Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2021

Course: Error Correcting Code **Semester: VI**
Program: B. Tech ECE **Time 03 hrs.**
Course Code: ECEG 3037P **Max. Marks: 100**

Section A

Each Question will carry 5 Marks
Type the final answer in the space provided.

S. No.		**CO**
Q 1	Check whether the received code (Y = 1 0 1 0 0 1 0 ≡ $x^6 + x^4 + x$) for a (7,4) systematic cyclic code is error free or it has any error. If there is an error, what would be the correct code? The generator polynomial for this is $x^3 + x + 1$	**CO3**
Q 2	The parity check matrix of a particular (7, 4) linear block code as given as $\begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$ Find the syndrome for first bit in error	**CO2**
Q 3	Calculate the code of a non-systematic cyclic code for the message 1110. The generator polynomial for this is $p^3 + p + 1$	**CO3**
Q 4	Find out the number of flip-flops and Gate required in designing the encoder of a systematic cyclic code. The generator polynomial for this is $1 + x^2 + x^3 + x^6 + x^7$	**CO3**
Q 5	Determine the generator polynomial (in binary form) of a BCH code, which is capable of correcting triple bit error. The function of the BCH code is given as: $m_1(x) = (x^4 + x + 1)$, $m_2(x) = m_1(x)$, $m_3(x) = (x^4 + x^3 + x^2 + x + 1)$, $m_4(x) = m_2(x)$, $m_5(x) = (x^2 + 1)$ and $m_6(x) = m_3(x)$.	**CO2**

<table>
<tr><td>Q 6</td><td>Calculate the average length of the code using Shannon Fano coding with 4 message having probability of 1/8, 1/2, 1/4 and 1/8.</td><td>CO1</td></tr>
<tr><td colspan="3">Section B
Each question will carry 10 marks
Instruction: Write short / brief notes</td></tr>
<tr><td>Q 1</td><td>A communication channel has a bandwidth of 3400 Hz.
(a) Calculate the capacity of the channel for a signal to noise ratio of 30 dB
(b) Calculate the minimum value of signal to noise ratio required to support error free transmission through it at for a transmission rate of 5100 bits per second.</td><td>CO1</td></tr>
<tr><td>Q 2</td><td>A Convolutional coder is consisting of 3 shift-registers. The code output from this encoder is generated by using the design as given below.
$V_1 = S_1 + S_2 + S_3$ and $V_2 = S_1 + S_2$.
(a) Design the layout of the coder
(b) Draw the State table.
(c) Draw the code trellis
(d) Draw the code tree.</td><td>CO4</td></tr>
<tr><td>Q 3</td><td>(a) Construct a (7, 4) cyclic code using gate and flip-flops. The generator polynomial for this is given as $x^3 + x + 1$.
(b) Compute the code for the message 1010.</td><td>CO3</td></tr>
<tr><td>Q 4</td><td>The seven colors of Rainbow are arranged in a picture of 10×5 matrix as following.
<table><tr><td>V</td><td>I</td><td>B</td><td>R</td><td>R</td><td>Y</td><td>G</td><td>V</td><td>I</td><td>R</td></tr><tr><td>O</td><td>G</td><td>G</td><td>O</td><td>R</td><td>R</td><td>Y</td><td>Y</td><td>Y</td><td>G</td></tr><tr><td>V</td><td>I</td><td>B</td><td>B</td><td>B</td><td>G</td><td>G</td><td>Y</td><td>Y</td><td>Y</td></tr><tr><td>V</td><td>I</td><td>B</td><td>G</td><td>V</td><td>I</td><td>B</td><td>B</td><td>B</td><td>V</td></tr><tr><td>R</td><td>R</td><td>O</td><td>O</td><td>G</td><td>G</td><td>Y</td><td>V</td><td>V</td><td>I</td></tr></table>Construct Huffman tree and determine the code of R and B.</td><td>CO1</td></tr>
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Q 5	Determine the **generator matrix** for the parity check matrix of a particular (7, 4) linear block code given as $\begin{bmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$	**CO2**
Section C **Each Question carries 20 Marks.** **Instruction: Write long answer.**		
Q 1	Design a Viterbi decoder using trellis diagram. The coder is consisting of 3 shift-registers, and the code vector from the output of shift register are $V_1 = S_1 + S_2 + S_3$, $V_2 = S_1 + S_3$. If the input bit sequence to this decoder is **11 10 10 10 11 00**. Then determine whether this received bit is correct or not? If there is an error, then find the correct code. From the correct code, determine the message input.	**CO4**