

University of Saskatchewan
EE 352 Communication Systems I

Quiz #3 – Apr.4/2003

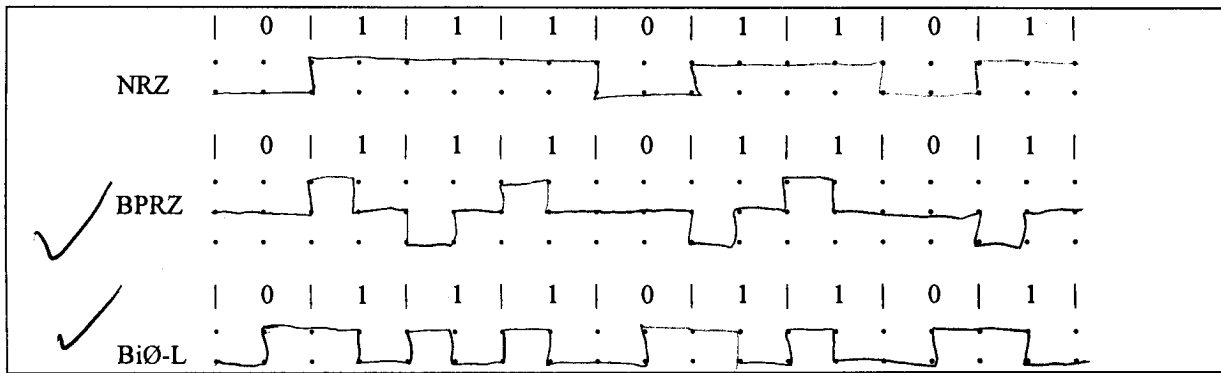
Time: 25 minutes

Permitted: - text, printed notes, student's own *hand-written* materials
Use the space below each question for your answer.

1 2
2 2
3 1 1/2
4 1 1/2
5 _____

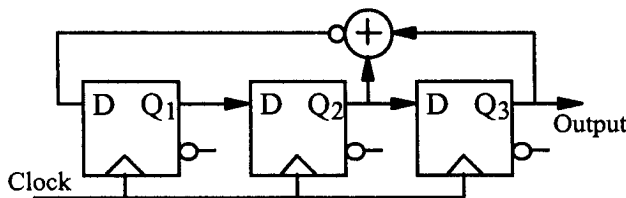
7/10

1 Illustrate non-return to zero (NRZ), bipolar return to zero (BPRZ) and Manchester (biphase-level) coding for the following binary sequence (2 pts)



*2 A three-stage shift register is connected to produce a pseudorandom binary sequence (PRBS). This is also known as a maximal length (ML) or pseudonoise (PN) sequence. Assume that the registers start in the all zero state (000) and that the output voltage levels are ± 2 volts. The clock frequency is 7 MHz (3 pts)

- 1) i) What is the length and bit pattern of the output sequence? How often does the sequence repeat?
- 1) ii) Sketch the two-sided spectrum (Fourier series) of the output. Calibrate the frequency and amplitude scales in your illustration and include units.
- ϕ iii) Calculate the power in the time domain. Consider Parseval's Theorem and estimate the power in the frequency domain up to the first spectral null.

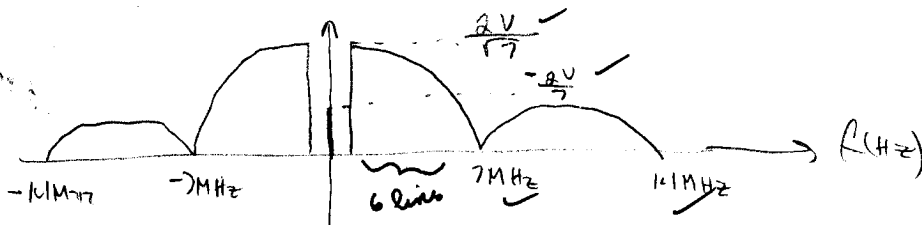


1) $2^3 - 1 = 8 - 1 = 7$ ✓

if $f_{clk} = 7 \text{ MHz}$ $T = \frac{1}{7 \text{ MHz}} = 142.85 \text{ ns}$

$7T = 1 \mu\text{s}$ repeat every $1 \mu\text{s}$ ✓

0	0	0	0
1	0	0	0
1	1	0	0
0	1	1	0
1	0	1	0
0	1	0	0
0	0	1	1



iii) power in time domain same as power in frequency domain with spectral 2V

*3 a) Complete the table below for digital transmission signals used in North America. (1 pt)

	DS1	DS1-C	DS3	STS-1
Number of voice signals	24 ✓	48 ✓	672	672
Transmission bit rate (Mb/s)	1.544	3.152	44.736 ✓	51.84 ✓
Number of bits per Multiframe (or STS-1 frame)	3316 ✓	1272	4760	6480
Duration of the Multiframe (us)	1500	1036 ✓	106.4	125
Number of framing bits per Multiframe (or STS-1 frame)	12 ✓	12	31	16 ✓
Checksum (truncated)	3853	1738	5614	7344

b) What is the probability that a given 16 bits of random data will resemble the STS-1 framing word? What is the probability that this pattern will occur at least once within the "random" data (or other overhead) portions of a 125 us STS-1 frame? (1 pt)

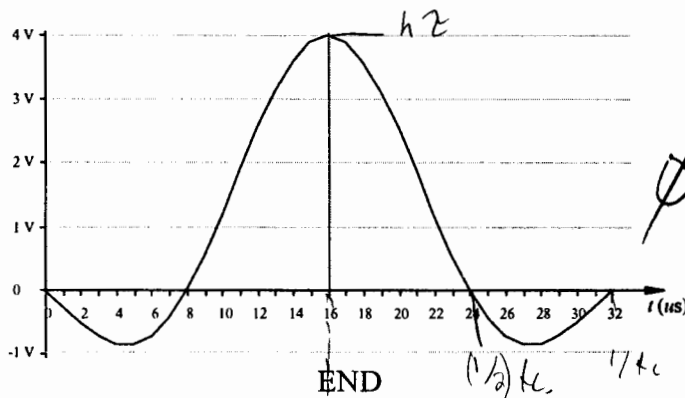
Bad wording

a) $P = 1 - (1 - 2^{-16})^{513} = 7.7 \times 10^{-3}$

b) $P_{FA} = 2^{-16} = 1.526 \times 10^{-6}$ ✓

*4 A transversal filter is constructed from a binary shift register with 16 taps. The transversal filter is arranged to generate an approximation to a single $\sin \pi f_b t / \pi f_b t$ pulse truncated at $t = 2/f_b$ where the bit rate $f_b = 100$ kb/s. The clock rate of the shift register is 4 times the bit rate thus each sidelobe of the time response has 4 samples and the main lobe has 8 samples. The peak voltage of the transmitted pulse is 4 volts. (3 pts)

- On scales below, sketch the time response of the filter output (i.e. the approximation).
- On a two-sided calibrated frequency axis, sketch the spectrum of the transmitted signal if the $\sin \pi f_b t / \pi f_b t$ pulse were not truncated.
- Approximately sketch the spectrum of the truncated transmitted pulse. Note that the transmitted pulse can be modeled as the product of a single $\sin \pi f_b t / \pi f_b t$ pulse and a gating pulse and that the resulting spectrum is the convolution of the two spectra in the product.



$t = T_A$

