Decompose the following equation using any Discrete Fourier Transform code. Use a sample rate of .001 over the time interval [0, 10].

$$3\sin(8\pi t)+6\sin(9\pi t)+8\sin(4\pi t)$$

a. Show your DFT code used to decompose the curve above. What are the three frequencies contained in this curve? What are their amplitudes?

Ans:
Python code to perform DFT using FFT:-

```
import numpy as np
import matplotlib.pyplot as plt
fs = 1000  # Sampling rate (Hz)
T = 10  # Duration of the signal (seconds)
t = np.linspace(0, T, fs*T)
y = 3 * np.sin(8 * np.pi * t) + 6 * np.sin(9 * np.pi * t) + 8 * np.sin(4 * np.pi * t)
N = len(y)
dft_y = np.fft.fft(y)
frequencies= np.fft.fftfreq(N, d=1/fs)  # Compute frequency bins
```

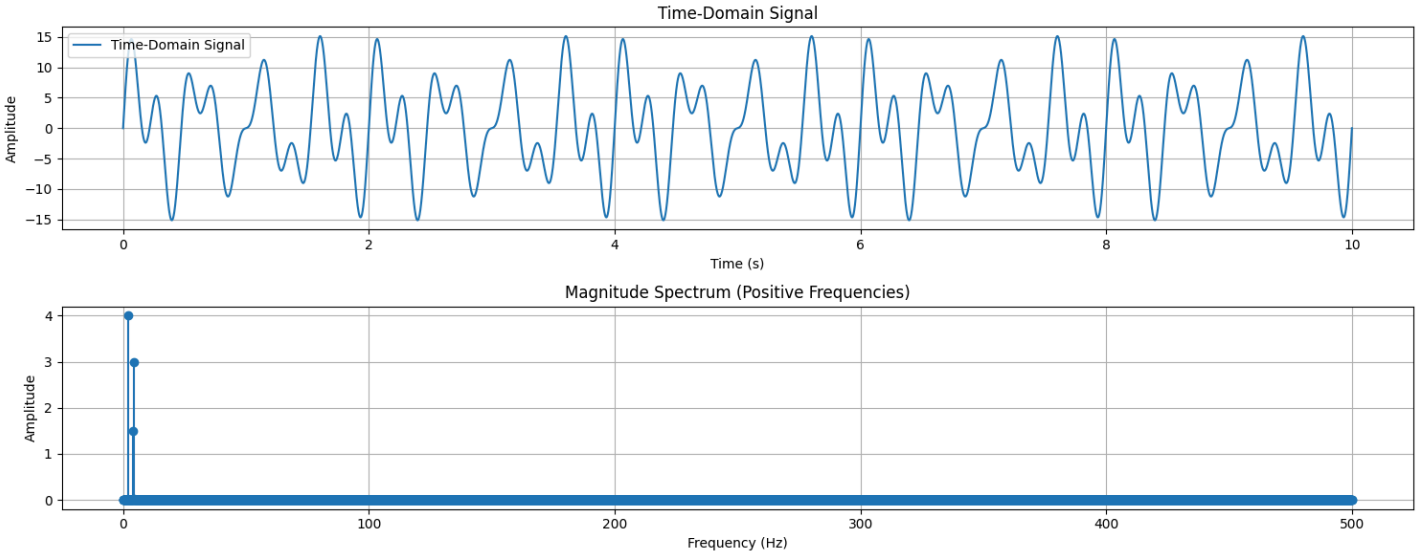
Frequencies contained in this curve:-

```
magnitude = np.abs(dft_y) / N  # Normalize the magnitude
# Separate positive and negative frequencies because DFT is symmetric around 0 with N/2 data points on # each side
positive_freq_idx = np.where(frequencies >= 0)  # Filter positive frequencies
frequencies_pos = frequencies[positive_freq_idx]  # Positive frequencies
magnitude_pos = magnitude[positive_freq_idx]  # Corresponding magnitudes
mag_idx = np.where(magnitude_pos > 1)
print("frequencies contained in this curve: ", frequencies_pos[mag_idx])
print("Their amplitudes: ", magnitude_pos[mag_idx])
```

```
frequencies contained in this curve:  [2.  4.  4.5]
Their amplitudes:  [4.00030586 1.50189098 2.99803523]
```

b. Plot the curve. Then plot the results of the DFT with appropriate amplitude and frequency.

Ans:


Time-Domain Signal
Time-Domain Signal
Amplitude
Time (s)
Magnitude Spectrum (Positive Frequencies)
Amplitude
Frequency (Hz)