number of possible choices for α_p and β_p on the R.H.S of (5) is

$$q^{2(b-1)}[(j-2b+1)(q-1)+1]. \quad (6)$$

Also, the number of linear combinations corresponding to the last two terms on the R.H.S. of (5) is the same as the number of 2-repeated bursts of length b or less within a sub-block of length t, excluding the vector of all zeros; which is (refer Dass and Verma (2008))

$$q^{2b-2}\left\{q+(q-1)^2\binom{t-2b+2}{2}+(q-1)\binom{t-2b+1}{1}\right\}-1.$$

Since there are $s-1$ previously chosen sub-blocks, the number of such linear combinations becomes

$$(s-1)\left[q^{2b-2}\left\{q+(q-1)^2\binom{t-2b+2}{2}+(q-1)\binom{t-2b+1}{1}\right\}-1\right]. \tag{7}$$

Thus, the number of linear combinations to which h_j can not be equal to is the product computed in expr. (6) and expr. (7). i.e.

$$expr.(6) \times expr.(7). \tag{8}$$

Thus, the total number of linear combinations that h_j can not be equal to is the sum of linear combinations in (4) and (8).

At worst, all these combinations might yield a distinct sum. Therefore, h_j can be added to the sth sub- block of H provided that

$$q^r > q^{2(b-1)}\left\{q^{2(b-1)}\left\{(q-1)^3\binom{j-4b+3}{3}+(q-1)^2\binom{j-4b+2}{2}+q(q-1)\binom{j-4b+1}{1}+q^2\right\}\right.$$

$$+\left\{(s-1)\left[(j-2b+1)(q-1)+1\right]\times\right.$$

$$\left.\left.\left[q^{2(b-1)}\left\{q+(q-1)^2\binom{t-2b+2}{2}+(q-1)\binom{t-2b+1}{1}\right\}-1\right]\right\}\right\}.$$

For completing the sth sub-block of length t, replacing j by t gives the result as stated in (2). □

Remark 3. By taking $s = 1$ in (2) the bound reduces to

$$q^r > q^{4(b-1)}\left\{(q-1)^3\binom{t-4b+3}{3}+(q-1)^2\binom{t-4b+2}{2}+q(q-1)\binom{t-4b+1}{1}+q^2\right\}$$

which coincides with the condition for existence of a code correcting 2-repeated bursts of length b or less(refer Dass and Verma(2008)).

We conclude this section with an example.

Example 1 Consider a $(26, 10)$ binary code with a 16×26 parity-check matrix

H given by

$$H = \begin{bmatrix}
1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 \\
0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 \\
0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0 \\
0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 1 \\
0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 0\ 0\ 1\ 0\ 0\ 1\ 0\ 1\ 0\ 0 \\
0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 0\ 1\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0 \\
0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 1\ 0\ 0\ 1\ 0\ 0\ 0\ 1\ 0\ 0 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 0\ 0\ 1\ 0\ 0\ 1\ 0\ 1\ 0\ 1 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0 & 0\ 0\ 0\ 1\ 0\ 0\ 1\ 0\ 0\ 0\ 1\ 0 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0 & 0\ 0\ 1\ 0\ 0\ 1\ 0\ 1\ 1\ 0\ 0\ 1 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0 & 0\ 0\ 0\ 0\ 1\ 0\ 0\ 1\ 0\ 0\ 0\ 0 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0 & 0\ 0\ 0\ 1\ 0\ 1\ 0\ 0\ 1\ 1\ 0\ 1 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 1 & 0\ 0\ 1\ 0\ 0\ 1\ 1\ 0\ 1\ 1\ 1\ 1 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 1\ 0\ 0\ 0\ 0\ 1\ 1\ 0\ 0\ 1\ 0\ 0 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 1\ 0\ 0\ 1\ 1\ 0\ 0\ 1\ 0\ 1\ 1 \\
0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0 & 0\ 0\ 1\ 0\ 0\ 0\ 1\ 0\ 0\ 1\ 0\ 0\ 0
\end{bmatrix}$$

This matrix has been constructed by the synthesis procedure outlined in the proof of Theorem 2 by taking $b = 3$, $s = 2$, $t = 13$ over $GF(2)$ (MS Excel Program was used for the construction of the matrix). It can be seen from the Table 1 that the syndromes of all distinct 2-repeated bursts of length 3 or less whether in the same sub-block or in different sub-blocks are different, showing thereby that the code that is the null space of this matrix corrects all 2-repeated bursts of length 3 or less occurring within a sub-block.

Table 1

Error Patterns - Syndrome vectors

Sub-block 1

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
1	1111110000000 0000000000000	1111110000000000	44	0111101000000 0000000000000	0111101000000000
2	1110111000000 0000000000000	1110111000000000	45	0111010100000 0000000000000	0111010100000000
3	1110011100000 0000000000000	1110011100000000	46	0111001010000 0000000000000	0111001010000000
4	1110001110000 0000000000000	1110001110000000	47	0111000101000 0000000000000	0111000101000000
5	1110000111000 0000000000000	1110000111000000	48	0111000010100 0000000000000	0111000010100000
6	1110000011100 0000000000000	1110000011100000	49	0111000001010 0000000000000	0111000001010000
7	1110000001110 0000000000000	1110000001110000	50	0111000000101 0000000000000	0111000000101000
8	1110000000111 0000000000000	1110000000111000	51	0111110000000 0000000000000	0111110000000000
9	1111010000000 0000000000000	1111010000000000	52	0111011000000 0000000000000	0111011000000000
10	1110101000000 0000000000000	1110101000000000	53	0111001100000 0000000000000	0111001100000000
11	1110010100000 0000000000000	1110010100000000	54	0111000110000 0000000000000	0111000110000000
12	1110001010000 0000000000000	1110001010000000	55	0111000011000 0000000000000	0111000011000000
13	1110000101000 0000000000000	1110000101000000	56	0111000001100 0000000000000	0111000001100000
14	1110000010100 0000000000000	1110000010100000	57	0111000000110 0000000000000	0111000000110000
15	1110000001010 0000000000000	1110000001010000	58	0111000000011 0000000000000	0111000000011000
16	1110000000101 0000000000000	1110000000101000	59	0111100000000 0000000000000	0111100000000000
17	1111100000000 0000000000000	1111100000000000	60	0111010000000 0000000000000	0111010000000000
18	1110110000000 0000000000000	1110110000000000	61	0111001000000 0000000000000	0111001000000000
19	1110011000000 0000000000000	1110011000000000	62	0111000100000 0000000000000	0111000100000000
20	1110001100000 0000000000000	1110001100000000	63	0111000010000 0000000000000	0111000010000000
21	1110000110000 0000000000000	1110000110000000	64	0111000001000 0000000000000	0111000001000000
22	1110000011000 0000000000000	1110000011000000	65	0111000000100 0000000000000	0111000000100000
23	1110000001100 0000000000000	1110000001100000	66	0111000000010 0000000000000	0111000000010000
24	1110000000110 0000000000000	1110000000110000	67	0111000000001 0000000000000	0111000000001000
25	1110000000011 0000000000000	1110000000011000	68	0111000000000 0000000000000	0111000000000000
26	1111000000000 0000000000000	1111000000000000	69	0011111100000 0000000000000	0011111100000000
27	1110100000000 0000000000000	1110100000000000	70	0011101110000 0000000000000	0011101110000000
28	1110010000000 0000000000000	1110010000000000	71	0011100111000 0000000000000	0011100111000000
29	1110001000000 0000000000000	1110001000000000	72	0011100011100 0000000000000	0011100011100000
30	1110000100000 0000000000000	1110000100000000	73	0011100001110 0000000000000	0011100001110000
31	1110000010000 0000000000000	1110000010000000	74	0011100000111 0000000000000	0011100000111000
32	1110000001000 0000000000000	1110000001000000	75	0011110100000 0000000000000	0011110100000000
33	1110000000100 0000000000000	1110000000100000	76	0011101010000 0000000000000	0011101010000000
34	1110000000010 0000000000000	1110000000010000	77	0011100101000 0000000000000	0011100101000000
35	1110000000001 0000000000000	1110000000001000	78	0011100010100 0000000000000	0011100010100000
36	1110000000000 0000000000000	1110000000000000	79	0011100001010 0000000000000	0011100001010000
37	0111111000000 0000000000000	0111111000000000	80	0011100000101 0000000000000	0011100000101000
38	0111011100000 0000000000000	0111011100000000	81	0011111000000 0000000000000	0011111000000000
39	0111001110000 0000000000000	0111001110000000	82	0011101100000 0000000000000	0011101100000000
40	0111000111000 0000000000000	0111000111000000	83	0011100110000 0000000000000	0011100110000000
41	0111000011100 0000000000000	0111000011100000	84	0011100011000 0000000000000	0011100011000000
42	0111000001110 0000000000000	0111000001110000	85	0011100001100 0000000000000	0011100001100000
43	0111000000111 0000000000000	0111000000111000	86	0011100000110 0000000000000	0011100000110000

Sub-block 1

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
87	0011100000011 0000000000000	0011100000011000	134	0000111100000 0000000000000	0000111100000000
88	0011110000000 0000000000000	0011110000000000	135	0000111010000 0000000000000	0000111010000000
89	0011101000000 0000000000000	0011101000000000	136	0000111001000 0000000000000	0000111001000000
90	0011100100000 0000000000000	0011100100000000	137	0000111000100 0000000000000	0000111000100000
91	0011100010000 0000000000000	0011100010000000	138	0000111000010 0000000000000	0000111000010000
92	0011100001000 0000000000000	0011100001000000	139	0000111000001 0000000000000	0000111000001000
93	0011100000100 0000000000000	0011100000100000	140	0000111000000 0000000000000	0000111000000000
94	0011100000010 0000000000000	0011100000010000	141	0000011111100 0000000000000	0000011111100000
95	0011100000001 0000000000000	0011100000001000	142	0000011101110 0000000000000	0000011101110000
96	0011100000000 0000000000000	0011100000000000	143	0000011100111 0000000000000	0000011100111000
97	0001111110000 0000000000000	0001111110000000	144	0000011110100 0000000000000	0000011110100000
98	0001110111000 0000000000000	0001110111000000	145	0000011101010 0000000000000	0000011101010000
99	0001110011100 0000000000000	0001110011100000	146	0000011100101 0000000000000	0000011100101000
100	0001110001110 0000000000000	0001110001110000	147	0000011111000 0000000000000	0000011111000000
101	0001110000111 0000000000000	0001110000111000	148	0000011101100 0000000000000	0000011101100000
102	0001111010000 0000000000000	0001111010000000	149	0000011100110 0000000000000	0000011100110000
103	0001110101000 0000000000000	0001110101000000	150	0000011100011 0000000000000	0000011100011000
104	0001110010100 0000000000000	0001110010100000	151	0000011110000 0000000000000	0000011110000000
105	0001110001010 0000000000000	0001110001010000	152	0000011101000 0000000000000	0000011101000000
106	0001110000101 0000000000000	0001110000101000	153	0000011100100 0000000000000	0000011100100000
107	0001111100000 0000000000000	0001111100000000	154	0000011100010 0000000000000	0000011100010000
108	0001110110000 0000000000000	0001110110000000	155	0000011100001 0000000000000	0000011100001000
109	0001110011000 0000000000000	0001110011000000	156	0000011100000 0000000000000	0000011100000000
110	0001110001100 0000000000000	0001110001100000	157	0000001111110 0000000000000	0000001111110000
111	0001110000110 0000000000000	0001110000110000	158	0000001110111 0000000000000	0000001110111000
112	0001110000011 0000000000000	0001110000011000	159	0000001111010 0000000000000	0000001111010000
113	0001111000000 0000000000000	0001111000000000	160	0000001110101 0000000000000	0000001110101000
114	0001110100000 0000000000000	0001110100000000	161	0000001111100 0000000000000	0000001111100000
115	0001110010000 0000000000000	0001110010000000	162	0000001110110 0000000000000	0000001110110000
116	0001110001000 0000000000000	0001110001000000	163	0000001110011 0000000000000	0000001110011000
117	0001110000100 0000000000000	0001110000100000	164	0000001111000 0000000000000	0000001111000000
118	0001110000010 0000000000000	0001110000010000	165	0000001110100 0000000000000	0000001110100000
119	0001110000001 0000000000000	0001110000001000	166	0000001110010 0000000000000	0000001110010000
120	0001110000000 0000000000000	0001110000000000	167	0000001110001 0000000000000	0000001110001000
121	0000111111000 0000000000000	0000111111000000	168	0000001110000 0000000000000	0000001110000000
122	0000111011100 0000000000000	0000111011100000	169	0000000111111 0000000000000	0000000111111000
123	0000111001110 0000000000000	0000111001110000	170	0000000111101 0000000000000	0000000111101000
124	0000111000111 0000000000000	0000111000111000	171	0000000111110 0000000000000	0000000111110000
125	0000111101000 0000000000000	0000111101000000	172	0000000111011 0000000000000	0000000111011000
126	0000111010100 0000000000000	0000111010100000	173	0000000111100 0000000000000	0000000111100000
127	0000111001010 0000000000000	0000111001010000	174	0000000111010 0000000000000	0000000111010000
128	0000111000101 0000000000000	0000111000101000	175	0000000111001 0000000000000	0000000111001000
129	0000111110000 0000000000000	0000111110000000	176	0000000111000 0000000000000	0000000111000000
130	0000111011000 0000000000000	0000111011000000	177	0000000011111 0000000000000	0000000011111000
131	0000111001100 0000000000000	0000111001100000	178	0000000011101 0000000000000	0000000011101000
132	0000111000110 0000000000000	0000111000110000	179	0000000011110 0000000000000	0000000011110000
133	0000111000011 0000000000000	0000111000011000	180	0000000011100 0000000000000	0000000011100000

Sub-block 1

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
181	0000000001111 0000000000000	0000000001111000	228	0101010100000 0000000000000	0101010100000000
182	0000000001110 0000000000000	0000000001110000	229	0101001010000 0000000000000	0101001010000000
183	0000000000111 0000000000000	0000000000111000	230	0101000101000 0000000000000	0101000101000000
184	1011110000000 0000000000000	1011110000000000	231	0101000010100 0000000000000	0101000010100000
185	1010111000000 0000000000000	1010111000000000	232	0101000001010 0000000000000	0101000001010000
186	1010011100000 0000000000000	1010011100000000	233	0101000000101 0000000000000	0101000000101000
187	1010001110000 0000000000000	1010001110000000	234	0101110000000 0000000000000	0101110000000000
188	1010000111000 0000000000000	1010000111000000	235	0101011000000 0000000000000	0101011000000000
189	1010000011100 0000000000000	1010000011100000	236	0101001100000 0000000000000	0101001100000000
190	1010000001110 0000000000000	1010000001110000	237	0101000110000 0000000000000	0101000110000000
191	1010000000111 0000000000000	1010000000111000	238	0101000011000 0000000000000	0101000011000000
192	1011010000000 0000000000000	1011010000000000	239	0101000001100 0000000000000	0101000001100000
193	1010101000000 0000000000000	1010101000000000	240	0101000000110 0000000000000	0101000000110000
194	1010010100000 0000000000000	1010010100000000	241	0101000000011 0000000000000	0101000000011000
195	1010001010000 0000000000000	1010001010000000	242	0101100000000 0000000000000	0101100000000000
196	1010000101000 0000000000000	1010000101000000	243	0101010000000 0000000000000	0101010000000000
197	1010000010100 0000000000000	1010000010100000	244	0101001000000 0000000000000	0101001000000000
198	1010000001010 0000000000000	1010000001010000	245	0101000100000 0000000000000	0101000100000000
199	1010000000101 0000000000000	1010000000101000	246	0101000010000 0000000000000	0101000010000000
200	1011100000000 0000000000000	1011100000000000	247	0101000001000 0000000000000	0101000001000000
201	1010110000000 0000000000000	1010110000000000	248	0101000000100 0000000000000	0101000000100000
202	1010011000000 0000000000000	1010011000000000	249	0101000000010 0000000000000	0101000000010000
203	1010001100000 0000000000000	1010001100000000	250	0101000000001 0000000000000	0101000000001000
204	1010000110000 0000000000000	1010000110000000	251	0101000000000 0000000000000	0101000000000000
205	1010000011000 0000000000000	1010000011000000	252	0010111100000 0000000000000	0010111100000000
206	1010000001100 0000000000000	1010000001100000	253	0010101110000 0000000000000	0010101110000000
207	1010000000110 0000000000000	1010000000110000	254	0010100111000 0000000000000	0010100111000000
208	1010000000011 0000000000000	1010000000011000	255	0010100011100 0000000000000	0010100011100000
209	1011000000000 0000000000000	1011000000000000	256	0010100001110 0000000000000	0010100001110000
210	1010100000000 0000000000000	1010100000000000	257	0010100000111 0000000000000	0010100000111000
211	1010010000000 0000000000000	1010010000000000	258	0010110100000 0000000000000	0010110100000000
212	1010001000000 0000000000000	1010001000000000	259	0010101010000 0000000000000	0010101010000000
213	1010000100000 0000000000000	1010000100000000	260	0010100101000 0000000000000	0010100101000000
214	1010000010000 0000000000000	1010000010000000	261	0010100010100 0000000000000	0010100010100000
215	1010000001000 0000000000000	1010000001000000	262	0010100001010 0000000000000	0010100001010000
216	1010000000100 0000000000000	1010000000100000	263	0010100000101 0000000000000	0010100000101000
217	1010000000010 0000000000000	1010000000010000	264	0010111000000 0000000000000	0010111000000000
218	1010000000001 0000000000000	1010000000001000	265	0010101100000 0000000000000	0010101100000000
219	1010000000000 0000000000000	1010000000000000	266	0010100110000 0000000000000	0010100110000000
220	0101111000000 0000000000000	0101111000000000	267	0010100011000 0000000000000	0010100011000000
221	0101011100000 0000000000000	0101011100000000	268	0010100001100 0000000000000	0010100001100000
222	0101001110000 0000000000000	0101001110000000	269	0010100000110 0000000000000	0010100000110000
223	0101000111000 0000000000000	0101000111000000	270	0010100000011 0000000000000	0010100000011000
224	0101000011100 0000000000000	0101000011100000	271	0010110000000 0000000000000	0010110000000000
225	0101000001110 0000000000000	0101000001110000	272	0010101000000 0000000000000	0010101000000000
226	0101000000111 0000000000000	0101000000111000	273	0010100100000 0000000000000	0010100100000000
227	0101101000000 0000000000000	0101101000000000	274	0010100010000 0000000000000	0010100010000000

Sub-block 1

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
275	0010100001000 0000000000000	0010100001000000	322	0000101000001 0000000000000	0000101000001000
276	0010100000100 0000000000000	0010100000100000	323	0000101000000 0000000000000	0000101000000000
277	0010100000010 0000000000000	0010100000010000	324	0000010111100 0000000000000	0000010111100000
278	0010100000001 0000000000000	0010100000001000	325	0000010101110 0000000000000	0000010101110000
279	0010100000000 0000000000000	0010100000000000	326	0000010100111 0000000000000	0000010100111000
280	0001011110000 0000000000000	0001011110000000	327	0000010110100 0000000000000	0000010110100000
281	0001010111000 0000000000000	0001010111000000	328	0000010101010 0000000000000	0000010101010000
282	0001010011100 0000000000000	0001010011100000	329	0000010100101 0000000000000	0000010100101000
283	0001010001110 0000000000000	0001010001110000	330	0000010111000 0000000000000	0000010111000000
284	0001010000111 0000000000000	0001010000111000	331	0000010101100 0000000000000	0000010101100000
285	0001011010000 0000000000000	0001011010000000	332	0000010100110 0000000000000	0000010100110000
286	0001010101000 0000000000000	0001010101000000	333	0000010100011 0000000000000	0000010100011000
287	0001010010100 0000000000000	0001010010100000	334	0000010110000 0000000000000	0000010110000000
288	0001010001010 0000000000000	0001010001010000	335	0000010101000 0000000000000	0000010101000000
289	0001010000101 0000000000000	0001010000101000	336	0000010100100 0000000000000	0000010100100000
290	0001011100000 0000000000000	0001011100000000	337	0000010100010 0000000000000	0000010100010000
291	0001010110000 0000000000000	0001010110000000	338	0000010100001 0000000000000	0000010100001000
292	0001010011000 0000000000000	0001010011000000	339	0000010100000 0000000000000	0000010100000000
293	0001010001100 0000000000000	0001010001100000	340	0000001011110 0000000000000	0000001011110000
294	0001010000110 0000000000000	0001010000110000	341	0000001010111 0000000000000	0000001010111000
295	0001010000011 0000000000000	0001010000011000	342	0000001011010 0000000000000	0000001011010000
296	0001011000000 0000000000000	0001011000000000	343	0000001010101 0000000000000	0000001010101000
297	0001010100000 0000000000000	0001010100000000	344	0000001011100 0000000000000	0000001011100000
298	0001010010000 0000000000000	0001010010000000	345	0000001010110 0000000000000	0000001010110000
299	0001010001000 0000000000000	0001010001000000	346	0000001010011 0000000000000	0000001010011000
300	0001010000100 0000000000000	0001010000100000	347	0000001011000 0000000000000	0000001011000000
301	0001010000010 0000000000000	0001010000010000	348	0000001010100 0000000000000	0000001010100000
302	0001010000001 0000000000000	0001010000001000	349	0000001010010 0000000000000	0000001010010000
303	0001010000000 0000000000000	0001010000000000	350	0000001010001 0000000000000	0000001010001000
304	0000101111000 0000000000000	0000101111000000	351	0000001010000 0000000000000	0000001010000000
305	0000101011100 0000000000000	0000101011100000	352	0000000101111 0000000000000	0000000101111000
306	0000101001110 0000000000000	0000101001110000	353	0000000101101 0000000000000	0000000101101000
307	0000101000111 0000000000000	0000101000111000	354	0000000101110 0000000000000	0000000101110000
308	0000101101000 0000000000000	0000101101000000	355	0000000101011 0000000000000	0000000101011000
309	0000101010100 0000000000000	0000101010100000	356	0000000101100 0000000000000	0000000101100000
310	0000101001010 0000000000000	0000101001010000	357	0000000101010 0000000000000	0000000101010000
311	0000101000101 0000000000000	0000101000101000	358	0000000101001 0000000000000	0000000101001000
312	0000101110000 0000000000000	0000101110000000	359	0000000101000 0000000000000	0000000101000000
313	0000101011000 0000000000000	0000101011000000	360	0000000010111 0000000000000	0000000010111000
314	0000101001100 0000000000000	0000101001100000	361	0000000010101 0000000000000	0000000010101000
315	0000101000110 0000000000000	0000101000110000	362	0000000010110 0000000000000	0000000010110000
316	0000101000011 0000000000000	0000101000011000	363	0000000010100 0000000000000	0000000010100000
317	0000101100000 0000000000000	0000101100000000	364	0000000001011 0000000000000	0000000001011000
318	0000101010000 0000000000000	0000101010000000	365	0000000001010 0000000000000	0000000001010000
319	0000101001000 0000000000000	0000101001000000	366	0000000000101 0000000000000	0000000000101000
320	0000101000100 0000000000000	0000101000100000	367	1101110000000 0000000000000	1101110000000000
321	0000101000010 0000000000000	0000101000010000	368	1100111000000 0000000000000	1100111000000000

Sub-block 1

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
369	1100011100000 0000000000000	1100011100000000	416	0110000000101 0000000000000	0110000000101000
370	1100001110000 0000000000000	1100001110000000	417	0110110000000 0000000000000	0110110000000000
371	1100000111000 0000000000000	1100000111000000	418	0110011000000 0000000000000	0110011000000000
372	1100000011100 0000000000000	1100000011100000	419	0110001100000 0000000000000	0110001100000000
373	1100000001110 0000000000000	1100000001110000	420	0110000110000 0000000000000	0110000110000000
374	1100000000111 0000000000000	1100000000111000	421	0110000011000 0000000000000	0110000011000000
375	1101010000000 0000000000000	1101010000000000	422	0110000001100 0000000000000	0110000001100000
376	1100101000000 0000000000000	1100101000000000	423	0110000000110 0000000000000	0110000000110000
377	1100010100000 0000000000000	1100010100000000	424	0110000000011 0000000000000	0110000000011000
378	1100001010000 0000000000000	1100001010000000	425	0110100000000 0000000000000	0110100000000000
379	1100000101000 0000000000000	1100000101000000	426	0110010000000 0000000000000	0110010000000000
380	1100000010100 0000000000000	1100000010100000	427	0110001000000 0000000000000	0110001000000000
381	1100000001010 0000000000000	1100000001010000	428	0110000100000 0000000000000	0110000100000000
382	1100000000101 0000000000000	1100000000101000	429	0110000010000 0000000000000	0110000010000000
383	1101100000000 0000000000000	1101100000000000	430	0110000001000 0000000000000	0110000001000000
384	1100110000000 0000000000000	1100110000000000	431	0110000000100 0000000000000	0110000000100000
385	1100011000000 0000000000000	1100011000000000	432	0110000000010 0000000000000	0110000000010000
386	1100001100000 0000000000000	1100001100000000	433	0110000000001 0000000000000	0110000000001000
387	1100000110000 0000000000000	1100000110000000	434	0110000000000 0000000000000	0110000000000000
388	1100000011000 0000000000000	1100000011000000	435	0011011100000 0000000000000	0011011100000000
389	1100000001100 0000000000000	1100000001100000	436	0011001110000 0000000000000	0011001110000000
390	1100000000110 0000000000000	1100000000110000	437	0011000111000 0000000000000	0011000111000000
391	1100000000011 0000000000000	1100000000011000	438	0011000011100 0000000000000	0011000011100000
392	1101000000000 0000000000000	1101000000000000	439	0011000001110 0000000000000	0011000001110000
393	1100100000000 0000000000000	1100100000000000	440	0011000000111 0000000000000	0011000000111000
394	1100010000000 0000000000000	1100010000000000	441	0011010100000 0000000000000	0011010100000000
395	1100001000000 0000000000000	1100001000000000	442	0011001010000 0000000000000	0011001010000000
396	1100000100000 0000000000000	1100000100000000	443	0011000101000 0000000000000	0011000101000000
397	1100000010000 0000000000000	1100000010000000	444	0011000010100 0000000000000	0011000010100000
398	1100000001000 0000000000000	1100000001000000	445	0011000001010 0000000000000	0011000001010000
399	1100000000100 0000000000000	1100000000100000	446	0011000000101 0000000000000	0011000000101000
400	1100000000010 0000000000000	1100000000010000	447	0011011000000 0000000000000	0011011000000000
401	1100000000001 0000000000000	1100000000001000	448	0011001100000 0000000000000	0011001100000000
402	1100000000000 0000000000000	1100000000000000	449	0011000110000 0000000000000	0011000110000000
403	0110111000000 0000000000000	0110111000000000	450	0011000011000 0000000000000	0011000011000000
404	0110011100000 0000000000000	0110011100000000	451	0011000001100 0000000000000	0011000001100000
405	0110001110000 0000000000000	0110001110000000	452	0011000000110 0000000000000	0011000000110000
406	0110000111000 0000000000000	0110000111000000	453	0011000000011 0000000000000	0011000000011000
407	0110000011100 0000000000000	0110000011100000	454	0011010000000 0000000000000	0011010000000000
408	0110000001110 0000000000000	0110000001110000	455	0011001000000 0000000000000	0011001000000000
409	0110000000111 0000000000000	0110000000111000	456	0011000100000 0000000000000	0011000100000000
410	0110101000000 0000000000000	0110101000000000	457	0011000010000 0000000000000	0011000010000000
411	0110010100000 0000000000000	0110010100000000	458	0011000001000 0000000000000	0011000001000000
412	0110001010000 0000000000000	0110001010000000	459	0011000000100 0000000000000	0011000000100000
413	0110000101000 0000000000000	0110000101000000	460	0011000000010 0000000000000	0011000000010000
414	0110000010100 0000000000000	0110000010100000	461	0011000000001 0000000000000	0011000000001000
415	0110000001010 0000000000000	0110000001010000	462	0011000000000 0000000000000	0011000000000000

Sub-block 1

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
463	0001101110000 0000000000000	0001101110000000	510	0000011010100 0000000000000	0000011010100000
464	0001100111000 0000000000000	0001100111000000	511	0000011001010 0000000000000	0000011001010000
465	0001100011100 0000000000000	0001100011100000	512	0000011000101 0000000000000	0000011000101000
466	0001100001110 0000000000000	0001100001110000	513	0000011011000 0000000000000	0000011011000000
467	0001100000111 0000000000000	0001100000111000	514	0000011001100 0000000000000	0000011001100000
468	0001101010000 0000000000000	0001101010000000	515	0000011000110 0000000000000	0000011000110000
469	0001100101000 0000000000000	0001100101000000	516	0000011000011 0000000000000	0000011000011000
470	0001100010100 0000000000000	0001100010100000	517	0000011010000 0000000000000	0000011010000000
471	0001100001010 0000000000000	0001100001010000	518	0000011001000 0000000000000	0000011001000000
472	0001100000101 0000000000000	0001100000101000	519	0000011000100 0000000000000	0000011000100000
473	0001101100000 0000000000000	0001101100000000	520	0000011000010 0000000000000	0000011000010000
474	0001100110000 0000000000000	0001100110000000	521	0000011000001 0000000000000	0000011000001000
475	0001100011000 0000000000000	0001100011000000	522	0000011000000 0000000000000	0000011000000000
476	0001100001100 0000000000000	0001100001100000	523	0000001101110 0000000000000	0000001101110000
477	0001100000110 0000000000000	0001100000110000	524	0000001100111 0000000000000	0000001100111000
478	0001100000011 0000000000000	0001100000011000	525	0000001101010 0000000000000	0000001101010000
479	0001101000000 0000000000000	0001101000000000	526	0000001100101 0000000000000	0000001100101000
480	0001100100000 0000000000000	0001100100000000	527	0000001101100 0000000000000	0000001101100000
481	0001100010000 0000000000000	0001100010000000	528	0000001100110 0000000000000	0000001100110000
482	0001100001000 0000000000000	0001100001000000	529	0000001100011 0000000000000	0000001100011000
483	0001100000100 0000000000000	0001100000100000	530	0000001101000 0000000000000	0000001101000000
484	0001100000010 0000000000000	0001100000010000	531	0000001100100 0000000000000	0000001100100000
485	0001100000001 0000000000000	0001100000001000	532	0000001100010 0000000000000	0000001100010000
486	0001100000000 0000000000000	0001100000000000	533	0000001100001 0000000000000	0000001100001000
487	0000110111000 0000000000000	0000110111000000	534	0000001100000 0000000000000	0000001100000000
488	0000110011100 0000000000000	0000110011100000	535	0000000110111 0000000000000	0000000110111000
489	0000110001110 0000000000000	0000110001110000	536	0000000110101 0000000000000	0000000110101000
490	0000110000111 0000000000000	0000110000111000	537	0000000110110 0000000000000	0000000110110000
491	0000110101000 0000000000000	0000110101000000	538	0000000110011 0000000000000	0000000110011000
492	0000110010100 0000000000000	0000110010100000	539	0000000110100 0000000000000	0000000110100000
493	0000110001010 0000000000000	0000110001010000	540	0000000110010 0000000000000	0000000110010000
494	0000110000101 0000000000000	0000110000101000	541	0000000110001 0000000000000	0000000110001000
495	0000110110000 0000000000000	0000110110000000	542	0000000110000 0000000000000	0000000110000000
496	0000110011000 0000000000000	0000110011000000	543	0000000011011 0000000000000	0000000011011000
497	0000110001100 0000000000000	0000110001100000	544	0000000011001 0000000000000	0000000011001000
498	0000110000110 0000000000000	0000110000110000	545	0000000011010 0000000000000	0000000011010000
499	0000110000011 0000000000000	0000110000011000	546	0000000011000 0000000000000	0000000011000000
500	0000110100000 0000000000000	0000110100000000	547	0000000001101 0000000000000	0000000001101000
501	0000110010000 0000000000000	0000110010000000	548	0000000001100 0000000000000	0000000001100000
502	0000110001000 0000000000000	0000110001000000	549	0000000000110 0000000000000	0000000000110000
503	0000110000100 0000000000000	0000110000100000	550	0000000000011 0000000000000	0000000000011000
504	0000110000010 0000000000000	0000110000010000	551	1001110000000 0000000000000	1001110000000000
505	0000110000001 0000000000000	0000110000001000	552	1000111000000 0000000000000	1000111000000000
506	0000110000000 0000000000000	0000110000000000	553	1000011100000 0000000000000	1000011100000000
507	0000011011100 0000000000000	0000011011100000	554	1000001110000 0000000000000	1000001110000000
508	0000011001110 0000000000000	0000011001110000	555	1000000111000 0000000000000	1000000111000000
509	0000011000111 0000000000000	0000011000111000	556	1000000011100 0000000000000	1000000011100000

Sub-block 1

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
557	1000000001110 0000000000000	1000000001110000	604	0100000110000 0000000000000	0100000110000000
558	1000000000111 0000000000000	1000000000111000	605	0100000011000 0000000000000	0100000011000000
559	1001010000000 0000000000000	1001010000000000	606	0100000001100 0000000000000	0100000001100000
560	1000101000000 0000000000000	1000101000000000	607	0100000000110 0000000000000	0100000000110000
561	1000010100000 0000000000000	1000010100000000	608	0100000000011 0000000000000	0100000000011000
562	1000001010000 0000000000000	1000001010000000	609	0100100000000 0000000000000	0100100000000000
563	1000000101000 0000000000000	1000000101000000	610	0100010000000 0000000000000	0100010000000000
564	1000000010100 0000000000000	1000000010100000	611	0100001000000 0000000000000	0100001000000000
565	1000000001010 0000000000000	1000000001010000	612	0100000100000 0000000000000	0100000100000000
566	1000000000101 0000000000000	1000000000101000	613	0100000010000 0000000000000	0100000010000000
567	1001100000000 0000000000000	1001100000000000	614	0100000001000 0000000000000	0100000001000000
568	1000110000000 0000000000000	1000110000000000	615	0100000000100 0000000000000	0100000000100000
569	1000011000000 0000000000000	1000011000000000	616	0100000000010 0000000000000	0100000000010000
570	1000001100000 0000000000000	1000001100000000	617	0100000000001 0000000000000	0100000000001000
571	1000000110000 0000000000000	1000000110000000	618	0100000000000 0000000000000	0100000000000000
572	1000000011000 0000000000000	1000000011000000	619	0010011100000 0000000000000	0010011100000000
573	1000000001100 0000000000000	1000000001100000	620	0010001110000 0000000000000	0010001110000000
574	1000000000110 0000000000000	1000000000110000	621	0010000111000 0000000000000	0010000111000000
575	1000000000011 0000000000000	1000000000011000	622	0010000011100 0000000000000	0010000011100000
576	1001000000000 0000000000000	1001000000000000	623	0010000001110 0000000000000	0010000001110000
577	1000100000000 0000000000000	1000100000000000	624	0010000000111 0000000000000	0010000000111000
578	1000010000000 0000000000000	1000010000000000	625	0010010100000 0000000000000	0010010100000000
579	1000001000000 0000000000000	1000001000000000	626	0010001010000 0000000000000	0010001010000000
580	1000000100000 0000000000000	1000000100000000	627	0010000101000 0000000000000	0010000101000000
581	1000000010000 0000000000000	1000000010000000	628	0010000010100 0000000000000	0010000010100000
582	1000000001000 0000000000000	1000000001000000	629	0010000001010 0000000000000	0010000001010000
583	1000000000100 0000000000000	1000000000100000	630	0010000000101 0000000000000	0010000000101000
584	1000000000010 0000000000000	1000000000010000	631	0010011000000 0000000000000	0010011000000000
585	1000000000001 0000000000000	1000000000001000	632	0010001100000 0000000000000	0010001100000000
586	1000000000000 0000000000000	1000000000000000	633	0010000110000 0000000000000	0010000110000000
587	0100111000000 0000000000000	0100111000000000	634	0010000011000 0000000000000	0010000011000000
588	0100011100000 0000000000000	0100011100000000	635	0010000001100 0000000000000	0010000001100000
589	0100001110000 0000000000000	0100001110000000	636	0010000000110 0000000000000	0010000000110000
590	0100000111000 0000000000000	0100000111000000	637	0010000000011 0000000000000	0010000000011000
591	0100000011100 0000000000000	0100000011100000	638	0010010000000 0000000000000	0010010000000000
592	0100000001110 0000000000000	0100000001110000	639	0010001000000 0000000000000	0010001000000000
593	0100000000111 0000000000000	0100000000111000	640	0010000100000 0000000000000	0010000100000000
594	0100101000000 0000000000000	0100101000000000	641	0010000010000 0000000000000	0010000010000000
595	0100010100000 0000000000000	0100010100000000	642	0010000001000 0000000000000	0010000001000000
596	0100001010000 0000000000000	0100001010000000	643	0010000000100 0000000000000	0010000000100000
597	0100000101000 0000000000000	0100000101000000	644	0010000000010 0000000000000	0010000000010000
598	0100000010100 0000000000000	0100000010100000	645	0010000000001 0000000000000	0010000000001000
599	0100000001010 0000000000000	0100000001010000	646	0010000000000 0000000000000	0010000000000000
600	0100000000101 0000000000000	0100000000101000	647	0001001110000 0000000000000	0001001110000000
601	0100110000000 0000000000000	0100110000000000	648	0001000111000 0000000000000	0001000111000000
602	0100011000000 0000000000000	0100011000000000	649	0001000011100 0000000000000	0001000011100000
603	0100001100000 0000000000000	0100001100000000	650	0001000001110 0000000000000	0001000001110000

Sub-block 1

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
651	0001000000111 0000000000000	0001000000111000	694	0000010010100 0000000000000	0000010010100000
652	0001001010000 0000000000000	0001001010000000	695	0000010001010 0000000000000	0000010001010000
653	0001000101000 0000000000000	0001000101000000	696	0000010000101 0000000000000	0000010000101000
654	0001000010100 0000000000000	0001000010100000	697	0000010011000 0000000000000	0000010011000000
655	0001000001010 0000000000000	0001000001010000	698	0000010001100 0000000000000	0000010001100000
656	0001000000101 0000000000000	0001000000101000	699	0000010000110 0000000000000	0000010000110000
657	0001001100000 0000000000000	0001001100000000	700	0000010000011 0000000000000	0000010000011000
658	0001000110000 0000000000000	0001000110000000	701	0000010010000 0000000000000	0000010010000000
659	0001000011000 0000000000000	0001000011000000	702	0000010001000 0000000000000	0000010001000000
660	0001000001100 0000000000000	0001000001100000	703	0000010000100 0000000000000	0000010000100000
661	0001000000110 0000000000000	0001000000110000	704	0000010000010 0000000000000	0000010000010000
662	0001000000011 0000000000000	0001000000011000	705	0000010000001 0000000000000	0000010000001000
663	0001001000000 0000000000000	0001001000000000	706	0000010000000 0000000000000	0000010000000000
664	0001000100000 0000000000000	0001000100000000	707	0000001001110 0000000000000	0000001001110000
665	0001000010000 0000000000000	0001000010000000	708	0000001000111 0000000000000	0000001000111000
666	0001000001000 0000000000000	0001000001000000	709	0000001001010 0000000000000	0000001001010000
667	0001000000100 0000000000000	0001000000100000	710	0000001000101 0000000000000	0000001000101000
668	0001000000010 0000000000000	0001000000010000	711	0000001001100 0000000000000	0000001001100000
669	0001000000001 0000000000000	0001000000001000	712	0000001000110 0000000000000	0000001000110000
670	0001000000000 0000000000000	0001000000000000	713	0000001000011 0000000000000	0000001000011000
671	0000100111000 0000000000000	0000100111000000	714	0000001001000 0000000000000	0000001001000000
672	0000100011100 0000000000000	0000100011100000	715	0000001000100 0000000000000	0000001000100000
673	0000100001110 0000000000000	0000100001110000	716	0000001000010 0000000000000	0000001000010000
674	0000100000111 0000000000000	0000100000111000	717	0000001000001 0000000000000	0000001000001000
675	0000100101000 0000000000000	0000100101000000	718	0000001000000 0000000000000	0000001000000000
676	0000100010100 0000000000000	0000100010100000	719	0000000100111 0000000000000	0000000100111000
677	0000100001010 0000000000000	0000100001010000	720	0000000100101 0000000000000	0000000100101000
678	0000100000101 0000000000000	0000100000101000	721	0000000100110 0000000000000	0000000100110000
679	0000100110000 0000000000000	0000100110000000	722	0000000100011 0000000000000	0000000100011000
680	0000100011000 0000000000000	0000100011000000	723	0000000100100 0000000000000	0000000100100000
681	0000100001100 0000000000000	0000100001100000	724	0000000100010 0000000000000	0000000100010000
682	0000100000110 0000000000000	0000100000110000	725	0000000100001 0000000000000	0000000100001000
683	0000100000011 0000000000000	0000100000011000	726	0000000100000 0000000000000	0000000100000000
684	0000100100000 0000000000000	0000100100000000	727	0000000010011 0000000000000	0000000010011000
685	0000100010000 0000000000000	0000100010000000	728	0000000010001 0000000000000	0000000010001000
686	0000100001000 0000000000000	0000100001000000	729	0000000010010 0000000000000	0000000010010000
687	0000100000100 0000000000000	0000100000100000	730	0000000010000 0000000000000	0000000010000000
688	0000100000010 0000000000000	0000100000010000	731	0000000001001 0000000000000	0000000001001000
689	0000100000001 0000000000000	0000100000001000	732	0000000001000 0000000000000	0000000001000000
690	0000100000000 0000000000000	0000100000000000	733	0000000000100 0000000000000	0000000000100000
691	0000010011100 0000000000000	0000010011100000	734	0000000000010 0000000000000	0000000000010000
692	0000010001110 0000000000000	0000010001110000	735	0000000000001 0000000000000	0000000000001000
693	0000010000111 0000000000000	0000010000111000			

Sub-block 2

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
736	0000000000000 1111110000000	0000111111111101	779	0000000000000 0111101000000	0000010010000100
737	0000000000000 1110111000000	0000111111101010	780	0000000000000 0111010100000	0000111111100101
738	0000000000000 1110011100000	0000111111110110	781	0000000000000 0111001010000	0000100101110100
739	0000000000000 1110001110000	0000111110110100	782	0000000000000 0111000101000	0001011010011100
740	0000000000000 1110000111000	0001110110110000	783	0000000000000 0111000010100	0000000000110111
741	0000000000000 1110000011100	0001001000100000	784	0000000000000 0111000001010	0011001010011010
742	0000000000000 1110000001110	0011101111001010	785	0000000000000 0111000000101	0001100000001101
743	0000000000000 1110000000111	0011101011001011	786	0000000000000 0111110000000	0000111111111001
744	0000000000000 1111010000000	0000101101101101	787	0000000000000 0111011000000	0000100100110110
745	0000000000000 1110101000000	0000011011001000	788	0000000000000 0111001100000	0000010010011000
746	0000000000000 1110010100000	0000110110101001	789	0000000000000 0111000110000	0000111110100111
747	0000000000000 1110001010000	0000101100111000	790	0000000000000 0111000011000	0001101101110000
748	0000000000000 1110000101000	0001010011010000	791	0000000000000 0111000001100	0001100100001100
749	0000000000000 1110000010100	0000001001111011	792	0000000000000 0111000000110	0010100111011101
750	0000000000000 1110000001010	0011000011010110	793	0000000000000 0111000000011	0011001110011011
751	0000000000000 1110000000101	0001101001000001	794	0000000000000 0111100000000	0000011011011011
752	0000000000000 1111100000000	0000011011011111	795	0000000000000 0111010000000	0000101101101001
753	0000000000000 1110110000000	0000110110110101	796	0000000000000 0111001000000	0000000000010100
754	0000000000000 1110011000000	0000101101111010	797	0000000000000 0111000100000	0000011011000111
755	0000000000000 1110001100000	0000011011010100	798	0000000000000 0111000010000	0000101100101011
756	0000000000000 1110000110000	0000110111101011	799	0000000000000 0111000001000	0001001000010000
757	0000000000000 1110000011000	0001100100111100	800	0000000000000 0111000000100	0000100101010111
758	0000000000000 1110000001100	0001101101000000	801	0000000000000 0111000000010	0010001011000001
759	0000000000000 1110000000110	0010101110010001	802	0000000000000 0111000000001	0001001100010001
760	0000000000000 1110000000011	0011000111010111	803	0000000000000 0111000000000	0000001001001011
761	0000000000000 1111000000000	0000001001001111	804	0000000000000 0011111100000	0000100100101000
762	0000000000000 1110100000000	0000010010010111	805	0000000000000 0011101110000	0000100101101010
763	0000000000000 1110010000000	0000100100100101	806	0000000000000 0011100111000	0001101101101110
764	0000000000000 1110001000000	0000001001011000	807	0000000000000 0011100011100	0001010011111110
765	0000000000000 1110000100000	0000010010001011	808	0000000000000 0011100001110	0011110100010100
766	0000000000000 1110000010000	0000100101100111	809	0000000000000 0011100000111	0011110000010101
767	0000000000000 1110000001000	0001000001011100	810	0000000000000 0011110100000	0000101101110111
768	0000000000000 1110000000100	0000101100011011	811	0000000000000 0011101010000	0000110111100110
769	0000000000000 1110000000010	0010000010001101	812	0000000000000 0011100101000	0001001000001110
770	0000000000000 1110000000001	0001000101011101	813	0000000000000 0011100010100	0000010010100101
771	0000000000000 1110000000000	0000000000000111	814	0000000000000 0011100001010	0010011000001000
772	0000000000000 0111111000000	0000110110100110	815	0000000000000 0011100000101	0001110010011111
773	0000000000000 0111011100000	0000110110111010	816	0000000000000 0011111000000	0000110110100100
774	0000000000000 0111001110000	0000110111111000	817	0000000000000 0011101100000	0000000000001010
775	0000000000000 0111000111000	0001111111111100	818	0000000000000 0011100110000	0000101100110101
776	0000000000000 0111000011100	0001000001101100	819	0000000000000 0011100011000	0001111111100010
777	0000000000000 0111000001110	0011100110000110	820	0000000000000 0011100001100	0001110110011110
778	0000000000000 0111000000111	0011100010000111	821	0000000000000 0011100000110	0010110101001111

Sub-block 2

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
822	0000000000000 0011100000011	0011011100001001	869	0000000000000 0000111100000	0000101101100001
823	0000000000000 0011110000000	0000111111111011	870	0000000000000 0000111010000	0000011010001101
824	0000000000000 0011101000000	0000010010000110	871	0000000000000 0000111001000	0001111110110110
825	0000000000000 0011100100000	0000001001010101	872	0000000000000 0000111000100	0000010011110001
826	0000000000000 0011100010000	0000111110111001	873	0000000000000 0000111000010	0010111101100111
827	0000000000000 0011100001000	0001011010000010	874	0000000000000 0000111000001	0001111010110111
828	0000000000000 0011100000100	0000110111000101	875	0000000000000 0000111000000	0000111111101101
829	0000000000000 0011100000010	0010011001010011	876	0000000000000 0000011111100	0001110111010110
830	0000000000000 0011100000001	0001011110000011	877	0000000000000 0000011101110	0011010000111100
831	0000000000000 0011100000000	0000011011011001	878	0000000000000 0000011100111	0011010100111101
832	0000000000000 0001111110000	0000000001001001	879	0000000000000 0000011110100	0000110110001101
833	0000000000000 0001110111000	0001001001001101	880	0000000000000 0000011101010	0011111100100000
834	0000000000000 0001110011100	0001110111011101	881	0000000000000 0000011100101	0001010110110111
835	0000000000000 0001110001110	0011010000110111	882	0000000000000 0000011111000	0001011011001010
836	0000000000000 0001110000111	0011010100110110	883	0000000000000 0000011101100	0001010010110110
837	0000000000000 0001111010000	0000010011000101	884	0000000000000 0000011100110	0010010001100111
838	0000000000000 0001110101000	0001101100101101	885	0000000000000 0000011100011	0011111000100001
839	0000000000000 0001110010100	0000110110000110	886	0000000000000 0000011110000	0000011010010001
840	0000000000000 0001110001010	0011111100101011	887	0000000000000 0000011101000	0001111110101010
841	0000000000000 0001110000101	0001010110111100	888	0000000000000 0000011100100	0000010011101101
842	0000000000000 0001111100000	0000100100101001	889	0000000000000 0000011100010	0010111101111011
843	0000000000000 0001110110000	0000001000010110	890	0000000000000 0000011100001	0001110010101011
844	0000000000000 0001110011000	0001011011000001	891	0000000000000 0000011100000	0000111111110001
845	0000000000000 0001110001100	0001010010111101	892	0000000000000 0000001111110	0011010001111110
846	0000000000000 0001110000110	0010010001101100	893	0000000000000 0000001110111	0011010101111111
847	0000000000000 0001110000011	0011111000101010	894	0000000000000 0000001111010	0011111101100010
848	0000000000000 0001111000000	0000110110100101	895	0000000000000 0000001110101	0001010111110101
849	0000000000000 0001110100000	0000101101110110	896	0000000000000 0000001111100	0001010011110100
850	0000000000000 0001110010000	0000011010011010	897	0000000000000 0000001110110	0010010000100101
851	0000000000000 0001110001000	0001111110100001	898	0000000000000 0000001110011	0011111001100011
852	0000000000000 0001110000100	0000010011100110	899	0000000000000 0000001111000	0001111111101000
853	0000000000000 0001110000010	0010111101110000	900	0000000000000 0000001110100	0000010010101111
854	0000000000000 0001110000001	0001111010100000	901	0000000000000 0000001110010	0010111100111001
855	0000000000000 0001110000000	0000111111111010	902	0000000000000 0000001110001	0001110011101001
856	0000000000000 0000111111000	0001001001011010	903	0000000000000 0000001110000	0000111110110011
857	0000000000000 0000111011100	0001110111001010	904	0000000000000 0000000111111	0010011101111011
858	0000000000000 0000111001110	0011010000100000	905	0000000000000 0000000111101	0000011111110001
859	0000000000000 0000111000111	0011010100100001	906	0000000000000 0000000111110	0011011000100001
860	0000000000000 0000111101000	0001101100111010	907	0000000000000 0000000111011	0010110001100111
861	0000000000000 0000111010100	0000110110010001	908	0000000000000 0000000111100	0001011010101011
862	0000000000000 0000111001010	0011111100111100	909	0000000000000 0000000111010	0011110100111101
863	0000000000000 0000111000101	0001010110101011	910	0000000000000 0000000111001	0000110011101101
864	0000000000000 0000111110000	0000001000000001	911	0000000000000 0000000111000	0001110110110111
865	0000000000000 0000111011000	0001011011010110	912	0000000000000 0000000011111	0010001111110111
866	0000000000000 0000111001100	0001010010101010	913	0000000000000 0000000011101	0000001101111101
867	0000000000000 0000111000110	0010010001111011	914	0000000000000 0000000011110	0011001010101101
868	0000000000000 0000111000011	0011111000111101	915	0000000000000 0000000011100	0001001000100111

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S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
916	0000000000000 0000000001111	0010101010010111	963	0000000000000 0101010100000	0000111111100100
917	0000000000000 0000000001110	0011101111001101	964	0000000000000 0101001010000	0000100101110101
918	0000000000000 0000000000111	0011101011001100	965	0000000000000 0101000101000	0001011010011101
919	0000000000000 1011110000000	0000111111111111	966	0000000000000 0101000010100	0000000000110110
920	0000000000000 1010111000000	0000111111101000	967	0000000000000 0101000001010	0011001010011011
921	0000000000000 1010011100000	0000111111110100	968	0000000000000 0101000000101	0001100000001100
922	0000000000000 1010001110000	0000111110110110	969	0000000000000 0101110000000	0000111111111000
923	0000000000000 1010000111000	0001110110110010	970	0000000000000 0101011000000	0000100100110111
924	0000000000000 1010000011100	0001001000100010	971	0000000000000 0101001100000	0000010010011001
925	0000000000000 1010000001110	0011101111001000	972	0000000000000 0101000110000	0000111110100110
926	0000000000000 1010000000111	0011101011001001	973	0000000000000 0101000011000	0001101101110001
927	0000000000000 1011010000000	0000101101101111	974	0000000000000 0101000001100	0001100100001101
928	0000000000000 1010101000000	0000011011001010	975	0000000000000 0101000000110	0010100111011100
929	0000000000000 1010010100000	0000110110101011	976	0000000000000 0101000000011	0011001110011010
930	0000000000000 1010001010000	0000101100111010	977	0000000000000 0101100000000	0000011011011010
931	0000000000000 1010000101000	0001010011010010	978	0000000000000 0101010000000	0000101101101000
932	0000000000000 1010000010100	0000001001111001	979	0000000000000 0101001000000	0000000000010101
933	0000000000000 1010000001010	0011000011010100	980	0000000000000 0101000100000	0000011011000110
934	0000000000000 1010000000101	0001101001000011	981	0000000000000 0101000010000	0000101100101010
935	0000000000000 1011100000000	0000011011011101	982	0000000000000 0101000001000	0001001000010001
936	0000000000000 1010110000000	0000110110110111	983	0000000000000 0101000000100	0000100101010110
937	0000000000000 1010011000000	0000101101111000	984	0000000000000 0101000000010	0010010011000000
938	0000000000000 1010001100000	0000011011010110	985	0000000000000 0101000000001	0001001100010000
939	0000000000000 1010000110000	0000110111101001	986	0000000000000 0101000000000	0000001001001010
940	0000000000000 1010000011000	0001100100111110	987	0000000000000 0010111100000	0000101101100000
941	0000000000000 1010000001100	0001101101000010	988	0000000000000 0010101110000	0000101100100010
942	0000000000000 1010000000110	0010101110010011	989	0000000000000 0010100111000	0001100100100110
943	0000000000000 1010000000011	0011000111010101	990	0000000000000 0010100011100	0001011010110110
944	0000000000000 1011000000000	0000001001001101	991	0000000000000 0010100001110	0011111101011100
945	0000000000000 1010100000000	0000010010010101	992	0000000000000 0010100000111	0011111001011101
946	0000000000000 1010010000000	0000100100100111	993	0000000000000 0010110100000	0000100100111111
947	0000000000000 1010001000000	0000001001011010	994	0000000000000 0010101010000	0000111110101110
948	0000000000000 1010000100000	0000010010001001	995	0000000000000 0010100101000	0001000001000110
949	0000000000000 1010000010000	0000100101100101	996	0000000000000 0010100010100	0000011011101101
950	0000000000000 1010000001000	0001000001011110	997	0000000000000 0010100001010	0011010001000000
951	0000000000000 1010000000100	0000101100011001	998	0000000000000 0010100000101	0001111011010111
952	0000000000000 1010000000010	0010000010001111	999	0000000000000 0010111000000	0000111111101100
953	0000000000000 1010000000001	0001000101011111	1000	0000000000000 0010101100000	0000001001000010
954	0000000000000 1010000000000	0000000000000101	1001	0000000000000 0010100110000	0000100101111101
955	0000000000000 0101111000000	0000110110100111	1002	0000000000000 0010100011000	0001110110101010
956	0000000000000 0101011100000	0000110110111011	1003	0000000000000 0010100001100	0001111111010110
957	0000000000000 0101001110000	0000110111111001	1004	0000000000000 0010100000110	0010111100000111
958	0000000000000 0101000111000	0001111111111101	1005	0000000000000 0010100000011	0011010101000001
959	0000000000000 0101000011100	0001000001101101	1006	0000000000000 0010110000000	0000110110110011
960	0000000000000 0101000001110	0011100110000111	1007	0000000000000 0010101000000	0000011011001110
961	0000000000000 0101000000111	0011100010000110	1008	0000000000000 0010100100000	0000000000011101
962	0000000000000 0101101000000	0000010010000101	1009	0000000000000 0010100010000	0000110111110001

Sub-block 2

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
1010	0000000000000 0010100001000	0001010011001010	1057	0000000000000 0000101000001	0001011110010101
1011	0000000000000 0010100000100	0000111110001101	1058	0000000000000 0000101000000	0000011011001111
1012	0000000000000 0010100000010	0010010000011011	1059	0000000000000 0000010111100	0001111110001001
1013	0000000000000 0010100000001	0001010111001011	1060	0000000000000 0000010101110	0010011001100011
1014	0000000000000 0010100000000	0000010010010001	1061	0000000000000 0000010100111	0010011101100010
1015	0000000000000 0001011110000	0000010011011001	1062	0000000000000 0000010110100	0000111111010010
1016	0000000000000 0001010111000	0001011011011101	1063	0000000000000 0000010101010	0111101101111111
1017	0000000000000 0001010011100	0001100101001101	1064	0000000000000 0000010100101	0001011111101000
1018	0000000000000 0001010001110	0011000010100111	1065	0000000000000 0000010111000	0001010010010101
1019	0000000000000 0001010000111	0011000110100110	1066	0000000000000 0000010101100	0001011011101001
1020	0000000000000 0001011010000	0000000001010101	1067	0000000000000 0000010100110	0010011000111000
1021	0000000000000 0001010101000	0001111110111101	1068	0000000000000 0000010100011	0011110001111110
1022	0000000000000 0001010010100	0000100100010110	1069	0000000000000 0000010110000	0000010011001110
1023	0000000000000 0001010001010	0011101110111011	1070	0000000000000 0000010101000	0001110111110101
1024	0000000000000 0001010000101	0001000100101100	1071	0000000000000 0000010100100	0000011010110010
1025	0000000000000 0001011100000	0000110110111001	1072	0000000000000 0000010100010	0010110100100100
1026	0000000000000 0001010110000	0000011010000110	1073	0000000000000 0000010100001	0001110011110100
1027	0000000000000 0001010011000	0001001001010001	1074	0000000000000 0000010100000	0000110110101110
1028	0000000000000 0001010001100	0001000000101101	1075	0000000000000 0000001011110	0011000011110010
1029	0000000000000 0001010000110	0010000011111100	1076	0000000000000 0000001010111	0011000111110011
1030	0000000000000 0001010000011	0011101010111010	1077	0000000000000 0000001011010	0011101111101110
1031	0000000000000 0001011000000	0000100100110101	1078	0000000000000 0000001010101	0001000101111001
1032	0000000000000 0001010100000	0000111111100110	1079	0000000000000 0000001011100	0001000001111000
1033	0000000000000 0001010010000	0000001000001010	1080	0000000000000 0000001010110	0010000010101001
1034	0000000000000 0001010001000	0001101100110001	1081	0000000000000 0000001010011	0011101011101111
1035	0000000000000 0001010000100	0000000001110110	1082	0000000000000 0000001011000	0001101101100100
1036	0000000000000 0001010000010	0010101111100000	1083	0000000000000 0000001010100	0000000000100011
1037	0000000000000 0001010000001	0001101000110000	1084	0000000000000 0000001010010	0010101110110101
1038	0000000000000 0001010000000	0000101101101010	1085	0000000000000 0000001010001	0001101001100101
1039	0000000000000 0000101111000	0001101101111000	1086	0000000000000 0000001010000	0000101100111111
1040	0000000000000 0000101011100	0001010011101000	1087	0000000000000 0000000101111	0010111000011011
1041	0000000000000 0000101001110	0011110100000010	1088	0000000000000 0000000101101	0000111010010001
1042	0000000000000 0000101000111	0011110000000011	1089	0000000000000 0000000101110	0011111101000001
1043	0000000000000 0000101101000	0001001000011000	1090	0000000000000 0000000101011	0010010100000111
1044	0000000000000 0000101010100	0000010010110011	1091	0000000000000 0000000101100	0001111111001011
1045	0000000000000 0000101001010	0011011000011110	1092	0000000000000 0000000101010	0011010001011101
1046	0000000000000 0000101000101	0001110010001001	1093	0000000000000 0000000101001	0000010110001101
1047	0000000000000 0000101110000	0000101100100011	1094	0000000000000 0000000101000	0001010011010111
1048	0000000000000 0000101011000	0001111111110100	1095	0000000000000 0000000010111	0011001110101100
1049	0000000000000 0000101001100	0001110110001000	1096	0000000000000 0000000010101	0001001100100110
1050	0000000000000 0000101000110	0010110101011001	1097	0000000000000 0000000010110	0010010011110110
1051	0000000000000 0000101000011	0011011100011111	1098	0000000000000 0000000010100	0000001001111100
1052	0000000000000 0000101100000	0000001001000011	1099	0000000000000 0000000001011	0010000110001011
1053	0000000000000 0000101010000	0000111110101111	1100	0000000000000 0000000001010	0011000011010001
1054	0000000000000 0000101001000	0001011010010100	1101	0000000000000 0000000000101	0001101001000110
1055	0000000000000 0000101000100	0000110111010011	1102	0000000000000 1101110000000	0000111111111100
1056	0000000000000 0000101000010	0010011001000101	1103	0000000000000 1100111000000	0000111111101011

Sub-block 2

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
1104	0000000000000 1100011100000	0000111111110111	1151	0000000000000 0110000000101	0001101001000101
1105	0000000000000 1100001110000	0000111110110101	1152	0000000000000 0110110000000	0000110110110001
1106	0000000000000 1100000111000	0001110110110001	1153	0000000000000 0110011000000	0000101101111110
1107	0000000000000 1100000011100	0001001000100001	1154	0000000000000 0110001100000	0000011011010000
1108	0000000000000 1100000001110	0011101111001011	1155	0000000000000 0110000110000	0000110111101111
1109	0000000000000 1100000000111	0011101011001010	1156	0000000000000 0110000011000	0001100100111000
1110	0000000000000 1101010000000	0000101101101100	1157	0000000000000 0110000001100	0001101101000100
1111	0000000000000 1100101000000	0000011011001001	1158	0000000000000 0110000000110	0010101110010101
1112	0000000000000 1100010100000	0001101101101000	1159	0000000000000 0110000000011	0011000111010011
1113	0000000000000 1100001010000	0001011100111001	1160	0000000000000 0110100000000	0000010010010011
1114	0000000000000 1100000101000	0001010011010001	1161	0000000000000 0110010000000	0000100100100001
1115	0000000000000 1100000010100	0000001001111010	1162	0000000000000 0110001000000	0000001001011100
1116	0000000000000 1100000001010	0011000011010111	1163	0000000000000 0110000100000	0000010010001111
1117	0000000000000 1100000000101	0001101001000000	1164	0000000000000 0110000010000	0000100101100011
1118	0000000000000 1101100000000	0000011011011110	1165	0000000000000 0110000001000	0001000001011000
1119	0000000000000 1100110000000	0000110110110100	1166	0000000000000 0110000000100	0000101100011111
1120	0000000000000 1100011000000	0000101101111011	1167	0000000000000 0110000000010	0010000010001001
1121	0000000000000 1100001100000	0000011011010101	1168	0000000000000 0110000000001	0001000101011001
1122	0000000000000 1100000110000	0001101111101010	1169	0000000000000 0110000000000	0000000000000011
1123	0000000000000 1100000011000	0001100100111101	1170	0000000000000 0011011100000	0000110110111000
1124	0000000000000 1100000001100	0001101101000001	1171	0000000000000 0011001110000	0000110111111010
1125	0000000000000 1100000000110	0010101110010000	1172	0000000000000 0011000111000	0001111111111110
1126	0000000000000 1100000000011	0011000111010110	1173	0000000000000 0011000011100	0001000001101110
1127	0000000000000 1101000000000	0000001001001110	1174	0000000000000 0011000001110	0011100110000100
1128	0000000000000 1100100000000	0000010010010110	1175	0000000000000 0011000000111	0011100010000101
1129	0000000000000 1100010000000	0000100100100100	1176	0000000000000 0011010100000	0000111111100111
1130	0000000000000 1100001000000	0000001001011001	1177	0000000000000 0011001010000	0000100101110110
1131	0000000000000 1100000100000	0000010010001010	1178	0000000000000 0011000101000	0001011010011110
1132	0000000000000 1100000010000	0000100101100110	1179	0000000000000 0011000010100	0000000000110101
1133	0000000000000 1100000001000	0001000001011101	1180	0000000000000 0011000001010	0011001010011000
1134	0000000000000 1100000000100	0000101100011010	1181	0000000000000 0011000000101	0001100000001111
1135	0000000000000 1100000000010	0010000010001100	1182	0000000000000 0011011000000	0000100100110100
1136	0000000000000 1100000000001	0001000101011100	1183	0000000000000 0011001100000	0000010010011010
1137	0000000000000 1100000000000	0000000000000110	1184	0000000000000 0011000110000	0000111110100101
1138	0000000000000 0110111000000	0000111111101110	1185	0000000000000 0011000011000	0001101101110010
1139	0000000000000 0110011100000	0000111111110010	1186	0000000000000 0011000001100	0001100100001110
1140	0000000000000 0110001110000	0000111110110000	1187	0000000000000 0011000000110	0010100111011111
1141	0000000000000 0110000111000	0001110110110100	1188	0000000000000 0011000000011	0011001110011001
1142	0000000000000 0110000011100	0001001000100100	1189	0000000000000 0011010000000	0000101101101011
1143	0000000000000 0110000001110	0011101111001110	1190	0000000000000 0011001000000	0000000000010110
1144	0000000000000 0110000000111	0011101011001111	1191	0000000000000 0011000100000	0000011011000101
1145	0000000000000 0110101000000	0000011011001100	1192	0000000000000 0011000010000	0000101100101001
1146	0000000000000 0110010100000	0000110110101101	1193	0000000000000 0011000001000	0001001000010010
1147	0000000000000 0110001010000	0000101100111100	1194	0000000000000 0011000000100	0000100101010101
1148	0000000000000 0110000101000	0001010011010100	1195	0000000000000 0011000000010	0010001011000011
1149	0000000000000 0110000010100	0000001001111111	1196	0000000000000 0011000000001	0001001100010011
1150	0000000000000 0110000001010	0011000011010010	1197	0000000000000 0011000000000	0000001001001001

Sub-block 2

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
1198	0000000000000 0001101110000	0000100101101011	1245	0000000000000 0000011010100	0000100100000001
1199	0000000000000 0001100111000	0001101101101111	1246	0000000000000 0000011001010	0011101110101100
1200	0000000000000 0001100011100	0001010011111111	1247	0000000000000 0000011000101	0001000100111011
1201	0000000000000 0001100001110	0011110100010101	1248	0000000000000 0000011011000	0001001001000110
1202	0000000000000 0001100000111	0011110000010100	1249	0000000000000 0000011001100	0001000000111010
1203	0000000000000 0001101010000	0000110111100111	1250	0000000000000 0000011000110	0010000011101011
1204	0000000000000 0001100101000	0001001000001111	1251	0000000000000 0000011000011	0011101010101101
1205	0000000000000 0001100010100	0000010010100100	1252	0000000000000 0000011010000	0000001000011101
1206	0000000000000 0001100001010	0011011000001001	1253	0000000000000 0000011001000	0001101100100110
1207	0000000000000 0001100000101	0001110010011110	1254	0000000000000 0000011000100	0000000001100001
1208	0000000000000 0001101100000	0000000000001011	1255	0000000000000 0000011000010	0010101111110111
1209	0000000000000 0001100110000	0000101100110100	1256	0000000000000 0000011000001	0001101000100111
1210	0000000000000 0001100011000	0001111111100011	1257	0000000000000 0000011000000	0000101101111101
1211	0000000000000 0001100001100	0001110110011111	1258	0000000000000 0000001101110	0011110100011110
1212	0000000000000 0001100000110	0010110101001110	1259	0000000000000 0000001100111	0011110000011111
1213	0000000000000 0001100000011	0011011100001000	1260	0000000000000 0000001101010	0011011000000010
1214	0000000000000 0001101000000	0000010010000111	1261	0000000000000 0000001100101	0001110010010101
1215	0000000000000 0001100100000	0000001001010100	1262	0000000000000 0000001101100	0001110110010100
1216	0000000000000 0001100010000	0000111110111000	1263	0000000000000 0000001100110	0010110101000101
1217	0000000000000 0001100001000	0001011010000011	1264	0000000000000 0000001100011	0011011100000011
1218	0000000000000 0001100000100	0000110111000100	1265	0000000000000 0000001101000	0001011010001000
1219	0000000000000 0001100000010	0010011001010010	1266	0000000000000 0000001100100	0000110111001111
1220	0000000000000 0001100000001	0001011110000010	1267	0000000000000 0000001100010	0010011001011001
1221	0000000000000 0001100000000	0000011011011000	1268	0000000000000 0000001100001	0001011110001001
1222	0000000000000 0000110111000	0001000000000101	1269	0000000000000 0000001100000	0000011011010011
1223	0000000000000 0000110011100	0001111110010101	1270	0000000000000 0000000110111	0011011100100000
1224	0000000000000 0000110001110	0011011001111111	1271	0000000000000 0000000110101	0001011110101010
1225	0000000000000 0000110000111	0011011101111110	1272	0000000000000 0000000110110	0010011001111010
1226	0000000000000 0000110101000	0001100101100101	1273	0000000000000 0000000110011	0011110000111100
1227	0000000000000 0000110010100	0000111111001110	1274	0000000000000 0000000110100	0000011011110000
1228	0000000000000 0000110001010	0011110101100011	1275	0000000000000 0000000110010	0010110101100110
1229	0000000000000 0000110000101	0001011111110100	1276	0000000000000 0000000110001	0001110010110110
1230	0000000000000 0000110110000	0000000001011110	1277	0000000000000 0000000110000	0000110111101100
1231	0000000000000 0000110011000	0001010010001001	1278	0000000000000 0000000011011	0010100011101011
1232	0000000000000 0000110001100	0001011011110101	1279	0000000000000 0000000011001	0000100001100001
1233	0000000000000 0000110000110	0010011000100100	1280	0000000000000 0000000011010	0011100110110001
1234	0000000000000 0000110000011	0011110001100010	1281	0000000000000 0000000011000	0001100100111011
1235	0000000000000 0000110100000	0000100100111110	1282	0000000000000 0000000001101	0000010100011101
1236	0000000000000 0000110010000	0000010011010010	1283	0000000000000 0000000001100	0001101101000111
1237	0000000000000 0000110001000	0001110111101001	1284	0000000000000 0000000000110	0010101110010110
1238	0000000000000 0000110000100	0000011010101110	1285	0000000000000 0000000000011	0011000111010000
1239	0000000000000 0000110000010	0010110100111000	1286	0000000000000 1001110000000	0000111111111110
1240	0000000000000 0000110000001	0001110011101000	1287	0000000000000 1000111000000	0000111111101001
1241	0000000000000 0000110000000	0000110110110010	1288	0000000000000 1000011100000	0000111111110101
1242	0000000000000 0000011011100	0001100101011010	1289	0000000000000 1000001110000	0000111110110111
1243	0000000000000 0000011001110	0011000010110000	1290	0000000000000 1000000111000	0001110110110011
1244	0000000000000 0000011000111	0011000110110001	1291	0000000000000 1000000011100	0001001000100011

Sub-block 2

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
1292	0000000000000 1000000001110	0011101111001001	1339	0000000000000 0100000110000	0000110111101110
1293	0000000000000 1000000000111	0011101011001000	1340	0000000000000 0100000011000	0001100100111001
1294	0000000000000 1001010000000	0000101101101110	1341	0000000000000 0100000001100	0001101101000101
1295	0000000000000 1000101000000	0000011011001011	1342	0000000000000 0100000000110	0010101110010100
1296	0000000000000 1000010100000	0000110110101010	1343	0000000000000 0100000000011	0011000111010010
1297	0000000000000 1000001010000	0000101100111011	1344	0000000000000 0100100000000	0000010010010010
1298	0000000000000 1000000101000	0001010011010011	1345	0000000000000 0100010000000	0000100100100000
1299	0000000000000 1000000010100	0000001001111000	1346	0000000000000 0100001000000	0000001001011101
1300	0000000000000 1000000001010	0011000011010101	1347	0000000000000 0100000100000	0000010010001110
1301	0000000000000 1000000000101	0001101001000010	1348	0000000000000 0100000010000	0000100101100010
1302	0000000000000 1001100000000	0000011011011100	1349	0000000000000 0100000001000	0001000001011001
1303	0000000000000 1000110000000	0000110110110110	1350	0000000000000 0100000000100	0000101100011110
1304	0000000000000 1000011000000	0000101101111001	1351	0000000000000 0100000000010	0010000010001000
1305	0000000000000 1000001100000	0000011011010111	1352	0000000000000 0100000000001	0001000101011000
1306	0000000000000 1000000110000	0001101111101000	1353	0000000000000 0100000000000	0000000000000010
1307	0000000000000 1000000011000	0001100100111111	1354	0000000000000 0010011100000	0000111111110000
1308	0000000000000 1000000001100	0001101101000011	1355	0000000000000 0010001110000	0000111110110010
1309	0000000000000 1000000000110	0010101110010010	1356	0000000000000 0010000111000	0001110110110110
1310	0000000000000 1000000000011	0011000111010100	1357	0000000000000 0010000011100	0001001000100110
1311	0000000000000 1001000000000	0000001001001100	1358	0000000000000 0010000001110	0011101111001100
1312	0000000000000 1000100000000	0000010010010100	1359	0000000000000 0010000000111	0011101011001101
1313	0000000000000 1000010000000	0000100100100110	1360	0000000000000 0010010100000	0001110110101111
1314	0000000000000 1000001000000	0000001001011011	1361	0000000000000 0010001010000	0000101100111110
1315	0000000000000 1000000100000	0000010010001000	1362	0000000000000 0010000101000	0001010011010110
1316	0000000000000 1000000010000	0000100101100100	1363	0000000000000 0010000010100	0000001001111101
1317	0000000000000 1000000001000	0001000001011111	1364	0000000000000 0010000001010	0011000011010000
1318	0000000000000 1000000000100	0000101100011000	1365	0000000000000 0010000000101	0001101001000111
1319	0000000000000 1000000000010	0010000010001110	1366	0000000000000 0010011000000	0000101101111100
1320	0000000000000 1000000000001	0001000101011110	1367	0000000000000 0010001100000	0000011011010010
1321	0000000000000 1000000000000	0000000000000100	1368	0000000000000 0010000110000	0000110111101101
1322	0000000000000 0100111000000	0000111111101111	1369	0000000000000 0010000011000	0001100100111010
1323	0000000000000 0100011100000	0000111111110011	1370	0000000000000 0010000001100	0001101101000110
1324	0000000000000 0100001110000	0000111110110001	1371	0000000000000 0010000000110	0010101110010111
1325	0000000000000 0100000111000	0001110110110101	1372	0000000000000 0010000000011	0011000111010001
1326	0000000000000 0100000011100	0001001000100101	1373	0000000000000 0010010000000	0000100100100011
1327	0000000000000 0100000001110	0011101111001111	1374	0000000000000 0010001000000	0000001001011110
1328	0000000000000 0100000000111	0011101011001110	1375	0000000000000 0010000100000	0000010010001101
1329	0000000000000 0100101000000	0000011011001101	1376	0000000000000 0010000010000	0000100101100001
1330	0000000000000 0100010100000	0000110110101100	1377	0000000000000 0010000001000	0001000001011010
1331	0000000000000 0100001010000	0000101100111101	1378	0000000000000 0010000000100	0000101100011101
1332	0000000000000 0100000101000	0001010011010101	1379	0000000000000 0010000000010	0010000010001011
1333	0000000000000 0100000010100	0000001001111110	1380	0000000000000 0010000000001	0001000101011011
1334	0000000000000 0100000001010	0011000011010011	1381	0000000000000 0010000000000	0000000000000001
1335	0000000000000 0100000000101	0001101001000100	1382	0000000000000 0001001110000	0000110111111011
1336	0000000000000 0100110000000	0000110110110000	1383	0000000000000 0001000111000	0001111111111111
1337	0000000000000 0100011000000	0000101101111111	1384	0000000000000 0001000011100	0001000001101111
1338	0000000000000 0100001100000	0000011011010001	1385	0000000000000 0001000001110	0011100110000101

Sub-block 2

S.No.	Error Vector	Syndrome	S. no.	Error vector	Syndrome
1386	0000000000000 0001000000111	0011100010000100	1429	0000000000000 0000010010100	0000101101011110
1387	0000000000000 0001001010000	0000100101110111	1430	0000000000000 0000010001010	0011100111110011
1388	0000000000000 0001000101000	0001011010011111	1431	0000000000000 0000010000101	0001001101100100
1389	0000000000000 0001000010100	0000000000110100	1432	0000000000000 0000010011000	0001000000011001
1390	0000000000000 0001000001010	0011001010011001	1433	0000000000000 0000010001100	0001001001100101
1391	0000000000000 0001000000101	0001100000001110	1434	0000000000000 0000010000110	0010001010110100
1392	0000000000000 0001001100000	0000010010011011	1435	0000000000000 0000010000011	0011100011110010
1393	0000000000000 0001000110000	0000111110100100	1436	0000000000000 0000010010000	0000000001000010
1394	0000000000000 0001000011000	0001101101110011	1437	0000000000000 0000010001000	0001100101111001
1395	0000000000000 0001000001100	0001100100001111	1438	0000000000000 0000010000100	0000001000111110
1396	0000000000000 0001000000110	0010100111011110	1439	0000000000000 0000010000010	0010100110101000
1397	0000000000000 0001000000011	0011001110011000	1440	0000000000000 0000010000001	0001100001111000
1398	0000000000000 0001001000000	0000000000010111	1441	0000000000000 0000010000000	0000100100100010
1399	0000000000000 0001000100000	0000011011000100	1442	0000000000000 0000001001110	0011100110010010
1400	0000000000000 0001000010000	0000101100101000	1443	0000000000000 0000001000111	0011100010010011
1401	0000000000000 0001000001000	0001001000010011	1444	0000000000000 0000001001010	0011001010001110
1402	0000000000000 0001000000100	0000100101010100	1445	0000000000000 0000001000101	0001100000011001
1403	0000000000000 0001000000010	0010001011000010	1446	0000000000000 0000001001100	0001100100011000
1404	0000000000000 0001000000001	0001001100010010	1447	0000000000000 0000001000110	0010100111001001
1405	0000000000000 0001000000000	0000001001001000	1448	0000000000000 0000001000011	0011001110001111
1406	0000000000000 0000100111000	0001100100100111	1449	0000000000000 0000001001000	0001001000000100
1407	0000000000000 0000100011100	0001011010110111	1450	0000000000000 0000001000100	0000100101000011
1408	0000000000000 0000100001110	0011111101011101	1451	0000000000000 0000001000010	0010001011010101
1409	0000000000000 0000100000111	0011111001011100	1452	0000000000000 0000001000001	0001001100000101
1410	0000000000000 0000100101000	0001000001000111	1453	0000000000000 0000001000000	0000001001011111
1411	0000000000000 0000100010100	0000011011101100	1454	0000000000000 0000000100111	0011111001000000
1412	0000000000000 0000100001010	0011010001000001	1455	0000000000000 0000000100101	0001111011001010
1413	0000000000000 0000100000101	0001111011010110	1456	0000000000000 0000000100110	0010111100011010
1414	0000000000000 0000100110000	0000100101111100	1457	0000000000000 0000000100011	0011010101011100
1415	0000000000000 0000100011000	0001110110101011	1458	0000000000000 0000000100100	0000111110010000
1416	0000000000000 0000100001100	0001111111010111	1459	0000000000000 0000000100010	0010010000000110
1417	0000000000000 0000100000110	0010111100000110	1460	0000000000000 0000000100001	0001010111010110
1418	0000000000000 0000100000011	0011010101000000	1461	0000000000000 0000000100000	0000010010001100
1419	0000000000000 0000100100000	0000000000011100	1462	0000000000000 0000000010011	0011100010110000
1420	0000000000000 0000100010000	0000110111110000	1463	0000000000000 0000000010001	0001100000111010
1421	0000000000000 0000100001000	0001010011001011	1464	0000000000000 0000000010010	0010100111101010
1422	0000000000000 0000100000100	0000111110001100	1465	0000000000000 0000000010000	0000100101100000
1423	0000000000000 0000100000010	0010010000011010	1466	0000000000000 0000000001001	0000000100000001
1424	0000000000000 0000100000001	0001010111001010	1467	0000000000000 0000000001000	0001000001011011
1425	0000000000000 0000100000000	0000010010010000	1468	0000000000000 0000000000100	0000101100011100
1426	0000000000000 0000010011100	0001101100000101	1469	0000000000000 0000000000010	0010000010001010
1427	0000000000000 0000010001110	0011001011101111	1470	0000000000000 0000000000001	0001000101011010
1428	0000000000000 0000010000111	0011001111101110			

III   Bounds for codes correcting m-repeated bursts

In this section, we extend the results of previous section to the case of m-repeated bursts of length b or less occurring within a single sub-block.

Similar to the case of correction of 2-repeated burst occurring within a sub-block, an (n, k) linear code over $GF(q)$ capable of correcting any sub-block containing m-repeated burst of length b or less must satisfy the following two conditions:

(v) The syndrome resulting from the occurrence of any m-repeated burst of length b or less within a single sub-block must be distinct from the syndrome resulting from any other m-repeated burst within the same sub-block.

(vi) The syndrome resulting from the occurrence of any m-repeated burst of length b or less within a single sub-block must be distinct from the syndrome resulting likewise from any m-repeated burst of length b or less within any other sub-block.

We now present a lower bound on the number of parity check digits required for such a code.

Theorem 3. *The number of check digits r required for an (n, k) linear code over $GF(q)$, subdivided into s sub-blocks of length t each, that corrects m-repeated bursts of length b or less lying within a single corrupted sub-block is atleast*

$$log_q \left\{ 1 + s \left[q^{m(b-1)} \left(\binom{t - mb + m}{m} (q-1)^m + \right. \right. \right.$$
$$\left. \left. \left. \sum_{l=0}^{m-1} \binom{t - mb + l}{l} (q-1)^l q^{m-1-l} \right) - 1 \right] \right\}. \tag{9}$$

Proof. The proof of this result is on the similar lines as that of proof of Theorem 1 so we omit the proof.

□

Remark 4. By taking $s = 1$ the bound obtained in (9) reduces to

$$log_q \left\{ q^{m(b-1)} \left(\binom{t - mb + m}{m} (q-1)^m + \sum_{l=0}^{m-1} \binom{t - mb + l}{l} (q-1)^l q^{m-1-l} \right) \right\}.$$

which coincides with the result for correction of m-repeated burst obtained by Dass and Verma(2008).

Remark 5. For $m = 2$, the bound obtained in (9) coincides with the bound obtained in (1) for the case of 2-repeated bursts.
In particular, for $m = 1$, the bound in (9) reduces to

$$1 + s\left(q^{b-1}\big((t - b + 1)(q - 1) + 1\big) - 1\right)$$

which reduces to the result for correction of burst of length b or less within a sub-block.

In the following result, we present another bound on the number of check digits required for the existence of the code considered in Theorem 3.

Theorem 4. *An (n, k) linear code over $GF(q)$ capable of correcting m-repeated burst of length b or less occurring within a single sub-block of length t ($2mb < t$) can always be constructed using r check digits where r is the smallest integer satisfying the inequality*

$$q^r > q^{m(b-1)}\left\{q^{m(b-1)}\left((q-1)^{2m-1}\binom{t - 2mb + (2m-1)}{2m-1}\right.\right.+$$

$$\left.\sum_{l=0}^{2m-2}(q-1)^l q^{2m-2-l}\binom{t - 2mb + l}{l}\right)+$$

$$\left((s-1) \times \left[(q-1)^{m-1}\binom{t - mb + (m-1)}{m-1}\right.\right.+$$

$$\left.\sum_{l=0}^{m-2}(q-1)^l q^{m-2-l}\binom{t - mb + l}{l}\right] \times$$

$$\left[q^{m(b-1)}\left(\binom{t - mb + m}{m}(q-1)^m\right.\right.+$$

$$\left.\left.\left.\sum_{l=0}^{m-1}\binom{t - mb + l}{l}(q-1)^l q^{m-1-l}\right) - 1\right]\right)\right\}. \tag{10}$$

Proof. As in Theorem 3, we omit the proof of this result since it can be derived on lines similar to that of Theorem 2.

$\square$

Remark 6. By taking $s = 1$ in (10) the bound reduces to

$$q^r > q^{2m(b-1)}\left((q-1)^{2m-1}\binom{t-2mb+(2m-1)}{2m-1} + \sum_{l=0}^{2m-2}(q-1)^l q^{2m-2-l}\binom{t-2mb+l}{l}\right)$$

which coincides with the sufficient condition for existence of a code correcting m-repeated bursts(refer Dass and Verma(2008)).

Remark 7. For $m = 2$, the result obtained in Theorem 4 coincides with the result in Theorem 2, for the case of 2-repeated burst of length b or less.
For $m = 1$, the bound in (10) reduces to

$$q^{b-1}\left(q^{b-1}\left[(q-1)(t-2b+1)+1\right] + (s-1)\left[q^{b-1}\left((t-b+1)(q-1)+1\right)-1\right]\right)$$

which is the condition for existence of a code correcting bursts of length b or less within a sub-block.

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