GATE ASSIGNMENT 3

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Download all latex codes from

https://github.com/sachinkarumanchi/EE3900/tree/main/Gateassignment3/Gateassignment3.tex

GATE EC 2005 Q.61

A signal $x(n) = sin(\omega_0 n + \phi)$ is the input to a linear time- invariant system having a frequency response $H(e^{j\omega})$. If the output of the system $Ax(n - n_0)$ then the most general form of $\angle H(e^{j\omega})$ will be
(a)$-n_0\omega_0 + \beta$ for any arbitrary real β
(b)$-n_0\omega_0 + 2\pi k$ for any arbitrary integer k
(c)$n_0\omega_0 + 2\pi k$ for any arbitrary integer k
(d)$-n_0\omega_0 + \phi$

Solution

From the given question

$$y(n) = Ax(n - n_0) \tag{0.0.1}$$

Now Taking the Fourier Transfrom

$$Y(e^j\omega) = Ae^{-j\omega_0 n_0}X(e^j\omega) \tag{0.0.2}$$

$$H(e^j\omega) = \frac{Y(e^j\omega)}{X(e^j\omega)} \tag{0.0.3}$$

$$\implies H(e^j\omega) = Ae^{-j\omega_0 n_0} \tag{0.0.4}$$

Therefore, $\angle H(e^{j\omega}) = -\omega_0 n_0$
For LTI discrete time system phase and frequency of $H(e^{j\omega})$ are periodic with period 2π
So in general form would be

$$\theta(\omega) = -n_0\omega_0 + 2\pi k \tag{0.0.5}$$

Hence, Option (B) is correct