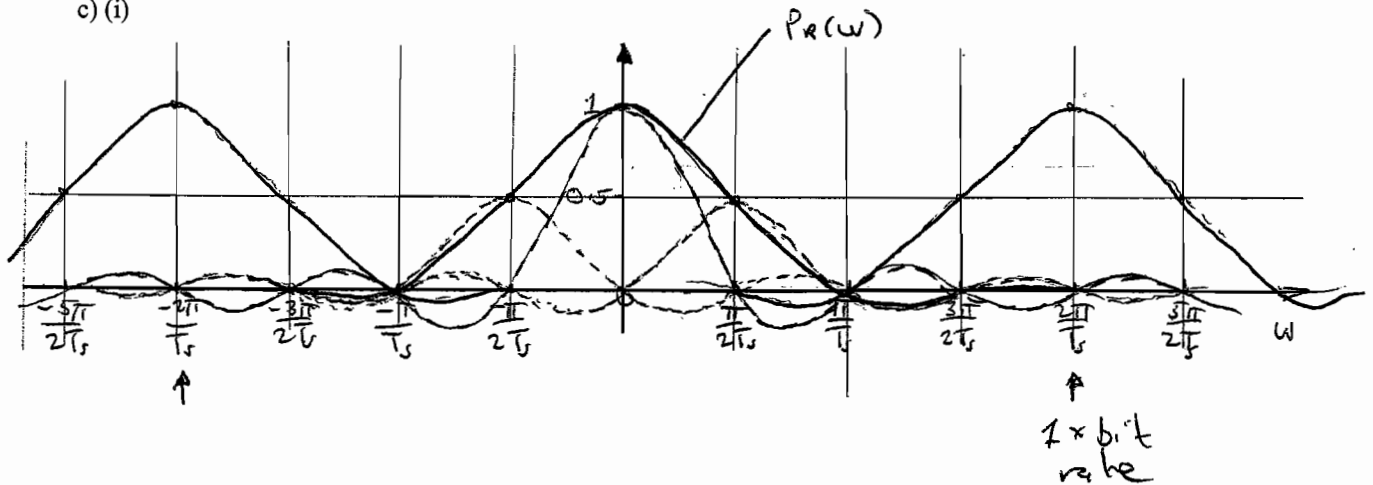


Engineering Triops Part 2A
Module 3F4. Data Transmission, May 2009 - Answers

1.
a) See notes.

b)
$$\sum_{k=-\infty}^{\infty} P_R \left(f - \frac{k}{T_s} \right) = \text{constant}$$

- c) (i)



(ii)
$$\frac{1}{2} \left(\frac{\pi^2}{T_s \omega (\pi^2 - 4T_s^2 \omega^2)} \right) \sin 2T_s \omega$$

d)
$$\frac{1}{4T_s}$$

2.
a) See notes.

b) (i)
$$G = \begin{bmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 \end{bmatrix}$$

- (ii) Detect 2 errors. Correct 1 error.
(iii) See notes.
(iv) See notes.

- 3.

a)
$$S(\omega) = \frac{1}{2} \left(P(\omega - \omega_c) + P^* (-(\omega + \omega_c)) \right)$$

b) (i)
$$|P(\omega)|^2 = 10T_s \operatorname{sinc}^2 \left(\frac{\omega T_s}{2} \right)$$

(ii)
$$|S(\omega)|^2 = \frac{5}{2} T_s \left[\operatorname{sinc}^2 \left(\frac{(\omega - \omega_c) T_s}{2} \right) + \operatorname{sinc}^2 \left(\frac{(\omega + \omega_c) T_s}{2} \right) \right]$$

- c) See notes

4.
a) See notes.

b) (i) $m = 3$.

(ii) For QPSK $u = 3$. For 32 MFSK $u = 6.358$.

$$\frac{\text{Power of QPSK}}{\text{Power of MFSK}} = \frac{11.97}{6.358} = 1.883 \approx 2.75\text{dB}$$

c) QPSK bandwidth = $\frac{1}{T_b}$ Hz. MFSK bandwidth = $\frac{33}{5T_b}$ Hz.

I. J. Wassell

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