3c

· Mean of $X_t = \sin\left(\frac{2\pi}{100}t + \phi\right)$; $\phi \sim U(-\pi, \pi)$

$$E(X_t) = \int_{-\pi}^{\pi} \sin\left(\frac{2\pi t}{100} + \phi\right) \frac{1}{2\pi} d\phi$$

$$= \frac{1}{2\pi} \int_{-\pi}^{\pi} \sin\left(\frac{2\pi t}{100} + \phi\right) d\phi$$

$$= \frac{1}{2\pi} \int_{-\pi}^{\pi} \sin\left(\frac{2\pi}{100}t + \phi\right) d\phi$$

$$= \frac{1}{2\pi} \left\{ -\cos\left(\frac{2\pi}{100}t + \phi\right) \Big|_{-\pi}^{\pi} \right\}$$

$$= 0$$

Now Consider $X_t = \sin\left(\frac{2\pi}{100}t + \phi\right)$; $\phi \sim U(0, \pi)$

$$E(X_t) = \int_{0}^{\pi} \sin\left(\frac{2\pi}{100}t + \phi\right) \frac{1}{\pi} d\phi$$

$$= \frac{1}{\pi} \int_{0}^{\pi} \sin\left(\frac{2\pi}{100}t + \phi\right) d\phi$$

$$= \frac{1}{\pi} \quad -\cos\left(\frac{2\pi}{100}t + \phi\right) \Big|_{0}^{\pi}$$

$$= \frac{1}{\pi} \; 2\cos\left(\frac{2\pi}{100}t\right) = \frac{2}{\pi} \cos\left(\frac{2\pi}{100}t\right)$$

So for 3(a) mean is not a function of time

But for 3(b) " is a function of time.