Reg. No.										

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

SEVENTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION
JANUARY/FEBRUARY 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. Verify whether the Set S={0, 1, 2, …., 7} mod 8 and H={0, 1, …., 10} mod 11 are fields. Justify your statements.

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

1C. Determine the minimal polynomial of α^{11} over GF(2^4) using p(x)=x^4+x+1.

(3+3+4)

2A. A linear block C(n, k) is defined by the generator matrix $G = \begin{bmatrix} 0 & 0 & 1 & 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$.

Determine
- i. G & H matrices in systematic form
- ii. Possible code words & weight distribution
- iii. Error pattern and corresponding syndrome
- iv. Determine the syndrome and the corrected code vector for the received vectors R1=(101101) and (010010).
- 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 (25, 20) shortened decoder. Explain every step with all necessary computations.

(5+5)

3A. Explain the design and implementation of the syndrome circuit for a triple error correcting BCH code over GF(2^4). Use p(x)=1+x+x^4. Explain the design steps clearly.

3B. Design the Chien's searching algorithm for a triple error correcting BCH code over GF(2^4), if the error location polynomial is 1+ α^5 x^2+ α^{12} x^3.

(5+5)

4A. A triple error correcting BCH code of length 15 is used, and if the received vector is r(x)=x^2+x^{10}, determine the syndromes, error location polynomial, error polynomial and corrected code polynomial.

4B. The convolutional encoder is defined by $g^{(1)}$=(111) and $g^{(2)}$=(101). Represent the encoder in state diagram, tree diagram and trellis diagram for 6 time slots. Using trellis diagram, determine the code word for a given message (110011).

(6+4)

5A. A triple error correcting RS code of length 15 is used. Decode received polynomial $r(x) = \alpha^9 x^7$.

5B. Determine the generator sequences for a convolutional encoder shown in **Figure. 5B**. Determine the encoder generator matrix G. The encoder is fed with two input sequences $u^{(1)}$=(0 1 1 0) & $u^{(2)}$= (1 1 1 1). Compute the output sequence of an encoder by applying:

i. convolution operation ii. G matrix.

(5+5)

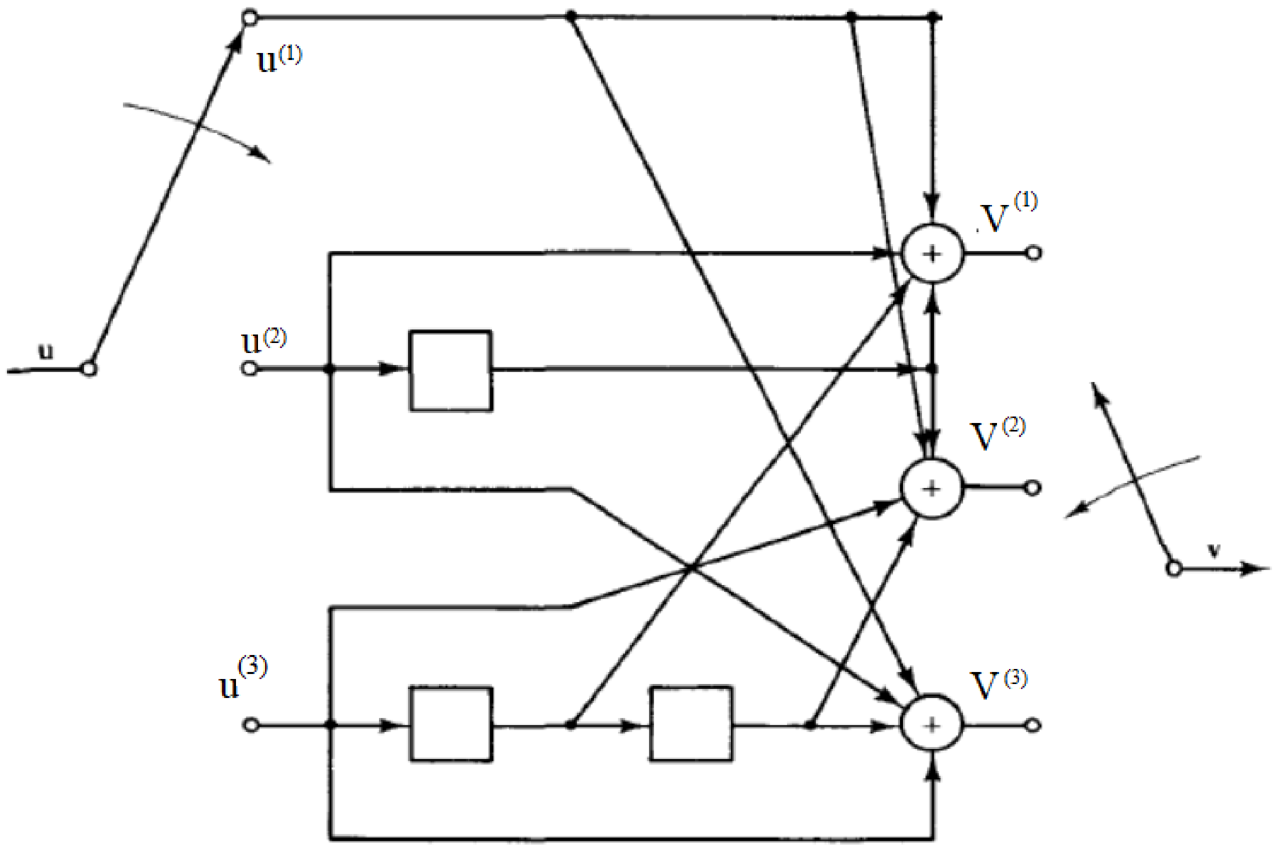

Figure. 5B