VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

REG.NO.: 25BE

SCHOOL OF ELECTRONICS ENGINEERING
CONTINUOUS ASSESSMENT TEST - I
WINTER SEMESTER 2025 - 2026

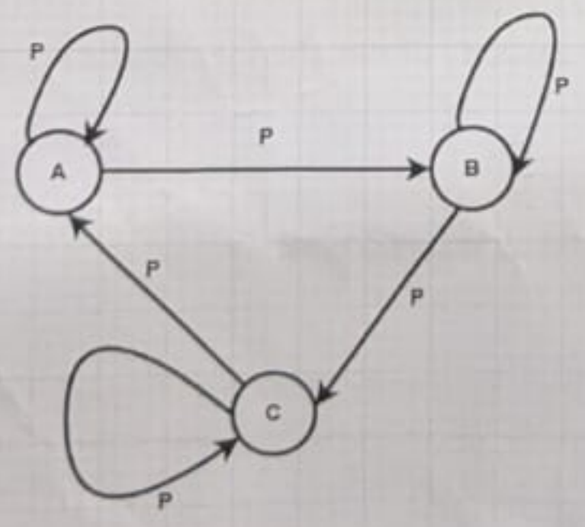
SLOT: E1+TE1

Programme Name & Branch	:	B. Tech ECE
Course Code and Course Name	:	BECE313L - Information Theory and Coding
Faculty Name(s)	:	Prof K Saravanan & Prof Noor Mohammed V
Class Number(s)	:	VL2025260500860 & 862
Date of Examination	:	31-1-2026
Exam Duration	:	90 minutes

Maximum Marks: 50

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes
  CO1 - Apply probability theory to calculate entropies and mutual information.
  CO2 - Compute channel capacity for various communication channels.
  CO3 - Analyze source coding algorithms for effective and efficient compression.

Q. No	Question	M	CO	BL
1.	a) A card is drawn from deck. i) If you are informed that the card drawn is a spade, how much information is received? ii) If you are informed that the card drawn is an ace, how much information is received? iii) If you are informed that the card drawn is the ace of spades, how much information is received. iv) Is the information obtained in part (iii) equal to the sum of the information obtained in parts (i) and (ii)? Justify your answer.	5	1	3
	b) An information source graph is shown in Figure 1. The transition probability in each stage is represented by "P". i) Find the transition probability "P" ii) Find the source entropy.  Figure 1. Information source graph	5		

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2.	A transmitter transmits three symbols and receiver receives three symbols. The joint probability matrix P(A, B) is given below in Figure 2. Calculate (i) H(A), (ii) H(B) (iii) H(A, B) (iv) H(A/B). $\begin{bmatrix} 0.3 & 0.02 & 0.01 \\ 0.02 & 0.3 & 0.02 \\ 0.01 & 0.02 & 0.3 \end{bmatrix}$ Figure 2	10	1	3
3.	Consider a Binary Symmetrical Channel whose crossover probability for each bit is p = 0.35. Suppose the marginal probability related to source P (0) is 0.45. Draw the channel diagram i) Find the channel noise matrix ii) Find the joint probability mass function matrix iii) Find also the channel capacity	10	2	3
4.	i) Consider a noisy continuous communication channel of bandwidth 1 MHz, which is perturbed by additive white gaussian noise whose total spectral power is $N_oW = 1$. Continuous signals are transmitted across such a channel, with average transmitted power P = 1,000 . Give a numerical estimate for the channel capacity, in bits per second, of this noisy channel. Then, for a channel having the same bandwidth W but whose signal to noise ratio P/N_oW is 4 times better, repeat your numerical estimate of capacity in bits per second. ii) Suppose that for such a continuous channel with added white Gaussian noise, the ratio of signal power to noise power is given as 30 decibels, and the frequency bandwidth of the channel is 10 MHz. Roughly what is the information capacity of this channel, in bits per second? iii) With no constraints on the parameters of such a channel, is there any limit to its capacity if you increase its signal to noise ratio P/N_oW without limit? If so, what is that limit? iv) Is there any limit to the capacity of such a channel if you can increase its spectral bandwidth W (in Hertz) without limit, while not changing No or P? If so, what is that limit?	10	2	3

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d receiver receives three symbols.
Figure 2. Calculate (i) H(A),

		10	1	3

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5.	By now, you are an expert at compressing alien's language, the Indian government assigns you the task of compressing Krypton language. Kryptonite are very smart (or) stupid beings, as such their entire language can be represented by sequences consisting of only three letter k1, k2 and k3. Being a compression expert that you are, your examine the krypton text, and notice there are 7000 k1's, 2000 k2's and 1000 k3's out of the given Kryptonite text containing 10,000 letters. i) What is the average information of the source generating Krypton text? ii) If Shannon Fano binary algorithm is used to code the letters, what is the average length of symbols? iii) Due to the bandwidth limitations, the Indian government wants to improve your Shannon Fano binary compression scheme. Suggest a suitable Shannon Fano binary coding technique to compress further? iv) Find the codewords and efficiency for the Shannon Fano Codes suggested.	10	3	3

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