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 spectrum of sampled waveform, in case of impulse sampling, is the repetition of the spectrum of low-pass bandlimited signal.	14
2.	a)	Discuss the operation of a delta modulator (DM). What are the two sources of noise in the delta modulator? Discuss briefly.	$6+2+2 = 10$
	b)	If a TV signal of 4.5 MHz bandwidth is transmitted using 8-bit binary PCM, determine: (i) maximum signal-to-quantization ratio, (ii) minimum bit rate, (iii) minimum transmission bandwidth needed.	$5+5 = 10$
3.	a)	Show that the error probability (BER) for digital baseband signalling is given by $P_e = Q\left(\dfrac{d}{2}\right)$; where 'Q' is the Q-function given by $Q(k) = \dfrac{1}{\sqrt{2\pi}} \displaystyle\int_{k}^{\infty} e^{-x^2/2} dx$ and $d = \dfrac{S_{02}(T_b) - S_{01}(T_b)}{\sigma}$.	10
	b)	Show that the mean-squared error value of a uniform quantizer is $\overline{e_q^2} = \dfrac{\Delta^2}{12}$, where '$\Delta$' is the step size. Explain the need of a non-uniform quantizer. Derive the expression for maximum SNR_Q for a sinusoidal message input. Waveform coding is to be done by Delta Modulator under no slope overload condition.	$3+3+4$
4.	a)	Draw the different line codes and their power spectral density (psd) used for digital transmission of bandpass signals; you may take the input digital bit stream to be '0 1 1 0 0 1 0 1' and assume the bit duration to be 'T_b' sec.	$4+3+3$
	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.	10

5.	a)	Show that the BER (average error probability) for a polar NRZ signal using matched filter technique is given by $P_e\big|_{Polar,NRZ} = Q\left[\sqrt{\dfrac{2E_b}{\eta}}\right]$; where the symbols have their usual meaning.	10
	b)	Discuss the demodulation of BFSK signal. Also calculate the BER for BFSK signal in terms of input SNR $\left(\dfrac{E_b}{\eta}\right)$.	5+5
6.		Write short notes on any *two* of the following	10x2 = 20
	a)	Flat top sampling.	
	b)	PCM bandwidth.	
	c)	First order and second order (strict sense) stationary process.	
	d)	Matched filter.	

XXXXXXXX