Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SECOND SEMESTER M.TECH. (DEC) DEGREE END SEMESTER EXAMINATION

APRIL/MAY 2019

SUBJECT: CODING THEORY (ECE - 5235)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Consider a second order Markov source with the binary source alphabet $S = \{0, 1\}$ and $p(0/00) = p(1/11) = 0.6$, $p(1/00) = p(0/11) = 0.4$ $p(0/01) = p(0/10) = p(1/01) = p(1/10) = 0.5$. Draw the state diagram. Compute state probabilities, first order symbol probabilities and H(S).

1B. Two BSCs, each with error probability 0.1, are cascaded as shown in the **Figure 1B**. The inputs 0 and 1 are chosen with the probabilities 0.4 and 0.6 respectively. Compute mutual information and the capacity of this channel.

1C. Find a basis for the dual space to the vector space spanned by $\{(1101100), (1110010), and\ (0111001)\}$ over the binary field. Also find vectors spanned by given vector space.

(4+3+3)

2A. Decode the sequence"**00000001111010001011000001 00**" using adaptive Huffman coding algorithm for the source with 26 letter alphabet (a to z).

2B. Consider a systematic (8, 4) code whose parity check equations are $v_0 = u_1 + u_2 + u_3$, $v_1 = u_0 + u_1 + u_2$, $v_2 = u_0 + u_1 + u_3$ and $v_3 = u_0 + u_2 + u_3$, where $u_0, u_1, u_2\ and\ u_3$ are message digits. Find the generator and parity check matrices for this code. Show analytically that the minimum distance of this code is 4. Construct encoder and syndrome circuit for this code.

(5+5)

3A. Explain the r^{th} order Reed Muller code. Construct the generator matrix for (16,11) RM code. Determine the minimum distance of this code. List the properties of this code.

3B. Construct a generator matrix $G_{RM}(2, 4)$ using $G_{(2,2)} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$.

(5+5)

4A. Given the generator polynomial $g(X) = 1 + X + X^3$ for (7, 4) cyclic code. Obtain the systematic generator matrix, systematic parity check matrix without performing elementary row operations. Also find the code.

4B. Construct an encoder for systematic (7, 4) cyclic code whose parity polynomial is $h(X) = 1 + X + X^2 + X^4$. Encode the message 0111 using the same.

(5+5)

5A. Construct a syndrome calculator circuit for a (7, 4) cyclic code whose generator polynomial is $g(X) = 1 + X + X^3$. If the received vector is 0010110, determine the syndrome vector for this code-word using the same.

5B. Write down the properties of Low density parity check code. Also mention the advantages of this code over other codes.

5C. Obtain the output sequence of the non-systematic feed forward convolutional encoder shown in the **Figure 5C**.

(3+3+4)

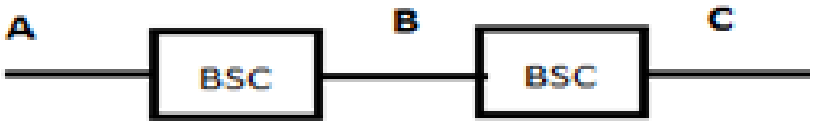

Figure 1B

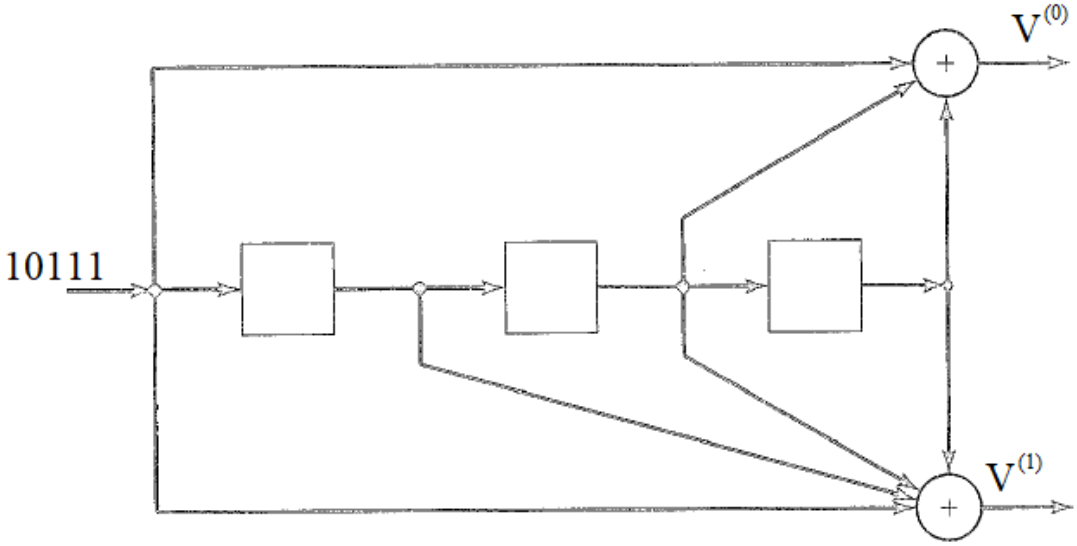

Figure 5C