Engineering Triops Part 2A
Module 3F4. Data Transmission, May 2005 - Answers

1. Generally well answered. Some candidates confused line coding with forward error correction (FEC) coding in part (a). A number of candidates made errors when calculating the power spectrum in part (b).

a) See notes.
b)

$$S_x(\omega) = \frac{0.08\pi}{T_s^2}\sum_{m=-\infty}^{\infty}\delta\left(\omega - m\frac{2\pi}{T_s}\right) + \frac{0.96}{T_s}$$

c)

$$S_y(\omega) = 0.08\pi\delta(\omega) + 0.96T_s\left|\text{sinc}\left(\frac{\omega T_s}{2}\right)\right|^2$$

2. This question was in general answered very well. In part (c) some errors were made when calculating the min eye opening and neglecting to take into account noise power enhancement with the equaliser in place.

a) See notes.
b)

$$H_E(z) = 1.25\times\frac{1}{1 - z^{-1}a_1 - z^{-2}a_2}$$

where $a_1 = 0.75$ and $a_2 = -0.125$

c)

$$H_E(z) = b_0 + b_1 z^{-1} + b_2 z^{-2}$$

where $b_0 = 1.25$, $b_1 = 0.9375$ and $b_2 = 0.5469$

BER without equalisation = Q(1) = 0.1587

BER with equalisation = Q(4.294) = 8.78×10^{-6}

3. This question was answered very poorly. Part (a) was generally answered quite well. Given the bookwork nature of part (b) the number of errors was surprising. Relatively few candidates appreciated what was required in part (c).

a) See notes.
b)

$$i(t) = u(t)\cos(\phi_0 - \phi_1) - v(t)\sin(\phi_0 - \phi_1)$$
$$q(t) = u(t)\sin(\phi_0 - \phi_1) + v(t)\cos(\phi_0 - \phi_1)$$

c) See notes.
d) See notes.

4. This question was answered reasonably well. Most difficulties were experienced with part (d) where the assumptions made and the design rational was generally not explained very clearly.

a) See notes.
b) Use M^2-QAM. See notes.
c) Use OFDM. See notes.
d) For a guard band of 10μs, an FFT analysis period of 100μs and for 64-QAM. Will need approx 800 tones (allowing for additional tones for phase and amplitude references). Gives a total bandwidth of $800\times10\text{kHz} = 8\times10^6\text{Hz} = 8\,\text{MHz}$