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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

July 2023 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Electronics & Telecommunication Engineering **Duration: 3 hrs.**
Course Code: 19ET6PCDCM **Max Marks: 100**
Course: Digital Communication **Date: 05.07.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	***CO***	***PO***	**Marks**
1	a)	Explain the process of natural sampling with relevant diagrams and equations.	*CO1*		**10**
	b)	A signal $g(t) = 10\cos(200\pi t)\cos(2000\pi t)$ is sampled at the rate of 2500 samples/second. i. Sketch the spectrum of the sampled signal ii. Specify the cutoff ideal reconstruction filter so as to recover g(t) from $g_\delta(t)$. Specify the Nyquist rate for the signal g(t)	*CO2*	*PO1*	**06**
	c)	A signal $m_1(t)$ is band limited to 7.2 kHz, and three other signals $m_2(t)$, $m_3(t)$ and $m_4(t)$ are band limited to 2.4 kHz each. These signals are to be transmitted by means of TDM. i. Set up a scheme for realizing this multiplexing requirement, with each signal sampled at its Nyquist rate. ii. What must be the speed of the commutator in samples/second? iii. Determine the minimum bandwidth of the channel	*CO2*	*PO1*	**04**
		OR			
2	a)	What is the necessity of non-uniform quantization? Explain the two companding methods used in practice.	*CO1*		**10**
	b)	Consider a lowpass signal with a bandwidth of 3.4 kHz. A linear modulation system with step size $\delta = 0.1$ volts, is used to process this signal at a sampling rate of 5 times the Nyquist rate. i. Evaluate the maximum amplitude of a test sinusoidal signal of frequency 1 kHz, which can be processed by the system without slope overload distortion. ii. For the specifications given in (i), find the output SNR under prefiltered and postfiltered conditions.	*CO2*	*PO1*	**06**

		c)	A voice signal g(t) = 6sin2πt volts is sent using a 4-bit binary PCM system. The quantizer is midrise type, with a step size Δ = 1 volt. Sketch the PCM wave for one complete cycle of the input, assuming a sampling rate of 4 samples/second with samples taken at t = ±1/8, ±3/8, ±5/8, . . Seconds.	*CO3*	*PO2*	**04**
			UNIT - II			
	3	a)	Derive a mathematical scheme to describe ISI and also derive a condition for Nyquist criterion for distortion less base band binary transmission.	*CO2*	*PO1*	**10**
		b)	The following data is applied to a duo-binary coder **0 1 1 0 1 1 0 0 1** i. Sketch the block diagram and write the equations of the duo-binary coder and derive the output for the above data ii. Consider a pre – coder with initial value of 0 and solve i.	*CO3*	*PO2*	**06**
		c)	Analyze the importance of an Eye diagram in a digital communication scheme with relevant diagrams.	*CO1*		**04**
			UNIT - III			
	4	a)	State and prove the properties of the matched filter.	*CO2*	*PO1*	**10**
		b)	Prove the Gram Schmidt Orthogonalization procedure.	*CO2*	*PO1*	**10**
			OR			
	5	a)	With relevant terminologies, derive the Probability of Error for the coherent detection of ASK.	*CO3*	*PO2*	**10**
		b)	Calculate the probability of error for BPSK considering the data as follows: AWGN with power spectral density of 4 X 10^{-20} Watts/Hz, bit duration of 0.5µs, amplitude of received signal is 1.5µV.	*CO3*	*PO2*	**06**
		c)	With relevant block diagram, explain the working of a Non-Coherent FSK receiver.	*CO1*		**04**
			UNIT - IV			
	6	a)	Explain with relevant block diagrams and equations the working of QPSK transmitter and receiver. Also sketch its signal space diagram.	*CO1*		**10**
		b)	Explain with relevant block diagrams and equations the working of MSK transmitter and receiver.	*CO1*		**10**

			UNIT -V			
	7	a)	Explain and verify the properties of maximum length sequence for sequence generated from 3 stage shift register with linear feedback and with initial state 100.	*CO3*	*PO2*	**10**
		b)	Explain with appropriate block diagrams, equations and waveforms the generation and detection of Direct Sequence Spread Spectrum techniques.	*CO1*		**10**

Complementary Error Function Table

$$\operatorname{erfc}(x) = \frac{2}{\sqrt{\pi}} \int_x^{\infty} e^{-t^2}\, dt$$

x	Hundredths digit of x 0	1	2	3	4	5	6	7	8	9
0.0	1.00000	0.98872	0.97744	0.96616	0.95489	0.94363	0.93238	0.92114	0.90992	0.89872
0.1	0.88754	0.87638	0.86524	0.85413	0.84305	0.83200	0.82099	0.81001	0.79906	0.78816
0.2	0.77730	0.76648	0.75570	0.74498	0.73430	0.72367	0.71310	0.70258	0.69212	0.68172
0.3	0.67137	0.66109	0.65087	0.64072	0.63064	0.62062	0.61067	0.60079	0.59099	0.58126
0.4	0.57161	0.56203	0.55253	0.54311	0.53377	0.52452	0.51534	0.50625	0.49725	0.48833
0.5	0.47950	0.47076	0.46210	0.45354	0.44506	0.43668	0.42838	0.42018	0.41208	0.40406
0.6	0.39614	0.38832	0.38059	0.37295	0.36541	0.35797	0.35062	0.34337	0.33622	0.32916
0.7	0.32220	0.31533	0.30857	0.30190	0.29532	0.28884	0.28246	0.27618	0.26999	0.26390
0.8	0.25790	0.25200	0.24619	0.24048	0.23486	0.22933	0.22390	0.21856	0.21331	0.20816
0.9	0.20309	0.19812	0.19323	0.18844	0.18373	0.17911	0.17458	0.17013	0.16577	0.16149
1.0	0.15730	0.15319	0.14916	0.14522	0.14135	0.13756	0.13386	0.13023	0.12667	0.12320
1.1	0.11979	0.11647	0.11321	0.11003	0.10692	0.10388	0.10090	0.09800	0.09516	0.09239
1.2	0.08969	0.08704	0.08447	0.08195	0.07949	0.07710	0.07476	0.07249	0.07027	0.06810
1.3	0.06599	0.06394	0.06193	0.05998	0.05809	0.05624	0.05444	0.05269	0.05098	0.04933
1.4	0.04771	0.04615	0.04462	0.04314	0.04170	0.04030	0.03895	0.03763	0.03635	0.03510
1.5	0.03389	0.03272	0.03159	0.03048	0.02941	0.02838	0.02737	0.02640	0.02545	0.02454
1.6	0.02365	0.02279	0.02196	0.02116	0.02038	0.01962	0.01890	0.01819	0.01751	0.01685
1.7	0.01621	0.01559	0.01500	0.01442	0.01387	0.01333	0.01281	0.01231	0.01183	0.01136
1.8	0.01091	0.01048	0.01006	0.00965	0.00926	0.00889	0.00853	0.00818	0.00784	0.00752
1.9	0.00721	0.00691	0.00662	0.00634	0.00608	0.00582	0.00557	0.00534	0.00511	0.00489
2.0	0.00468	0.00448	0.00428	0.00409	0.00391	0.00374	0.00358	0.00342	0.00327	0.00312
2.1	0.00298	0.00285	0.00272	0.00259	0.00247	0.00236	0.00225	0.00215	0.00205	0.00195
2.2	0.00186	0.00178	0.00169	0.00161	0.00154	0.00146	0.00139	0.00133	0.00126	0.00120
2.3	0.00114	0.00109	0.00103	0.00098	0.00094	0.00089	0.00085	0.00080	0.00076	0.00072
2.4	0.00069	0.00065	0.00062	0.00059	0.00056	0.00053	0.00050	0.00048	0.00045	0.00043
2.5	0.00041	0.00039	0.00037	0.00035	0.00033	0.00031	0.00029	0.00028	0.00026	0.00025
2.6	0.00024	0.00022	0.00021	0.00020	0.00019	0.00018	0.00017	0.00016	0.00015	0.00014
2.7	0.00013	0.00013	0.00012	0.00011	0.00011	0.00010	0.00009	0.00009	0.00008	0.00008
2.8	0.00008	0.00007	0.00007	0.00006	0.00006	0.00006	0.00005	0.00005	0.00005	0.00004
2.9	0.00004	0.00004	0.00004	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00002
3.0	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001
3.1	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
3.2	0.00001	0.00001	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

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