Gate Assignment 3

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Download all python codes from

https://github.com/Adarsh541/EE3900/blob/main/Gate3/codes/Gate3.py

Download latex-tikz codes from

https://github.com/Adarsh541/EE3900/blob/main/Gate2/Gate3.tex

1 Problem(Gate EC 2005 Q.23)

The power in the signal $s(t) = 8\cos\left(20\pi t - \frac{\pi}{2}\right) + 4\sin(15\pi t)$ is

1) 40
2) 41
3) 42
4) 82

2 Solution

Lemma 2.1. *If two sinusoids have sufficiently different frequencies, the power of the sum is the sum of powers.*

Theorem 2.2. *The power of a sinusoidal signal $x(t) = A\sin(2\pi ft)$ is $\frac{A^2}{2}$.*

Proof.

$$P = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} (x(t))^2\, dt \tag{2.0.1}$$

$$\int_{-T}^{T} (x(t))^2\, dt = \int_{-T}^{T} \left(\sin(2\pi ft)\right)^2 dt \tag{2.0.2}$$

$$= \int_{-T}^{T} \frac{A^2}{2}\left(1 - \cos(4\pi ft)\right) dt \tag{2.0.3}$$

$$= \left[\frac{A^2}{2}\left(t - \frac{\sin(4\pi ft)}{4\pi ft}\right)\right]_{-T}^{T} \tag{2.0.4}$$

$$= A^2 T \tag{2.0.5}$$

$$\implies P = \lim_{T\to\infty} \frac{1}{2T}\left(A^2 T\right) \tag{2.0.6}$$

$$= \frac{A^2}{2} \tag{2.0.7}$$

□

$$s(t) = 8\cos\left(20\pi t - \frac{\pi}{2}\right) + 4\sin(15\pi t) \tag{2.0.8}$$

$$= 8\sin(20\pi t) + 4\sin(15\pi t) \tag{2.0.9}$$

From lemma-2.1 and Theorem-2.2, power in $s(t)$ is

$$P = \frac{8^2}{2} + \frac{4^2}{2} \tag{2.0.10}$$

$$= 40 \tag{2.0.11}$$

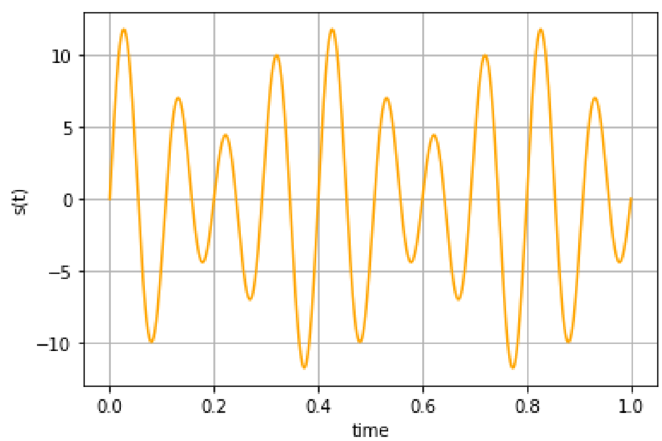

Fig. 4: Plot of $s(t)$.