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PES University, Bengaluru

(Established under Karnataka Act No. 16 of 2013)

UE16/18EC352

DECEMBER 2021: END SEMESTER ASSESSMENT (ESA) B TECH 6th SEMESTER

UE16/18EC352 – Digital Communication

Time: 3 Hrs	Answer All Questions	Max Marks: 100

1	a)	With the help of suitable diagrams, explain the DPCM operation at the transmitter and the receiver. Also explain the improvement in SNR over PCM.	8
	b)	Explain the following with respect to delta modulation: i) Slope overload and ii) Granular noise	6
	c)	Derive the expression for the power spectrum of the polar NRZ signal	6
2	a)	State the Nyquist criterion for distortionless transmission, and obtain the corresponding expression in the frequency domain.	6
	b)	Indicate any 5 factors of a binary communication system that can be determined by studying the eye diagram	5
	c)	For the AWGN channel, draw the block diagram of the i) detector and ii) vector receiver. Derive the minimum distance decision rule, starting from the MAP decision rule.	9
3	a)	Prove that the matched filter maximizes the output SNR	5
	b)	With the help of block diagrams, explain the generation and detection of the QPSK signal. Draw its constellation diagram, and indicate the probability of error and the required bandwidth.	7
	c)	A digital modulation system uses a sinusoidal carrier with amplitude $A = 0.5\ \mu V$. The bit rate is 10^6 bps. The additive white Gaussian noise has the power spectrum $S_N(f) = 2 \times 10^{-20}$ W/Hz. Find the probability of error for the following cases: i) BPSK, ii) BFSK and iii) QPSK. Express the answers in terms of the $erfc$ function.	8
4	a)	Define the entropy of a discrete random variable, and state its properties.	6
	b)	Let X and Y be discrete random variables. Show that $H(X\|Y) \leq H(X)$	6
	c)	Find the Huffman code for the source with symbol probabilities $\{0.3, 0.25, 0.25, 0.15, 0.05\}$. Also find the code efficiency.	8
5	a)	Derive the expression for the capacity of a binary symmetric channel	7
	b)	Find the differential entropy of a Gaussian random variable with zero mean and a variance of σ^2.	6
	c)	Show that the capacity of the Gaussian channel is $C = \frac{1}{2}\log\left(1 + \frac{P}{\sigma^2}\right)$	7