BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

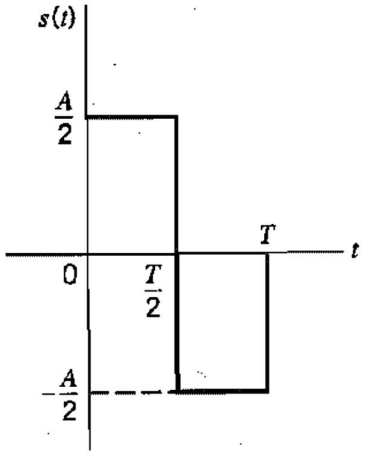
CLASS: BTECH **SEMESTER : V/ADD**
BRANCH: ECE **SESSION : MO/2025**

SUBJECT: EC301 DIGITAL COMMUNICATION

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	A sinusoidal modulating signal is given by $m(t) = Acos\ (2\pi f_m t)$. If the step size is Δ, and sampling frequency f_s, find the condition on 'A' so that slope overload can be avoided in Delta modulation. Prove that the output signal to quantization noise ratio (when there is no slope overload) is given by $\left(\frac{S_0}{N_q}\right)_0 = \frac{3f_s^3}{8\pi^2 f_M f_m{}^2}$ where, f_M is bandwidth of the low-pass reconstruction filter used at receiver.	[5]	CO1 CO2	BL4
Q.1(b)	The discrete sample of an analog signal is to be uniformly quantized for PCM system. If the maximum value of the analog sample is to be represented within 0.1% accuracy, find the maximum number of binary digits required.	[5]	CO1 CO2	BL4
Q.2(a)	Derive the Nyquist criterion for the distortion less baseband transmission of the digital data in absence of noise.	[5]	CO2	BL2
Q.2(b)	Consider the signal s(t) shown in the figure.	[5]	CO2 CO3	BL5



(i) Sketch the impulse response of the filter matched.
(ii) Plot the matched filter output as a function of time.
(iii) What is the peak value of the output?

Q.3(a)	Compare BPSK and BFSK in terms of bandwidth and energy efficiency. Draw the signal space representation of orthogonal BFSK.	[5]	CO3	BL4
Q.3(b)	Given the binary sequence 1100010001, sketch the waveform of the in-phase and quadrature components of the modulated wave as well as the modulated wave obtained by QPSK.	[5]	CO3	BL4
Q.4(a)	Define Shannon's channel capacity theorem. How does increasing bandwidth affect the capacity of a channel?	[5]	CO4	BL3

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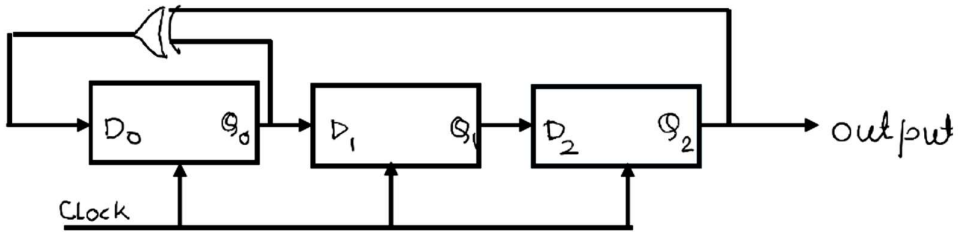
Q.4(b) A discrete memoryless source produces symbols $x_i, i = 0\ to\ 5$ with the following probabilities. [5] CO4 BL6

$p(x_0) = 0.1;\ p(x_1) = 0.2;\ p(x_2) = 0.15; p(x_3) = 0.09;\ p(x_4) = 0.20;\ p(x_5) = 0.26$ Design a Huffman code for the above source. Find the coding efficiency of the designed code.

Q.5(a) Define the term processing gain of a direct sequence spread spectrum system. Explain how a DS spread spectrum can suppress narrow band interfering signals. [5] CO5 BL2

Q.5(b) For the 3-stage shift register shown in the figure, determine the PN sequence. Determine the length of the sequence? Verify the balanced, run and the autocorrelation property of the generated PN sequence. Assume that the initial state of the shift register is 111. [5] CO5 BL6



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