Total number of printed pages: 2 **UG /5th Semester/UECE503**

2024

DIGITAL COMMUNICATION SYSTEMS AND STOCHASTIC PROCESS

Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	State 'Sampling Theorem' for a band limited low-pass signal. What is meant by 'aperture effect' in flat-top sampling?	3+3 = 6
	b)	Show that the output quantization SNR in a binary PCM is given by $SNR\|_{Q,dB} = 1.8 + 6 \times n$; where 'n' is the number of bits in a code word.	10
	c)	Discuss briefly the operation of a binary PCM.	4
2.	a)	Discuss the operation of a delta modulator. What are the two sources of noise in the delta modulator? Discuss briefly.	6+2+2 = 10
	b)	If the power spectrum of a signal is given by $S_{xx}(\omega) = \frac{10}{\left[1+\left(\omega/10\right)^2\right]^2}$ and the 6-dB bandwidth is 10 rad/s, calculate the r.m.s bandwidth, where the r.m.s bandwidth is given by $W_{rms} = \sqrt{\frac{\int_{-\infty}^{\infty} \omega^2 \times S_{XX}(\omega)\, d\omega}{\int_{-\infty}^{\infty} S_{XX}(\omega)\, d\omega}}$.	10
3.	a)	Prove that a 1st order predictor in a DPCM is a unit-delay block.	5
	b)	Show that the error probability for digital baseband signalling is given by $P_e = Q\left(\frac{d}{2}\right)$; where 'Q' is the Q-function given by $Q(k) = \frac{1}{\sqrt{2\pi}} \int_k^{\infty} e^{-x^2/2} dx$.	10
	c)	Show that the signal '$p(t)$' and the matched filter impulse response are mirror images of each other.	5

4.	a)	A baseband binary system transmits the signal $s_1(t)$ for binary '1' and $s_2(t)$ for binary '0', where $s_1(t)=\begin{cases} A\ ;0\le t\le T/2 \\ A/2\ ;\ T/2\le t\le T \\ 0\ ,\ elsewhere \end{cases}$ and $s_2(t)=\begin{cases} A/2\ ;0\le t\le T/2 \\ -A/2;\ T/2\le t\le T \\ 0\ ,\ elsewhere. \end{cases}$ The channel may be assumed to be AWGN with noise PSD of '$N_0/2$' and the symbols are equi-probable. Find the energy of the two transmitted signals and hence find the average energy per bit. Also find the probability of bit error 'P_e'.	15
	b)	Explain why polar signals are preferred over uni-polar signals for a given value of input SNR at the front end of a receiver.	5
5.	a)	Show that the BER (average error probability) for a polar NRZ signal using matched filter technique is given by $P_e\big\vert_{Polar,NRZ}=Q\left[\sqrt{\frac{2E_b}{\eta}}\right]$; where the symbols have their usual meaning.	10
	b)	If a signal '$x(t)=A\times\cos(\omega_0 t+\theta)$' is periodic with '$T_0$'; then prove that its auto-correlation '$R_{xx}(\tau)$' is also periodic with 'T_0'.	4
	c)	White noise with 2-sided PSD of '$N_0/2$' passes through an ideal LPF with a bandwidth of 'W' Hz. Determine the output noise power.	6
6.	Write short notes on any ***two*** of the following		10x2 = 20
	a)	Line codes for binary signal.	
	b)	PCM bandwidth.	
	c)	First order and second order (strict sense) stationary process.	
	d)	Matched filter.	

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