MECH 6325 HW 1 Intro. $\theta_1, \theta_2 = U[0, 2\pi]$

15) a) $X(t) = \cos(\omega_0 t + \theta_1)\cos(\omega_0 t + \theta_2)$

$$E[X(t)] = \int_0^{2\pi}\int_0^{2\pi} \cos(\omega_0 t + \theta_1)\cos(\omega_0 t + \theta_2)\left(\frac{d\theta_1}{2\pi}\right)\left(\frac{d\theta_2}{2\pi}\right)$$

$$= \left(\frac{1}{2\pi}\int_0^{2\pi} \cos(\omega_0 t + \theta_1)\, d\theta_1\right)\left(\frac{1}{2\pi}\int_0^{2\pi} \cos(\omega_0 t + \theta_2)\, d\theta_2\right)$$

$$\sin(\omega_0 t + \theta_1)\Big|_0^{2\pi} = 0 \qquad \sin(\omega_0 t + \theta_2)\Big|_0^{2\pi} = 0$$

$$\boxed{E[x(t)] = \bar{x} = 0}$$

$$R_x(t_1, t_2) = E[X(t_1)X(t_2)]$$

$$= E[\cos(\omega_0 t_1 + \theta_1)\cos(\omega_0 t_1 + \theta_2)\cos(\omega_0 t_2 + \theta_1)\cos(\omega_0 t_2 + \theta_2)]$$

$$= E[\cos(\omega_0 t_1 + \theta_1)\cos(\omega_0 t_2 + \theta_1)] + \ldots$$

$$= \int_0^{2\pi} \cos(\omega_0 t_1 + \theta_1)\cos(\omega_0 t_2 + \theta_1)\left(\frac{1}{2\pi}\right) d\theta_1 + \ldots$$

$$\boxed{R_x(t_1, t_2) = 2\pi \cos(\omega_0(t_1 - t_2)) + \ldots}$$