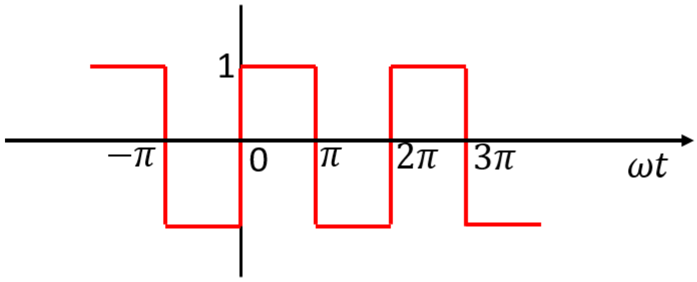
ME756A: Principles of Vibration Control

Self-assessment assignment

Q1. Determine the Fourier series for the wave shown below.

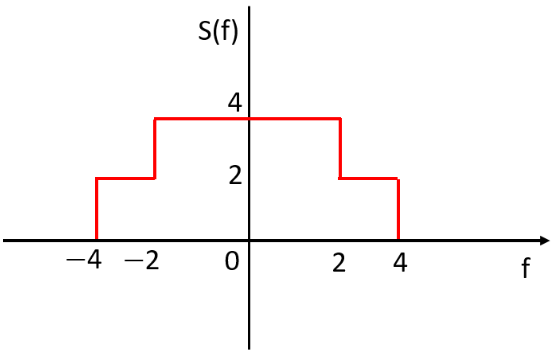


If the origin is shifted to the right by $\frac{\pi}{2}$, determine the new Fourier series.

Ans: (a) $x(t) = \frac{4}{\pi}(sin\omega t + \frac{1}{3}sin3\omega t + \frac{1}{5}sin5\omega t + \cdots)$

(b) $x(t) = \frac{4}{\pi}(cos\omega t - \frac{1}{3}cos3\omega t + \frac{1}{5}cos5\omega t - \cdots)$

Q2. The figure below shows the Power Spectral Density (PSD) of the signal x(t). Find out its average power.



Ans: 24 units

Q3. Consider a random process X(t) with

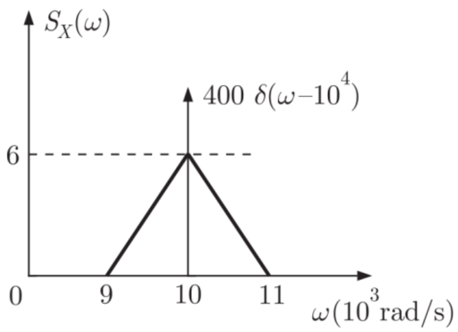
$$R_X(\tau) = e^{-a|\tau|}$$

Where **a** is a positive real number.

Find PSD of X(t).

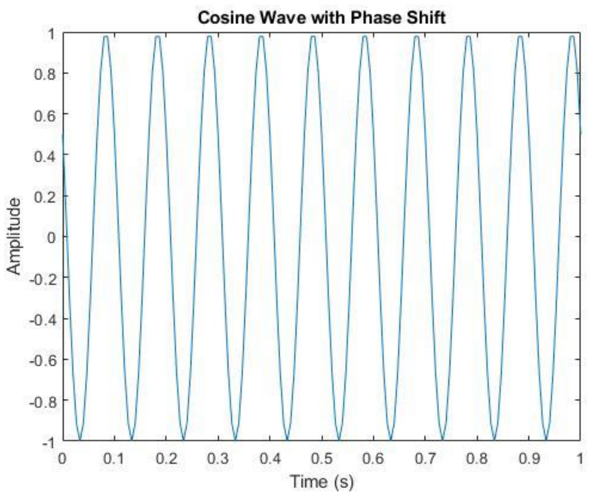
Ans: $\boldsymbol{\frac{2a}{a^2+4\pi^2 f^2}}$

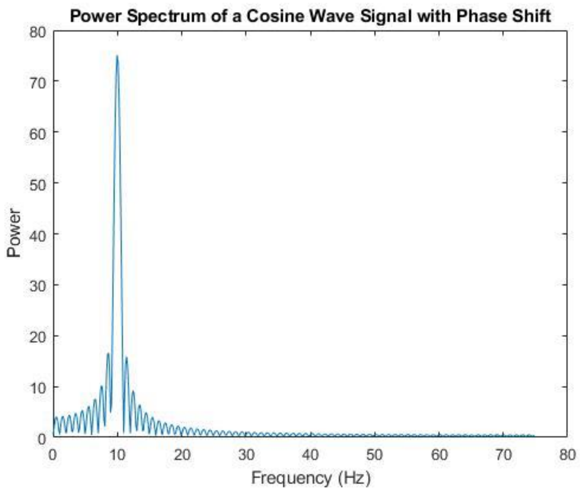
Q4. The power spectral density of a real process X(t) for positive frequencies is shown below. The values of $E[X^2(t)]$ and $E[X(t)]$ are



Ans: $\frac{6400}{\pi}$ *and Zero*

Q5. The code below shows the Cosine Wave with Phase Shift and its power spectrum. Now, generate a **square wave** and **chirp signal** and try to plot their respective power spectrum.






```
Fs = 150; % Sampling frequency
t = 0:1/Fs:1; % Time vector of 1 second
f = 10; % Create a wave of f Hz.
pha = 1/3*pi; % phase shift
x = cos(2*pi*t*f + pha);
nfft = 1024; % Length of FFT
% Take fft, padding with zeros so that
length(X) is equal to nfft
X = fft(x,nfft);
% FFT is symmetric, throw away second half
X = X(1:nfft/2);
% Take the magnitude of fft of x
mx = abs(X);
% Frequency vector
f = (0:nfft/2-1)*Fs/nfft;
% Generate the plot, title and labels.
figure(1);
plot(t,x);
title('Cosine Wave with Phase Shift');
xlabel('Time (s)');
ylabel('Amplitude');
figure(2);
plot(f,mx);
title('Power Spectrum of a Cosine Wave Signal with Phase Shift');
xlabel('Frequency (Hz)');
ylabel('Power');
```