2.4) $E[x(n)] = -P + (1-P) = 1-2P$

each realization independently happens $\rightarrow$ $E[x(n)\,x(m)] \overset{n\neq m}{=} E[x(n)]\,E[x(m)]$

$= (1-2P)^2$

$\Rightarrow E[y(n)] = (1-2P)^2 = m_y$

$r_y(k) = E[\,y(n)\,y(n+k)] = E[x(n)x(n-1)\,x(n+k)\,x(n+k-1)]$

$k=0 \Rightarrow r_y(0) = \underbrace{E[x(n)^2]}_{1}\,E[x(n-1)^2] = 1\times 1 = 1$

$k=1 \Rightarrow r_y(1) = E[x(n)^2]\,E[x(n-1)]\,E[x(n+1)] = (1-2P)^2 = r_y(-1)$

$|k|\geqslant 2 \Rightarrow r_y(k) = E[x(n)]\,E[x(n-1)]\,E[x(n+k)]\,E[x(n+k-1)] = (1-2P)^4$

2.8) $E[z(n)z(n+k)] = E[x^2\cos(2\pi\nu n)\cos(2\pi\nu(n+k)) + xy\,\sin(2\pi\nu n)\cos(2\pi\nu(n+k))$
$+ xy\,\sin(2\pi\nu(n+k))\cos(2\pi\nu n) + y^2\,\sin(2\pi\nu n)\sin(2\pi\nu(n+k))]$

$= \underbrace{\tfrac{1}{2}\cos(2\pi\nu(2n+k))}_{\text{function of } n}(\sigma_x^2 - \sigma_y^2) + \tfrac{1}{2}\cos(2\pi\nu k)(\sigma_y^2 + \sigma_x^2) + 0$

function of n $\Rightarrow$ for $z(n)$ to be WSS $\Rightarrow \sigma_x^2 = \sigma_y^2$

$E[z(n)] = 0$

if $\sigma_x^2 = \sigma_y^2 \Rightarrow R_z(k) = \sigma_x^2\cos(2\pi\nu k)$

2.10) $z(t) > 0 \Rightarrow g(x(t), y(t)) = 1 \Rightarrow x(t) \geqslant y(t)$

$P_r(x(t) \geqslant y(t)) = P_r(\underbrace{x(t) - y(t)}_{U(t)} \geqslant 0)$

$U(t) \rightarrow$ Gaussian because linear combination of independent Gaussian r.v.

$m_U = m_x - m_y = -2$

$\sigma_U^2 = E[(x(t)-y(t))^2] - 4 = \sigma_x^2 + \sigma_y^2 - 2m_x m_y - 4 + m_x^2 + m_y^2 \overset{\circ}{=} 4 + 16 - 6 - 4 + 1 + 9 = 20$

$P(U(t) \geqslant 0) = Q\left(\frac{0-(-2)}{\sqrt{20}}\right) = Q\left(\frac{2}{\sqrt{20}}\right)$

★ note: $Q(x) = \int_x^{\infty} \frac{1}{\sqrt{2\pi}} e^{-t^2/2}\,dt$