

Engineering Triops Part 2A
Module 3F4. Data Transmission, May 2007- Answers

1. Attempted by all candidates and was generally well answered. The most common mistakes were to incorrectly calculate the eye height or to neglect to calculate the noise power after the equaliser when evaluating the equalised Bit Error Rate (BER).

a) See notes.

b)

$$H_E(z) = \frac{1}{P(z)} = \frac{1}{1 + 0.5z^{-1}}$$

Stability not guaranteed.

Numerical instability.

Adaptive methods hard to derive.

c)

(i) 1, -0.5, 0.25, -0.125

(ii) Without equaliser, BER = Q(1.25) = 0.1058. With equaliser, BER = Q(2.03) = 0.0212.

2. This was the second most popular question and was in general answered quite well. A surprising number of candidates could not correctly perform the BER calculation in part (c).

a) (i) and (ii) see notes.

b)

(i) See notes.

(ii)

$$H = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix} \quad G = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{bmatrix}$$

c) 2.923×10^{-3}

3. This question was in general very well answered. Surprisingly, part (a) proved to be troublesome for some of the candidates even though the solution is in the course notes.

a)

$$i'(t) = i(t) + i(t)\cos(2\omega_C t) - q(t)\sin(2\omega_C t)$$

$$q'(t) = q(t) - q(t)\cos(2\omega_C t) - i(t)\sin(2\omega_C t)$$

Low pass filtering is required to reject the high frequency terms.

b) (i) and (ii) see notes.

(iii) BPSK: $1/T_b$ Hz

QPSK: $1/(2T_b)$ Hz

16-QAM: $1/(4T_b)$ Hz

The widths of the main lobes of the spectra to the first zeros are twice these values.

c) See notes

4. This question was the least popular and also the least well answered. The descriptions of OFDM required in part (b) proved to be quite variable in detail and accuracy. In addition, part (d) proved to be problematic for a number of candidates.

a) See notes.

b) See notes.

c) 802.57 sym/s, total bit rate = 2.4655 Mbit/s, bandwidth = 1.536 MHz, including frequency guard bands gives a total bandwidth = 1.736 MHz, yielding a required bandwidth per audio channel of 289.3 kHz.

d) See notes.