

Answer all questions



Q1: (8 Marks)

Put true or false for each sentences and correct the false one:

1. A correlator is type of matched filter. .
2. Quantization noise error can be reduced by increasing the quantization levels.
3. Noncoherent detection means detection with carrier phase information.
4. If  $\frac{\Delta f}{B} \ll 1$  we have FSK wideband system and if  $\frac{\Delta f}{B} > 1$  we have narrowband FSK system.
5. BPSK and QPSK don not have the same bit-error probability.
6. A channel can typically be modeled as a linear filter with addition of noise.
7. For orthogonal FSK signaling, tones must have a frequency separation that is multiple of  $1/(2T)$  Hz.
8. Spread spectrum modulation can be used to minimize the effect of interference.

Q2:

- a) What are the advantages of digital modulation? (4 Marks)
- b) Find the modulation rate and the bandwidth required for transmission data with a 8-PSK system using 24Mb/s and a carrier frequency of 160MHz? (4 Marks)

Q3:

- a) Draw a noncoherent Binary FSK receiver? (4 Marks)
- b) Show how to generate and detect a DPSK signal for the binary sequence  $b_k$ : (4 Marks)

$\{b_k\}$		1	0	0	1	1	0	0	0	1	1
-----------	--	---	---	---	---	---	---	---	---	---	---

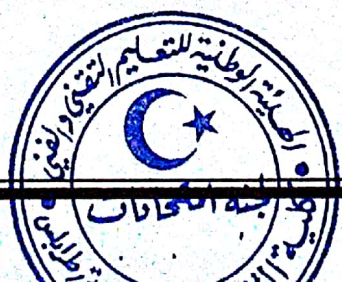
Q4:

A band limited signal  $m(t)$  of 6 MHz bandwidth is sampled at rate of  $66\frac{1}{6}\%$  higher than the Nyquist rate. The maximum allowable error in the sample amplitude is 0.15% of the peak amplitude  $m_p$ . Assume binary encoding. Find the minimum bandwidth of the channel to transmit the encoded binary signal? If 8 such signals are time multiplexed on a single line, What are the capacity and the bandwidth of this line? (8 Marks)



Q5: Compare the average power requirements of a binary PSK, DPSK and noncoherent FSK schemes operating at a data rate of 1k bits/sec over a bandpass channel having a bandwidth of 3k Hz and the noise PSD at the receiver inputs is  $\frac{n}{2} = 10^{-10}$  W/Hz, and  $P_e = 10^{-5}$ . Give your comments on the answer. (8 Marks)

$\text{erfc}(\sqrt{x})$	$x$	$\text{erfc}(\sqrt{x})$	$x$	$\text{erfc}(\sqrt{x})$	$x$	$\text{erfc}(\sqrt{x})$	$x$
$9 \times 10^{-1}$	0.007895	$9 \times 10^{-6}$	7.667845	$9 \times 10^{-9}$	16.523043	$9 \times 10^{-12}$	25.525468
$8 \times 10^{-1}$	0.032092	$8 \times 10^{-6}$	7.779146	$8 \times 10^{-9}$	16.637556	$8 \times 10^{-12}$	25.641072
$7 \times 10^{-1}$	0.074236	$7 \times 10^{-6}$	7.905424	$7 \times 10^{-9}$	16.767404	$7 \times 10^{-12}$	25.772145
$6 \times 10^{-1}$	0.137498	$6 \times 10^{-6}$	8.051325	$6 \times 10^{-9}$	16.917335	$6 \times 10^{-12}$	25.923472
$5 \times 10^{-1}$	0.227468	$5 \times 10^{-6}$	8.224055	$5 \times 10^{-9}$	17.094711	$5 \times 10^{-12}$	26.102474
$4 \times 10^{-1}$	0.354163	$4 \times 10^{-6}$	8.435635	$4 \times 10^{-9}$	17.311866	$4 \times 10^{-12}$	26.321584
$3 \times 10^{-1}$	0.537097	$3 \times 10^{-6}$	8.708911	$3 \times 10^{-9}$	17.591929	$3 \times 10^{-12}$	26.604113
$2 \times 10^{-1}$	0.821187	$2 \times 10^{-6}$	9.094647	$2 \times 10^{-9}$	17.986844	$2 \times 10^{-12}$	27.002402
$1 \times 10^{-1}$	1.352772	$1 \times 10^{-6}$	9.755711	$1 \times 10^{-9}$	18.662447	$1 \times 10^{-12}$	27.683512
$9 \times 10^{-2}$	1.437187	$9 \times 10^{-7}$	9.856363	$9 \times 10^{-10}$	18.765192	$9 \times 10^{-13}$	27.787068
$8 \times 10^{-2}$	1.532451	$8 \times 10^{-7}$	9.968934	$8 \times 10^{-10}$	18.880068	$8 \times 10^{-13}$	27.902841
$7 \times 10^{-2}$	1.641510	$7 \times 10^{-7}$	10.096618	$7 \times 10^{-10}$	19.010323	$7 \times 10^{-13}$	28.034103
$6 \times 10^{-2}$	1.768692	$6 \times 10^{-7}$	10.244100	$6 \times 10^{-10}$	19.160717	$6 \times 10^{-13}$	28.185646
$5 \times 10^{-2}$	1.920729	$5 \times 10^{-7}$	10.418644	$5 \times 10^{-10}$	19.338631	$5 \times 10^{-13}$	28.364901
$4 \times 10^{-2}$	2.108942	$4 \times 10^{-7}$	10.632424	$4 \times 10^{-10}$	19.556431	$4 \times 10^{-13}$	28.584317
$3 \times 10^{-2}$	2.354646	$3 \times 10^{-7}$	10.908279	$3 \times 10^{-10}$	19.837306	$3 \times 10^{-13}$	28.867233
$2 \times 10^{-2}$	2.705947	$2 \times 10^{-7}$	11.297521	$2 \times 10^{-10}$	20.233329	$2 \times 10^{-13}$	29.266055
$1 \times 10^{-2}$	3.317448	$1 \times 10^{-7}$	11.964063	$1 \times 10^{-10}$	20.910728	$1 \times 10^{-13}$	29.948044
$9 \times 10^{-3}$	3.411413	$9 \times 10^{-8}$	12.065497	$9 \times 10^{-11}$	21.013737	$9 \times 10^{-14}$	30.051730
$8 \times 10^{-3}$	3.516737	$8 \times 10^{-8}$	12.178926	$8 \times 10^{-11}$	21.128904	$8 \times 10^{-14}$	30.167647
$7 \times 10^{-3}$	3.636484	$7 \times 10^{-8}$	12.307565	$7 \times 10^{-11}$	21.259485	$7 \times 10^{-14}$	30.296072
$6 \times 10^{-3}$	3.773151	$6 \times 10^{-8}$	12.456124	$6 \times 10^{-11}$	21.410252	$6 \times 10^{-14}$	30.450801
$5 \times 10^{-3}$	3.939719	$5 \times 10^{-8}$	12.631910	$5 \times 10^{-11}$	21.588599	$5 \times 10^{-14}$	30.630273
$4 \times 10^{-3}$	4.141908	$4 \times 10^{-8}$	12.847166	$4 \times 10^{-11}$	21.806920	$4 \times 10^{-14}$	30.849952
$3 \times 10^{-3}$	4.403734	$3 \times 10^{-8}$	13.124855	$3 \times 10^{-11}$	22.088452	$3 \times 10^{-14}$	31.133201
$2 \times 10^{-3}$	4.774768	$2 \times 10^{-8}$	13.516556	$2 \times 10^{-11}$	22.485373	$2 \times 10^{-14}$	31.532483
$1 \times 10^{-3}$	5.413783	$1 \times 10^{-8}$	14.186994	$1 \times 10^{-11}$	23.164238	$1 \times 10^{-14}$	32.215232
$9 \times 10^{-4}$	5.511380	$9 \times 10^{-9}$	14.288989	$9 \times 10^{-12}$	23.267462	$9 \times 10^{-15}$	32.319030
$8 \times 10^{-4}$	5.620616	$8 \times 10^{-9}$	14.403035	$8 \times 10^{-12}$	23.382868	$8 \times 10^{-15}$	32.435073
$7 \times 10^{-4}$	5.744623	$7 \times 10^{-9}$	14.532363	$7 \times 10^{-12}$	23.513717	$7 \times 10^{-15}$	32.566638
$6 \times 10^{-4}$	5.887989	$6 \times 10^{-9}$	14.681703	$6 \times 10^{-12}$	23.664789	$6 \times 10^{-15}$	32.718529
$5 \times 10^{-4}$	6.057833	$5 \times 10^{-9}$	14.858393	$5 \times 10^{-12}$	23.843492	$5 \times 10^{-15}$	32.898190
$4 \times 10^{-4}$	6.266097	$4 \times 10^{-9}$	15.074727	$4 \times 10^{-12}$	24.062243	$4 \times 10^{-15}$	33.118096
$3 \times 10^{-4}$	6.535197	$3 \times 10^{-9}$	15.353760	$3 \times 10^{-12}$	24.344317	$3 \times 10^{-15}$	33.401635
$2 \times 10^{-4}$	6.915542	$2 \times 10^{-9}$	15.747279	$2 \times 10^{-12}$	24.741981	$2 \times 10^{-15}$	33.801318
$1 \times 10^{-4}$	7.568353	$1 \times 10^{-9}$	16.420627	$1 \times 10^{-12}$	25.422064	$1 \times 10^{-15}$	34.484730



مع تمنياتي للجميع بالتوفيق