B. Tech. (Sem. IV) (Back) Examination, June/July - 2011
Information Technology
4IT2 Information Theory & Coding

Time : **3** Hours]

[Total Marks : **80**
[Min. Passing Marks : **24**

*Attempt any **five** questions, selecting one question from each unit.*
All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used / calculated must be stated clearly.

Use of following supporting material is permitted during examination.
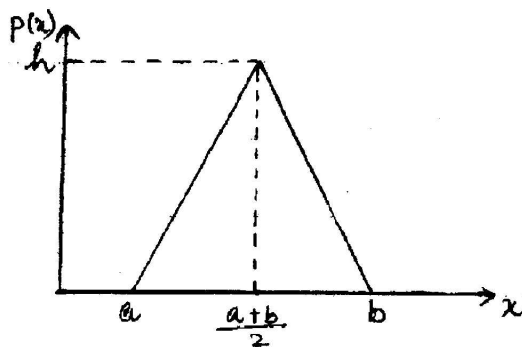*(Mentioned in form No. 205)*

1. _____ **NIL** _____   2. _____ **NIL** _____

UNIT I

1   (a)   Define Entropy. Show that the entropy is maximum when all the messages are equiprobable. Assume M = 3.

8

   (b)   A Random Variable has a density function as shown below. Find the corresponding entropy.

OR

8

2   (a)   In a message conveyed through a long sequence of dots and dashes, the probability of occurrence of a dash is one third of that of a dot. the duration of a dash is three times that of a dot. If the dot lasts for 10 m sec. and the same time is allowed between symbols, determine the following :

(i) The information in dot and dash

(ii) Average information in the dot-dash code

(iii) Average information rate.

$$4+4+4=12$$

(b) Give differences between Discrete and Continuous communication channel.

4

UNIT II

3 (a) State Shannon Hartley Theorem. Give its implications.

8

(b) Define Transinformation. Prove that the transinformation of a continuous system is non-negative.

8

OR

4 (a) Prove that the channel capacity of a white-bandlimited Gaussian channel is

$$C = w \log\left(1 + \frac{S}{N}\right) lit/s.$$

where

w = Channel Bandwidth

S/N = Signal to Noise Ratio.

10

(b) A Gaussian channel has 1 MHz bandwidth. Calculate the channel capacity if its signal power to (two sided) noise spectral density ratio is 5×10^4 Hz. Also find the maximum information rate.

6

UNIT III

5 (a) State Kraft's inequality.

4

(b) Define the following terms :

(i) Source coding

(ii) Channel coding

(iii) Entropy coding.

$$2+2+2=6$$

(c) Explain Error Control coding with the help of a suitable diagram.

6

OR

6 (a) Explain the following with suitable example :
       (i)   Variable Length Code
       (ii)   Prefix Free Code
       (iii) Uniquely Decodable Code
       (iv)   Instantaneous Code.

                                                    $\dot{2}$+2+2+2=8
   (b) Explain ARQ and FEC methods of Error Control Coding. List
        their advantages and disadvantages.

                                                              8

UNIT IV

7 (a) Given a (7,4) code with $g(x) = x^3 + x^2 + 1$, construct the
        decoding table for this single error correcting code.

                                                              4

   (b) Determine the data vector transmitted for the received vector,
        r = 1101101

                                                              6

   (c) Prove :
        $d_{min} \geq 2t + 1$ where
        d_{min} = minimum distance
        t = error correcting capability of code.

                                                              6

OR

8 Consider the following (k+1, k) systematic LBC, with the parity
   check digit, C_{k+1} given by

   $C_{k+1} = d_1 \oplus d_2 \oplus ..... \oplus d_k.$

   (a) Construct appropriate generator matrix for this code.
   (b) Construct the code generated by this matrix for k = 3.
   (c) Determine the error correcting and error detecting capability
        of this code.
   (d) Show that $CH^T = 0$
        and
        $rH^T = 0$ if no error occurs
              1 if error occurs

                                                    4+4+4+4=16

UNIT - V

9 (a) Compare coded and uncoded systems in terms of Probability
        of Error.

                                                              4
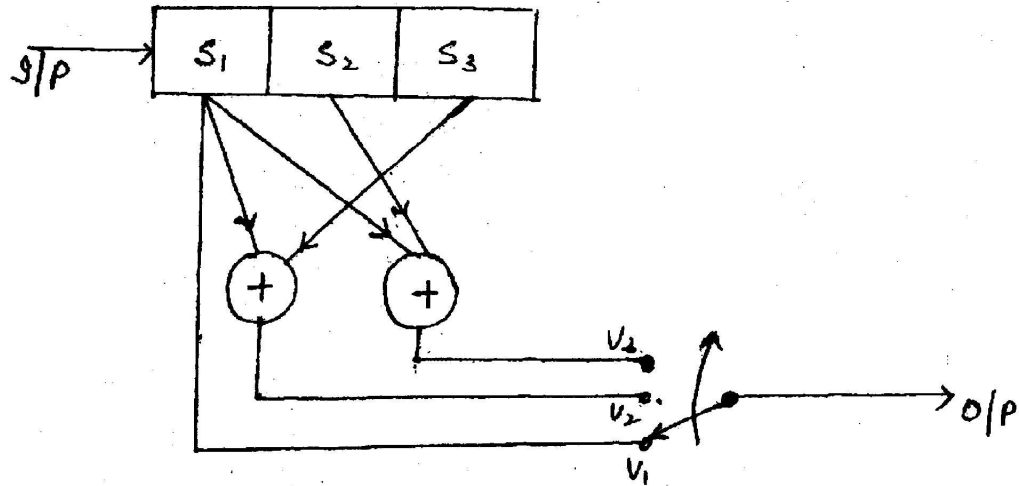
(b) Write short note on :
   (i) Interlaced Code
   (ii) Sequential Coding.

6+6=12

OR

10 (a) For the convolutional Encoder shown below
   (i) Draw the state diagram
   (ii) Draw the trellis diagram
   (iii) Determine the o/p sequence for the input data,
        d = 11010100.

Conxolutional Encoder

3+3+6=12

(b) Explain Viterbi Algorithm.

4