ENGN3214 Telecommunication Systems
Quiz
10 May 2001
Worth 15%

1. Consider a deterministic test pattern consisting series of 2 binary 1’s followed by 3 binary 0’s sending through a communication channel using unipolar RZ binary signaling scheme. Let $T_b$ be the time to send one bit of data.

(a) sketch the transmitted signal. (1 mark)

(b) Determine the magnitude spectrum of the transmitted signal. Assume the high level of the unipolar RZ signal is $+A$ volts. (3 marks).

2. A binary unipolar RZ line code is converted to multilevel polar NRZ signal for transmission over a channel. Let the number of levels in multilevel signal is 16 and the pulse width of the binary unipolar RZ signal is 0.1 ms. (see Figure 2)

(a) What is the bit rate? (0.5 marks)

(b) What is the symbol rate (baud) of the multilevel signal? (1 mark)

(c) If the binary unipolar RZ $w_1(t)$ is given in Figure 2, then draw the corresponding 16-level polar NRZ signal $w_2(t)$. You may assume any 4-bit to symbol converter code, but state your assumption (3 marks)
3. A Quadrature Modulated (QM) signal $s(t)$ with a carrier frequency 3.8MHz has a complex envelope $g(t) = A_c[m_1(t) + jm_2(t)]$. Let $A_c = 10V$, and the modulation is 1kHz and 1.5kHz sinusoidal test tones given by $m_1(t) = 2\sin(2\pi1000t)$ and $m_2(t) = 3\sin(2\pi1500t)$. Evaluate the voltage spectrum of this QM signal. (2 marks)

![Block Diagram](image)

**Figure 3: Question 4**

4. A part of a communication system is given as a block diagram in Figure 3. Let $v_\text{in}(t) = A_c\cos(\omega_c t + D_f \int_{-\infty}^{t} m(\sigma)d\sigma)$ and $v_0(t) = A_0 \cos(\omega_c t + \theta_0)$.

(a) If the cut-off frequency of the Low pass filter (LPF) $f_{\text{cut}} \ll f_c$, find $v_{\text{out}}(t)$? (2 marks)

(b) Suppose $\theta_0 = \pi/2$ and $|\theta(t)| \ll \pi/2$, then show that

$$\frac{dv_{\text{out}}(t)}{dt} \approx \frac{1}{2}A_0 A_c D_f m(t)$$

(2 marks).

(c) Based on the above results, modify the block diagram in Figure 3, to get the modulation signal $m(t)$ as the final output. (0.5 marks)