Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION MARCH 2021

SUBJECT: ERROR CONTROL CODING (ECE -4024)

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

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

1A. Determine order of 7 and 8 under mod 19.

1B. A polynomial with coefficients over $GF(2)$ satisfies $\{f(x)\}^{2^i} = f(x^{2^i})$. State and prove similar condition if $f(x)$ is a polynomial with coefficients over $GF(3)$.

1C. Determine the conjugates of α^7 over $GF(2^4)$ using $p(x)=x^4+x+1$, Also compute its minimal polynomial.

(3+3+4)

2A. A linear block C(n, k) is defined by the generator matrix defined by

$$G = \begin{bmatrix} 0 & 0 & 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}.$$

Determine:

i. Generator matrix and Parity check matrix in systematic form.
ii. Possible Coset leader and corresponding syndrome.
iii. Possible code words & weight distribution
iv. Determine the syndrome for the received vectors R_1=(0101101) and R_2= (0010010).
v. State the standard array with at least first two rows and two columns.

2B. Draw the cyclic Hamming decoding circuit using $g(x) = 1+x^2+x^5$. Explain how this circuit is modified to implement (24, 19) shortened decoder. Explain every step with all necessary computations

(5+5)

3A. A (n, k) BCH code has generating polynomial $g(x)=1+x+x^2+x^4+x^5+x^8+x^{10}$ defined over $GF(2^4)$ using $p(x)=1+x+x^4$. Determine (n, k). Design and implement the triple error correcting syndrome circuit for this code. Explain the design steps clearly.

3B. A triple error correcting BCH decoder over $GF(2^4)$ using $p(x)=1+x+x^4$ results in the error location polynomial equal to $1+ \alpha^{12} x^3$. Design the Chien's Searching circuit used to correct the errors.

(5+5)

4A. Determine the syndrome vector, error location polynomial, error polynomial and corrected code polynomial for the received vector $r(x)=x+x^9$ using a triple error correcting BCH decoder of length 15. Use $p(x)=1+x+x^4$

4B. The convolutional encoder is defined by $g^{(1)}=(1011)$ and $g^{(2)}=(1001)$. Represent the encoder in state diagram and trellis diagram for 6 time slots. Using trellis diagram determine the code word for a given message (110011).

(5+5)

5A. Decode received polynomial $r(x)=\alpha^2 x^7$ using a triple error correcting RS code of length 15 using $p(x)=1+x+x^4$.

5B. Determine the generator sequences and generator matrix G for a convolutional encoder shown in **Figure 5B**. Compute the output sequence of the encoder when fed with the input sequences $u^{(1)}=(0\ 1\ 1\ 0)$, $u^{(2)}=(1\ 1\ 1\ 1)$ & $u^{(2)}=(1\ 0\ 0\ 1)$ by applying (i) convolution operation and verify the output sequence using G matrix.

(5+5)

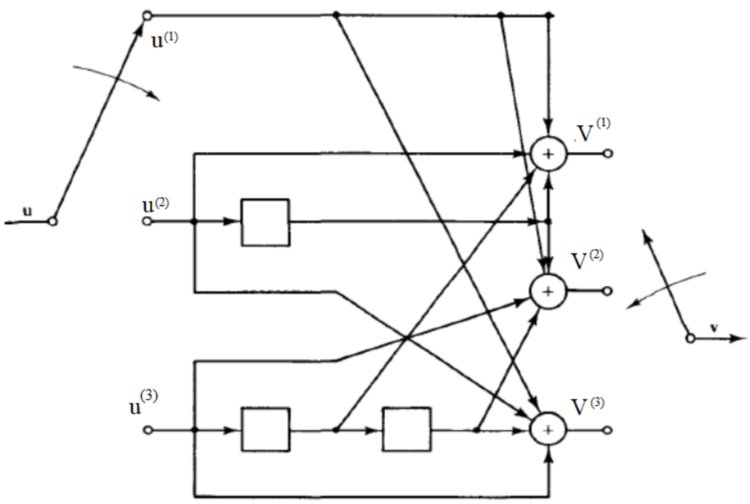

Figure. 5B