

PE-486-CV-19

M.A./M.SC. MATHEMATICS (4th Semester)

Examination, June 2022

INFORMATION THEORY-II

Time : Three Hours]

[Maximum Marks : 80

[Minimum Pass Marks : 29

Note : Answer from both the Sections as directed. The figures in the right-hand margin indicate marks.

Section-A

1. Answer the following questions:

1x10=10

- (a) In sphere packing, where is the received code vector with added noise located?
- a). Inside the sphere b). Outside the sphere
- c). On the boundary of the sphere d). All of the above
- (b) If the channel is band limited to 6kHz and signal to noise ratio is 16, what would be the capacity of channel?
- a). 15.15 Kbps b). 24.74 Kbps c). 30.12 Kbps d). 52.18 Kbps
- (c) In digital communication system, smaller the code rate.....are the redundant bits.
- a). Less b). More c). Equal d). Unpredictable
- (d) Which type of channel does not represent any correlation between input and output symbols.
- a). Noiseless channel b). Lossless channel
- c). Useless channel d). Deterministic channel
- (e) Define "Noise".
- (f) Define Observer.
- (g) Define Decoding.
- (h) Define Information function.
- (i) An event has two possible outcomes with probability $P_1 = 1/2$ and $P_2 = 1/64$. The rate of information with 16 outcomes per second is
- a). $\frac{38}{4} \text{ bits/sec}$ b). $\frac{38}{64} \text{ bits/sec}$ c). $\frac{38}{2} \text{ bits/sec}$ d). $\frac{38}{32} \text{ bits/sec}$
- (j) Consider a discrete memoryless source with alphabet $S = S_0, S_1, S_2, S_3, S_4, \dots$ and respective probabilities of occurrence $P = \left\{ \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32} \right\}$. The entropy of the source (In bits) is.....

2. Answer the following questions:-

2x5=10

- (a) If a noiseless channel band limited to 5KHz is sampled every 1msec, what will be the value of sampling frequency?
- (b) Define channel capacity.
- (c) Write short note about classification of channels.
- (d) Define conditional and mutual entropy.
- (e) Define parallel Gaussian channels.

Section-B

12x5=60

Answer the following questions:

3. Define Random coding Scheme.

OR

Write the general solution of the fundamental equation of information.

4. State and proof Shannon's entropy theorem.

OR

Explain In-gradients of noiseless coding problem.

5. Show that the capacity of a Gaussian channel with power constraint P and noise variance N is $C = \frac{1}{2} \log \left(1 + \frac{P}{N} \right)$ bits per transmission.

OR

Write short notes about "Random data and compression."

6. Show that for any binary prefix code encoding $x_1 x_2 \dots x_n$ the average length of a word must be greater than E . More explicitly, setting l_i as the length of the code word for x_i $\sum_{i=1}^n p_i l_i \geq E$

OR

State and proof Gibbs inequality.

7. Write short notes about "Decoding Schemes".

OR

Write down the comparison between discrete channel and continuous channel in details.