Module 3F1, April 2005 – SIGNALS AND SYSTEMS – Answers

1   (a) Stable.

     (c) $A_{max} \approx \frac{10}{\sqrt{1.81}}$

        $\Phi_{max} \approx -\frac{\pi}{4}$

     (d) $y_k \approx \frac{20}{\sqrt{1.81}} \cos(\frac{\pi}{4}k - \frac{\pi}{4})$

     (e) Bandwidth approximately covers the range $\pi/4 \pm 0.1$

2   (a) (i) $K_1 < -3$ or $K_1 > -1$

        (ii) $\lim_{k \to \infty} e_k = \frac{1}{K_1 + 1}$

        (iii) $K_1 < -101$ or $K_1 > 99$

3   (b) $r_{YY}(\tau) = \rho \int_{-\infty}^{\infty} h(\beta_1)\, h(\tau + \beta_1)\, d\beta_1 = \rho\, h(\tau) * h(-\tau)$

     (c) $r_{YY}(\tau) = \frac{\rho}{2T} \exp\left(\frac{-|\tau|}{T}\right)$

     (d) $\mathcal{S}_Y(\omega) = \frac{\rho}{1 + \omega^2 T^2}$

4   (b) $H(S_i) = 1.245$, $H(X_i) = 0.722$, $I(X_i; S_i) = 0.522$

     (c) $\eta = 0.8893$, and tends towards unity if order of source increases.

     (d) $H(S_1, S_2, X_1, X_2) = 2.168$