

IIII - HYDERABAD

Monsoon 2012

Information Theory & Coding  
2<sup>nd</sup> Mid term Examination

Time: 90 Minutes

Max Marks: 40

Instructions:

- ① Provide Mathematically & logically complete/correct answers
- ② Verbose answers lead to negative marks
- ③ You donot need too many additional
- ④ State the assumptions made

(Q1) For a Binary Symmetric Channel (BSC) with crossover probability ' $p$ ' ( $\begin{matrix} 0 \xrightarrow{p} 1 \\ \text{or} \\ 1 \xrightarrow{p} 0 \end{matrix}$ ) having input  $X$  and output  $Y$ , let the probability of the inputs be  $P(X=0)=q$  and  $P(X=1)=1-q$

(a) Show that the mutual information is

$$I(X; Y) = H(Y) + p \log_2 p + (1-p) \log_2 (1-p)$$

(b) Determine the channel capacity per channel use

10 Marks

(Q2) (a) Determine the optimal source code (Huffman code with  $D=2$  i.e.  $\{0,1\}$ ) for an I.I.D source with common probability mass function  $\{0.3, 0.25, 0.2, 0.1, 0.1, 0.05\}$

(b) Is the Huffman code unique

8 Marks

(Q3) (a) State and prove Shannon's channel coding theorem (for a noisy channel in all its generality. As a prerequisite state and prove Asymptotic Equipartition property

16 marks

(Q4) Derive the channel capacity of the Continuous time AWGN channel

6 Marks