Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION
DECEMBER 2020/JANUARY 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 H={1,3,7,9} mod 20 is a group under multiplication. Determine the order of 3 and 9

1B. Prove $\{f(x)\}^{2^i} = f(x^{2^i})$, if $f(x)$ is a polynomial with coefficients over $GF(2)$

1C. Determine the polynomial whose roots are α^7, α^{11}, α^{13}, and α^{14},over GF(2^4) using p(x)=x^4+x+1

(3+3+4)

2A. A linear block decoder circuit is as shown in Figure 2A. Determine

i. (n, k) & code rate
ii. G & H matrices in systematic form
iii. Minimum distance of code
iv. Error detection and error correction capability of the code
v. Possible code words & weight distribution
vi. Error pattern and corresponding syndrome
vii. Encoder circuit
viii. Number of undetected error patterns
ix. If the received vector is 10000001, determine the syndrome and the corrected code vector.

2B. Draw the cyclic Hamming decoding circuit using g(x) = 1+x^2+x^5. Modify the circuit to implement (26, 21) shortened decoder. Explain and show the computations to device the circuit.

(5+5)

3A. Using p(x)=x^4+x+1, design following circuits to
(i) Multiply any arbitrary field element from *GF* (2^4) by α^2,
(ii) Multiply two arbitrary field element from *GF* (2^4).

3B. Design the Chien's searching algorithm for a triple error correcting BCH code over GF(2^4), if the error location polynomial is $1+ \alpha^2 x^2+ \alpha^8 x^3$

(5+5)

4A. A triple error correcting BCH code of length 15 is used, and if the received vector is r(x)=x+x^9, Determine the syndromes, error location polynomial, error polynomial and corrected code polynomial.

4B. The convolution encoder is defined by $g^{(1)}$=(110) and $g^{(2)}$=(101). Represent the encoder in state diagram, tree diagram and trellis diagram for 6 time slots. Using the trellis diagram determine the code word for the message (010010).

(6+4)

5A. A triple error correcting RS code of length 15 is used. The syndrome computed for received vector r(x) is $S=\{\alpha^4, 1, \alpha^{10}, \alpha^7, 0, \alpha^{14}\}$ and error location polynomial obtained is $\sigma(x)=1+\alpha^2x+\alpha^{11}x^2+\alpha^5x^3$, that has roots as α^5, α^8, and α^{12}. Determine the error polynomial and corrected code polynomial.

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

(5+5)

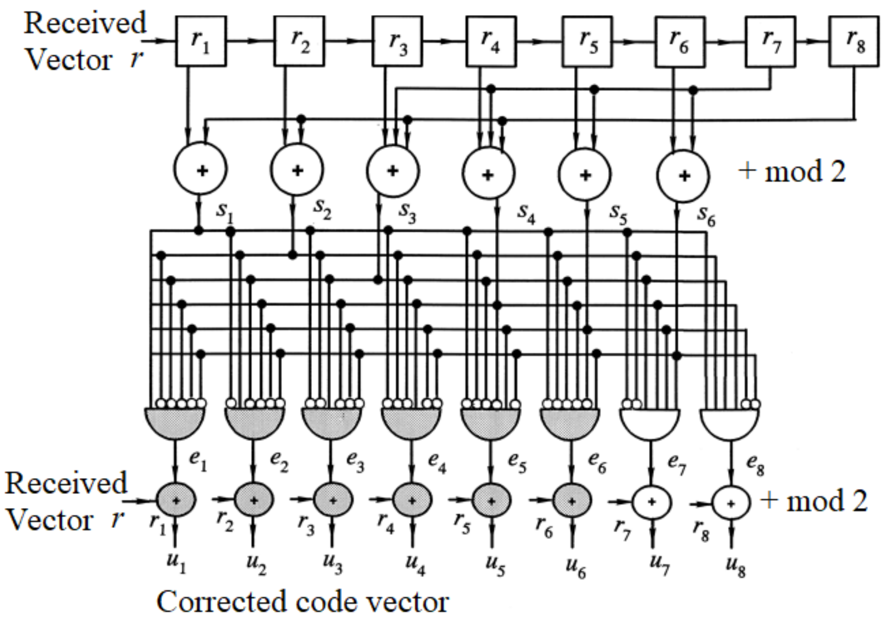

Figure 2A

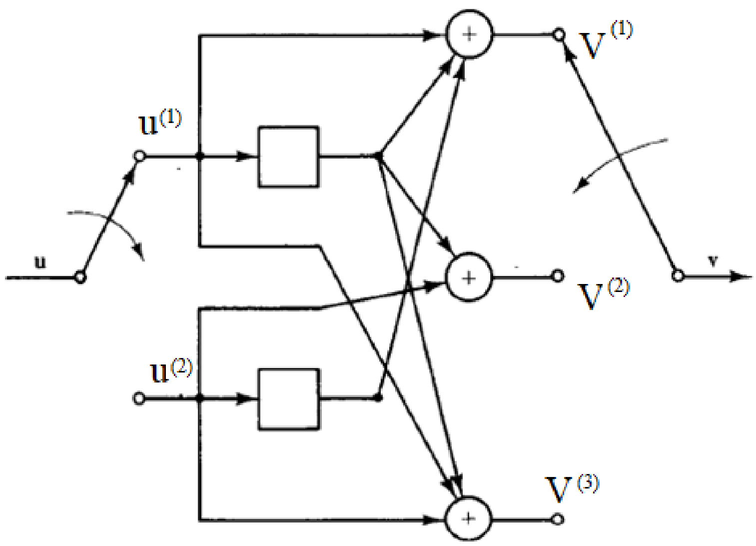

Figure 5B