

4F8 2015 Answers:

- 1 (a) (i) $G(\omega_1, \omega_2) = 2Aab \operatorname{sinc} b\omega_2 \operatorname{sinc} \frac{a\omega_1}{2} [1 + 2\cos 2a\omega_1 + 2\cos 4a\omega_1]$
(ii) Sampling period should be $\leq a/6$ (approx).

- (b) (i) –
(ii) $W_1(\omega_1) = U_1 \operatorname{sinc}^2 \frac{\omega_1 U_1}{2}$; $W(\omega_1, \omega_2) = U_1 U_2 \operatorname{sinc}^2 \frac{\omega_1 U_1}{2} \operatorname{sinc}^2 \frac{\omega_2 U_2}{2}$
(iii) –

- 2 (a) (i) $y(\mathbf{n}) = \sum_{\mathbf{m} \in \mathbb{Z}^2} h(\mathbf{m})x(\mathbf{n} - \mathbf{m}) + d(\mathbf{n})$
(ii) –
(iii) $G(\omega) = \frac{H^*(\omega)P_{xx}(\omega)}{|H(\omega)|^2 P_{xx}(\omega) + P_{dd}(\omega)}$

- (b) (i) $\alpha_0 = 2, \alpha_1 = 18, \alpha_2 = 25$
(ii) –

- 3 (a) –

- (b) –

- (c) $7.33 \cdot 10^6$ bits

- (d) It costs 23% more bits to include colour.

- 4 (a) –

- (b) 13 subbands; 3 subbands of size $\frac{N}{2} \times \frac{N}{2}$, 3 subbands $\frac{N}{4} \times \frac{N}{4}$, 3 subbands $\frac{N}{8} \times \frac{N}{8}$, and 4 subbands $\frac{N}{16} \times \frac{N}{16}$.

- (c) –

- (d) The coefs of the filters are:

$$H_0(z) H_1(z^2): \frac{1}{16} \{1 \ -2 \ -8 \ 2 \ 14 \ 2 \ -8 \ -2 \ 1\}$$

$$G_0(z) G_1(z^2): \frac{1}{16} \{-1 \ -2 \ -3 \ -4 \ 4 \ 12 \ 4 \ -4 \ -3 \ -2 \ -1\}$$

- (e) Do not swap the filters.