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BL.EN.U4AIE21044

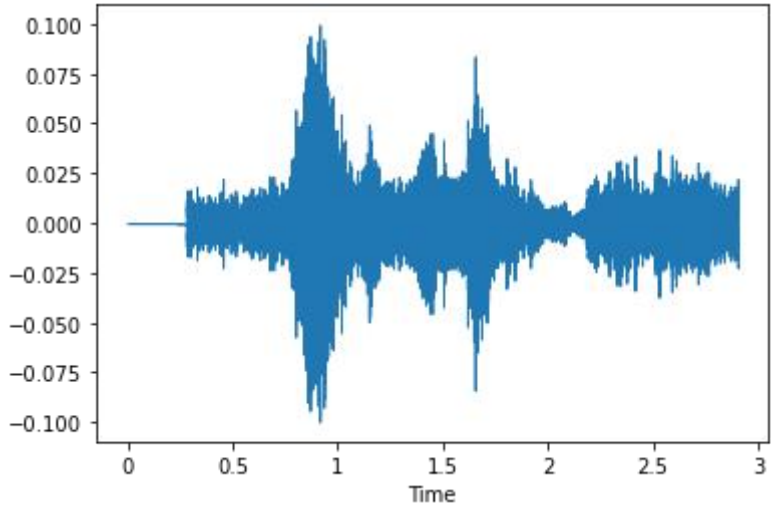
AIE - D

Lab - 6

In [34]:
```
import numpy as np
import librosa
import matplotlib.pyplot as plt
import IPython.display as ipd
import scipy.signal as signal
import scipy.io.wavfile as wavfile
from glob import glob
import seaborn as sns
from scipy.signal import spectrogram
```

In [35]:
```
y, sr = librosa.load('Abdulla.mp3')
librosa.display.waveshow(y)
```

Out[35]:
```
<librosa.display.AdaptiveWaveplot at 0x1ddedd66520>
```



In [36]:
```
a = glob('Abdulla.mp3')
ipd.Audio(a[0])
```

Out[36]:

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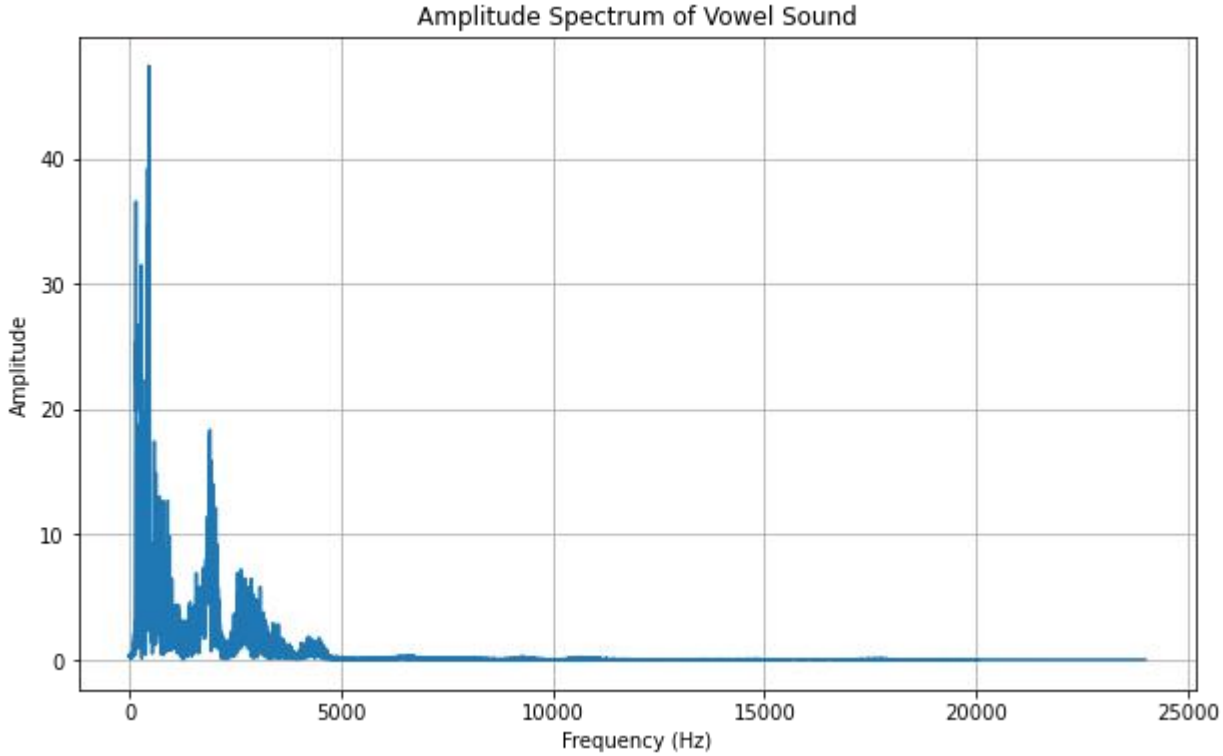
A1.Take a portion of your recorded signal which represents a vowel sound. Perform FFT on the signal snippet and observe the amplitude spectrum. Repeat the same for a few vowelsounds.

In [37]:
```
# Load MP3 file
audio_file = 'Abdulla.mp3'
signal, sample_rate = librosa.load(audio_file, sr=None, mono=True)

# Select a portion of the signal
start_time = int(0.5 * sample_rate)
end_time = int(1.0 * sample_rate)
vowel_sound = signal[start_time:end_time]

# Perform FFT
fft_result = np.fft.fft(vowel_sound)
frequency_bins = np.fft.fftfreq(len(fft_result), 1/sample_rate)
amplitude_spectrum = np.abs(fft_result)

# Plot the amplitude spectrum
plt.figure(figsize=(10, 6))
plt.plot(frequency_bins[:len(frequency_bins)//2], amplitude_spectrum[:len(frequency_bins)//2])
plt.title('Amplitude Spectrum of Vowel Sound')
plt.xlabel('Frequency (Hz)')
plt.ylabel('Amplitude')
plt.grid(True)
plt.show()
```



In [38]:
```
def plot_fft_and_play(signal, title, sr):
    # Plot FFT
    fft_result = np.fft.fft(signal)
    plt.figure(figsize=(12, 6))
    plt.plot(np.abs(fft_result))
    plt.title(title)
    plt.xlabel('Frequency (Hz)')
    plt.ylabel('Magnitude')
    plt.show()

    # Play audio
    ipd.display(ipd.Audio(signal, rate=sr))
```

In [48]:
```
# Vowel sounds
vowel_a = y[10000:16000]
plot_fft_and_play(vowel_a, "FFT of the Vowel 'A'", sr)
vowel_i = y[12700:19000]
plot_fft_and_play(vowel_i, "FFT of the Vowel 'I'", sr)
vowel_e = y[19000:26000]
plot_fft_and_play(vowel_e, "FFT of the Vowel 'E'", sr)
vowel_o = y[24000:31000]
plot_fft_and_play(vowel_o, "FFT of the Vowel 'O'", sr)
```

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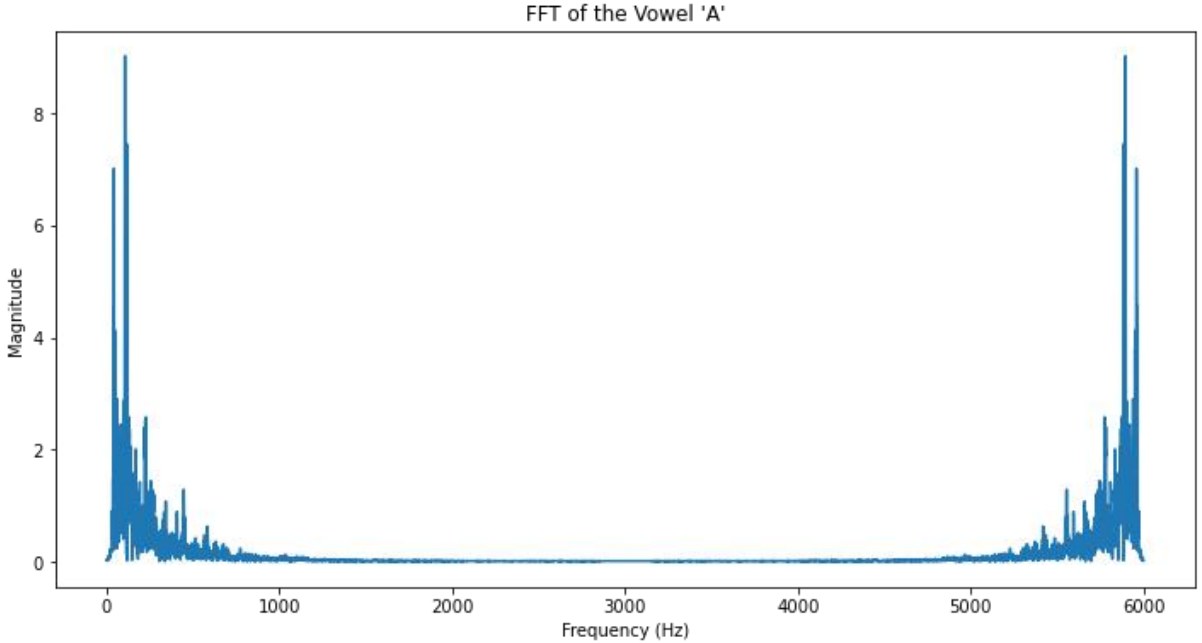
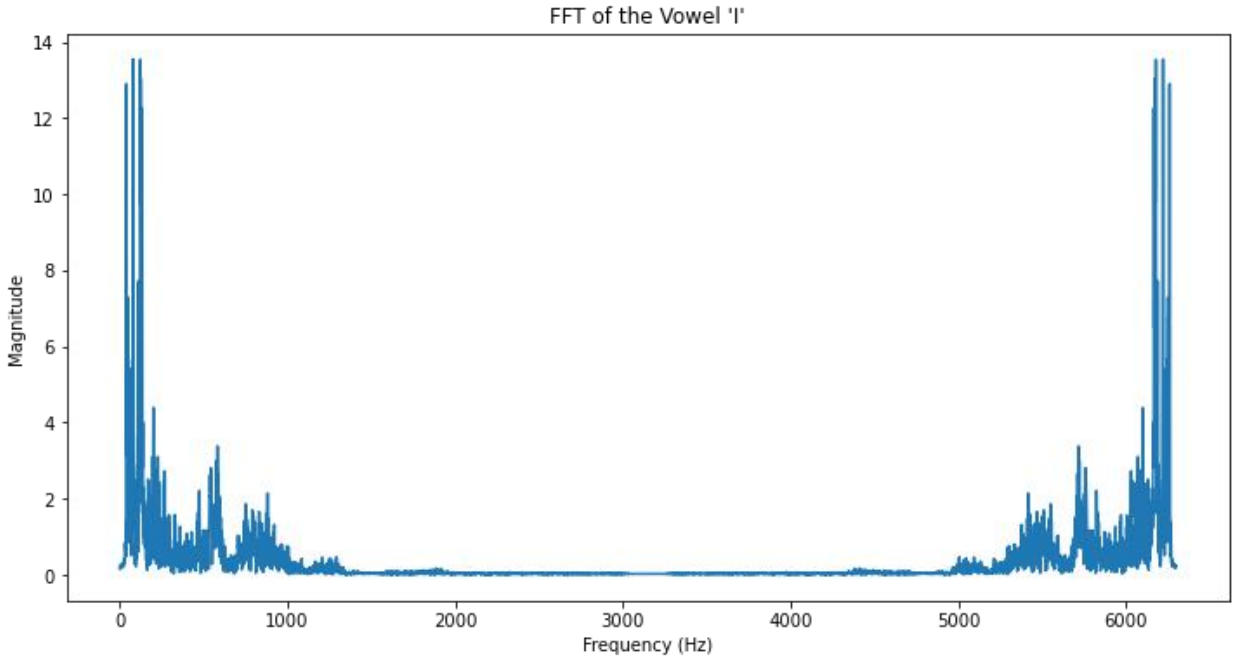
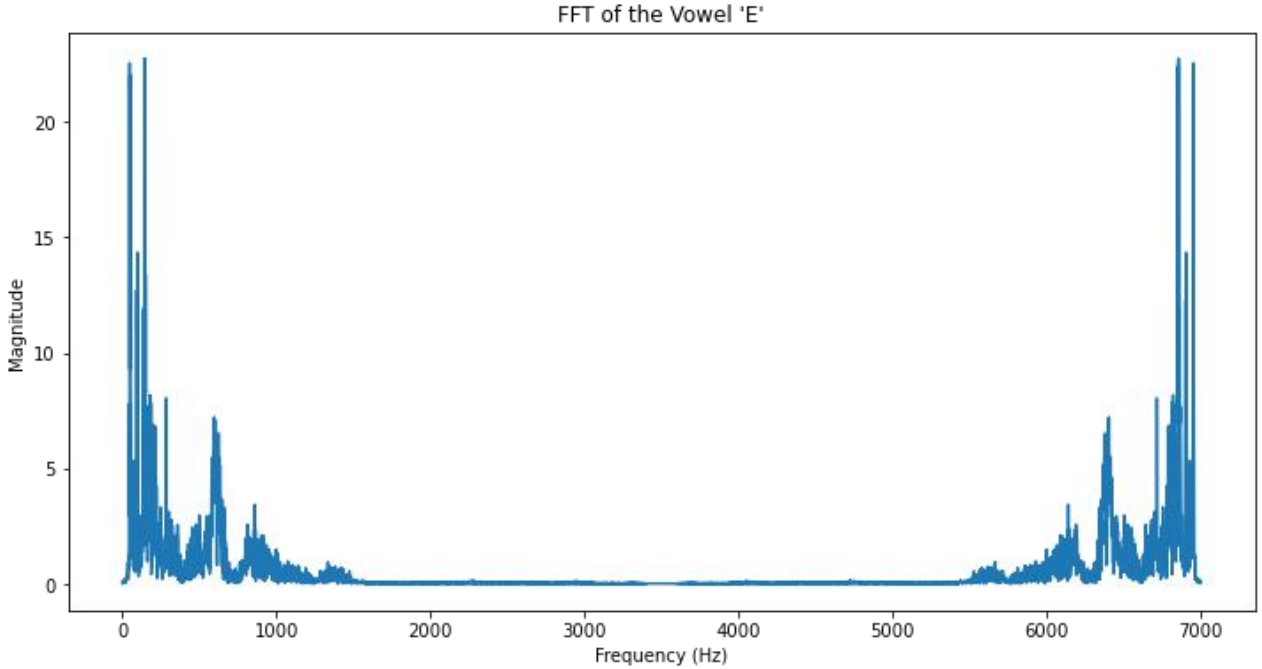
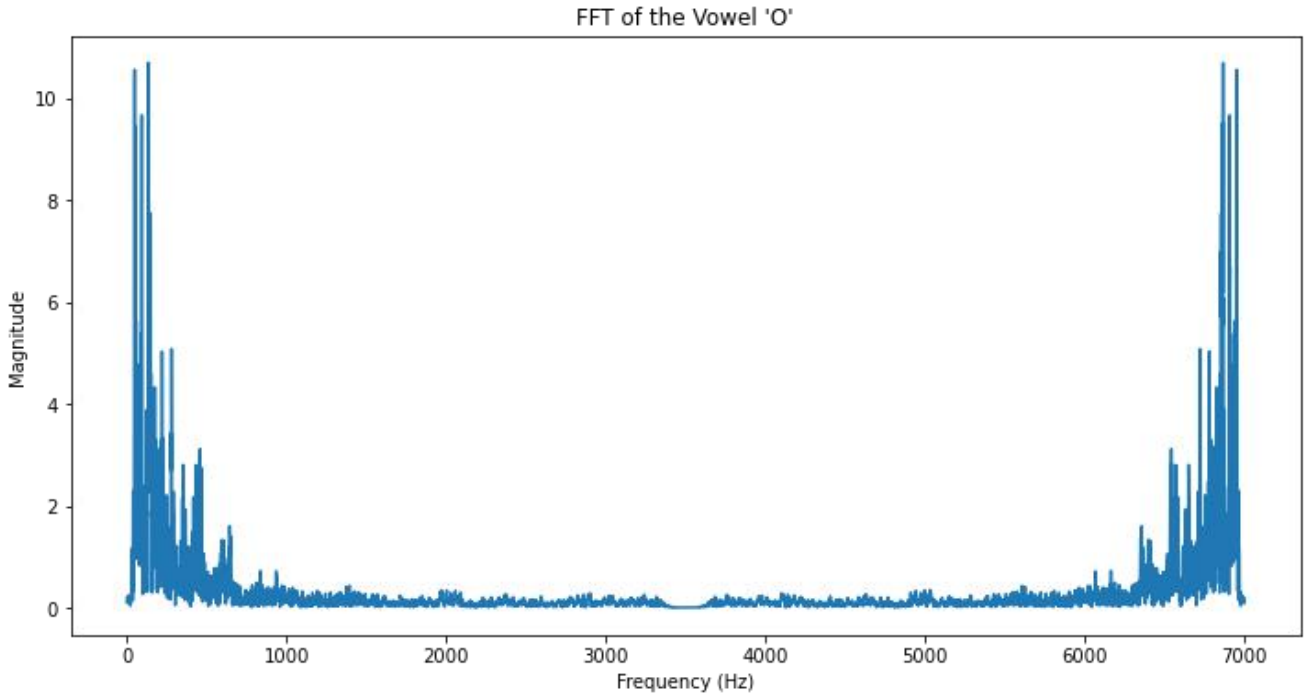



FFT of the Vowel 'I'
Magnitude
Frequency (Hz)
0
2
4
6
8
10
12
14
0
1000
2000
3000
4000
5000
6000


FFT of the Vowel 'E'
Magnitude
Frequency (Hz)
0
5
10
15
20
0
1000
2000
3000
4000
5000
6000
7000


FFT of the Vowel 'O'
Magnitude
Frequency (Hz)
0
2
4
6
8
10
0
1000
2000
3000
4000
5000
6000
7000

A2. Repeat the A1 for a consonant sound. Perform the same for a few consonant sounds.

In [49]:
```
# Consonant sounds
consonant_p = y[18000:26000]
plot_fft_and_play(consonant_p, "FFT of the Consonant 'P'", sr)
consonant_s = y[16000:22000]
plot_fft_and_play(consonant_s, "FFT of the Consonant 'S'", sr)
consonant_h = y[24000:31000]
plot_fft_and_play(consonant_h, "FFT of the Consonant 'H'", sr)
consonant_c = y[18000:25000]
plot_fft_and_play(consonant_c, "FFT of the Consonant 'C'", sr)
consonant_n = y[16000:23000]
plot_fft_and_play(consonant_n, "FFT of the Consonant 'N'", sr)
```

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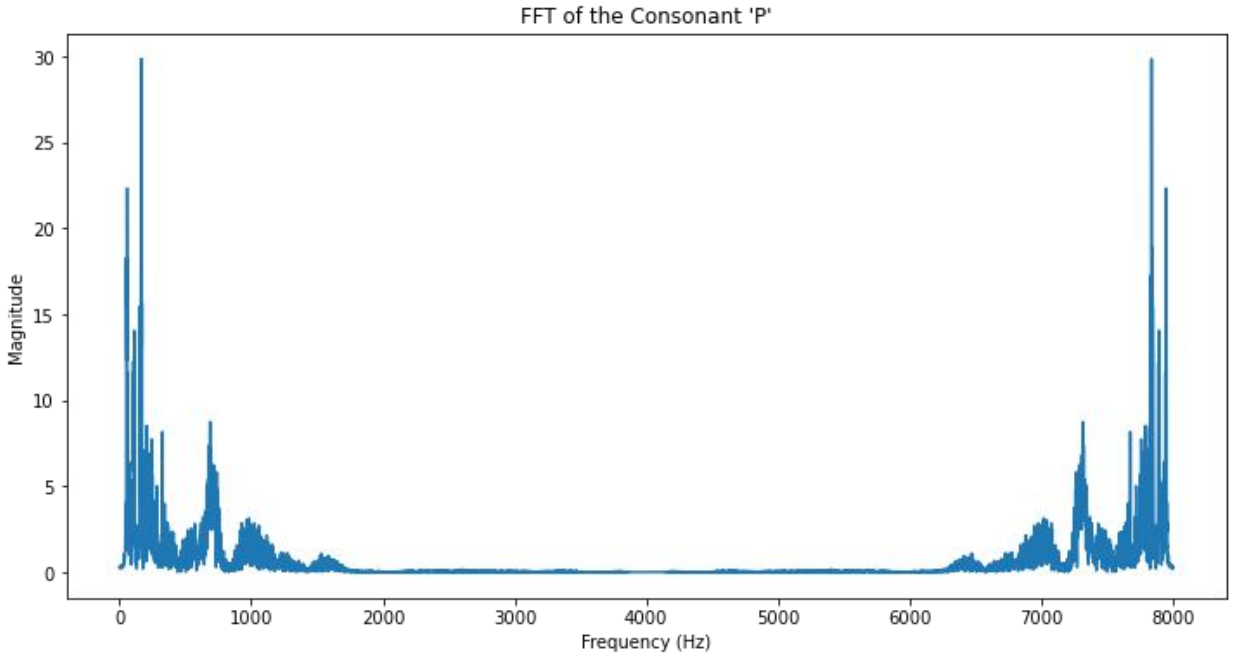
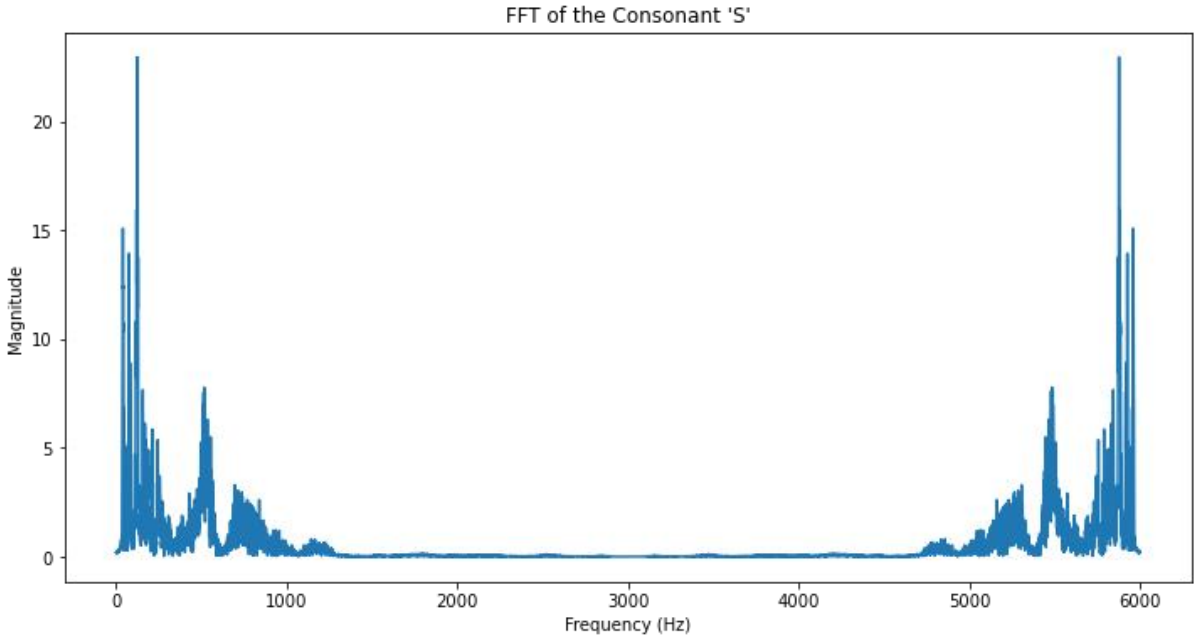
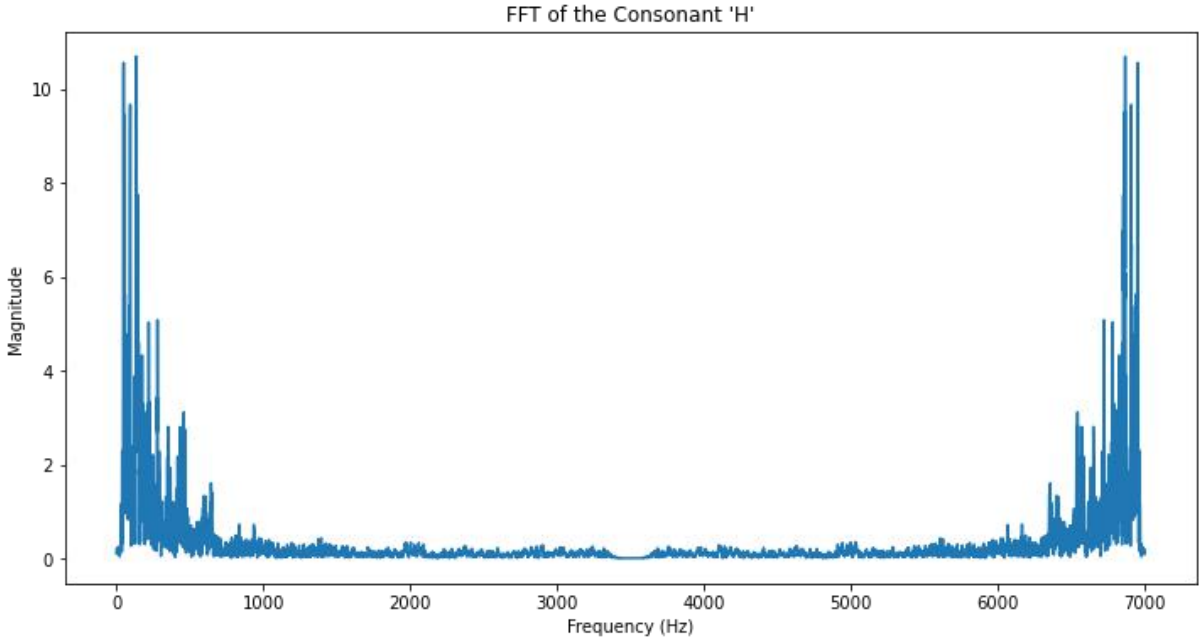
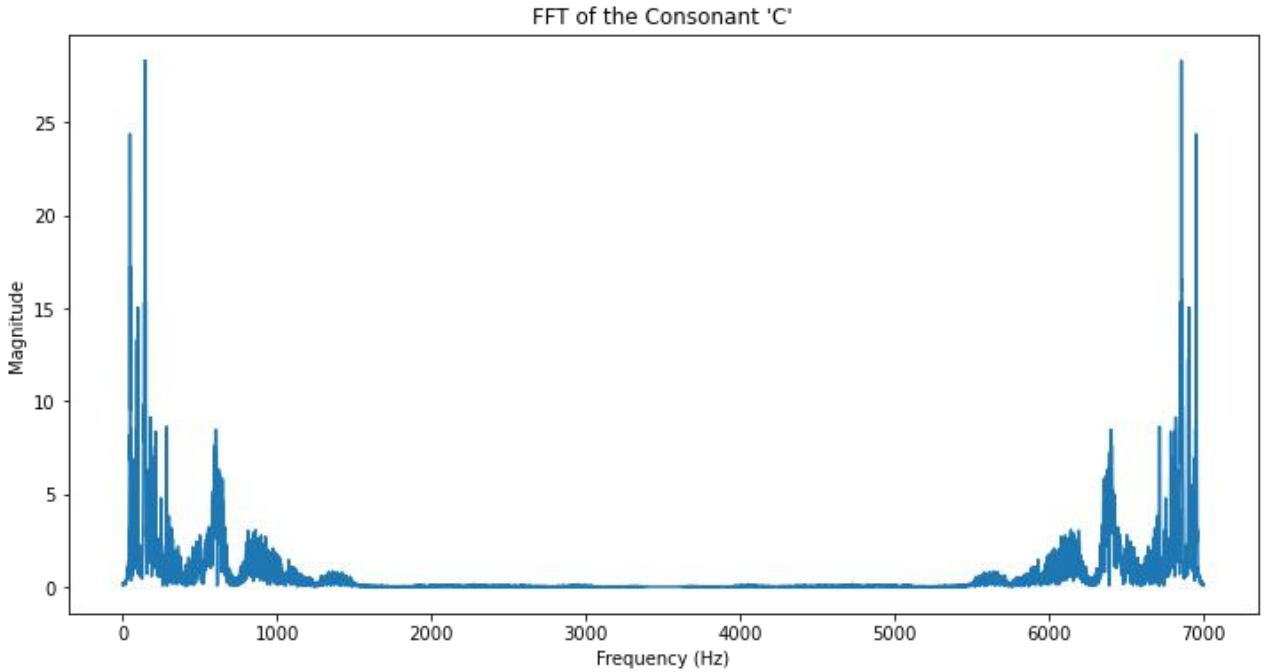
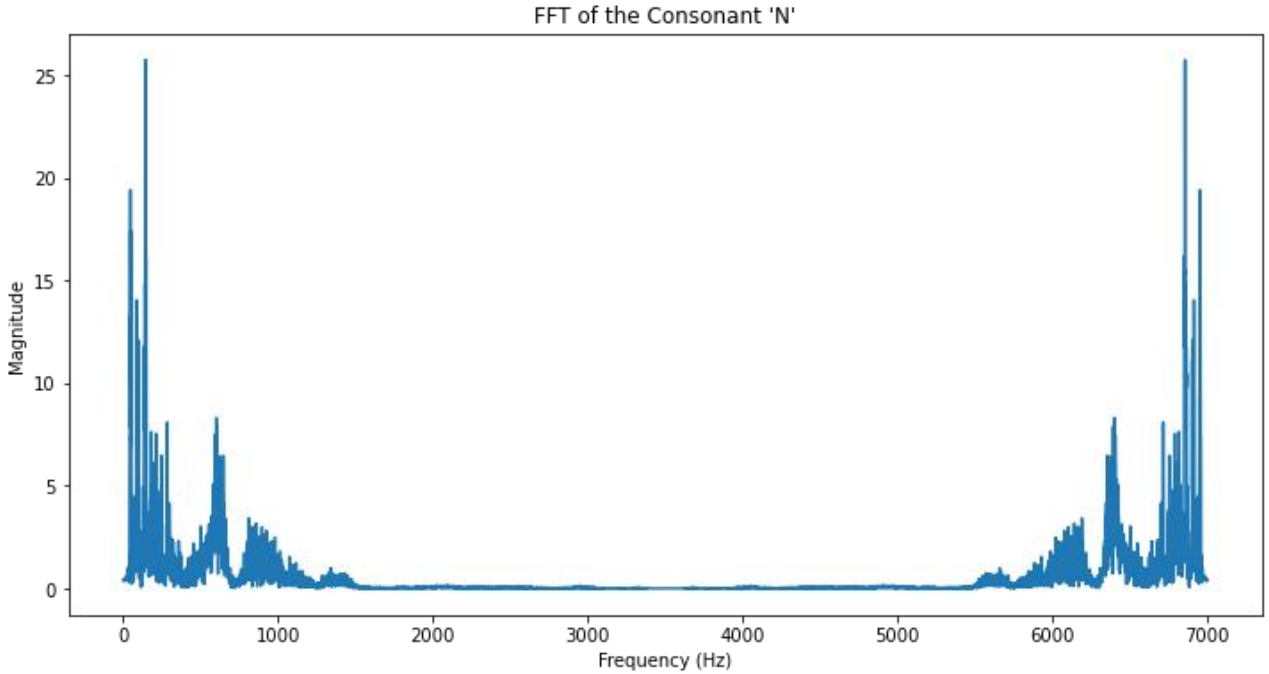



FFT of the Consonant 'S'
Magnitude
Frequency (Hz)
0
5
10
15
20
0
1000
2000
3000
4000
5000
6000

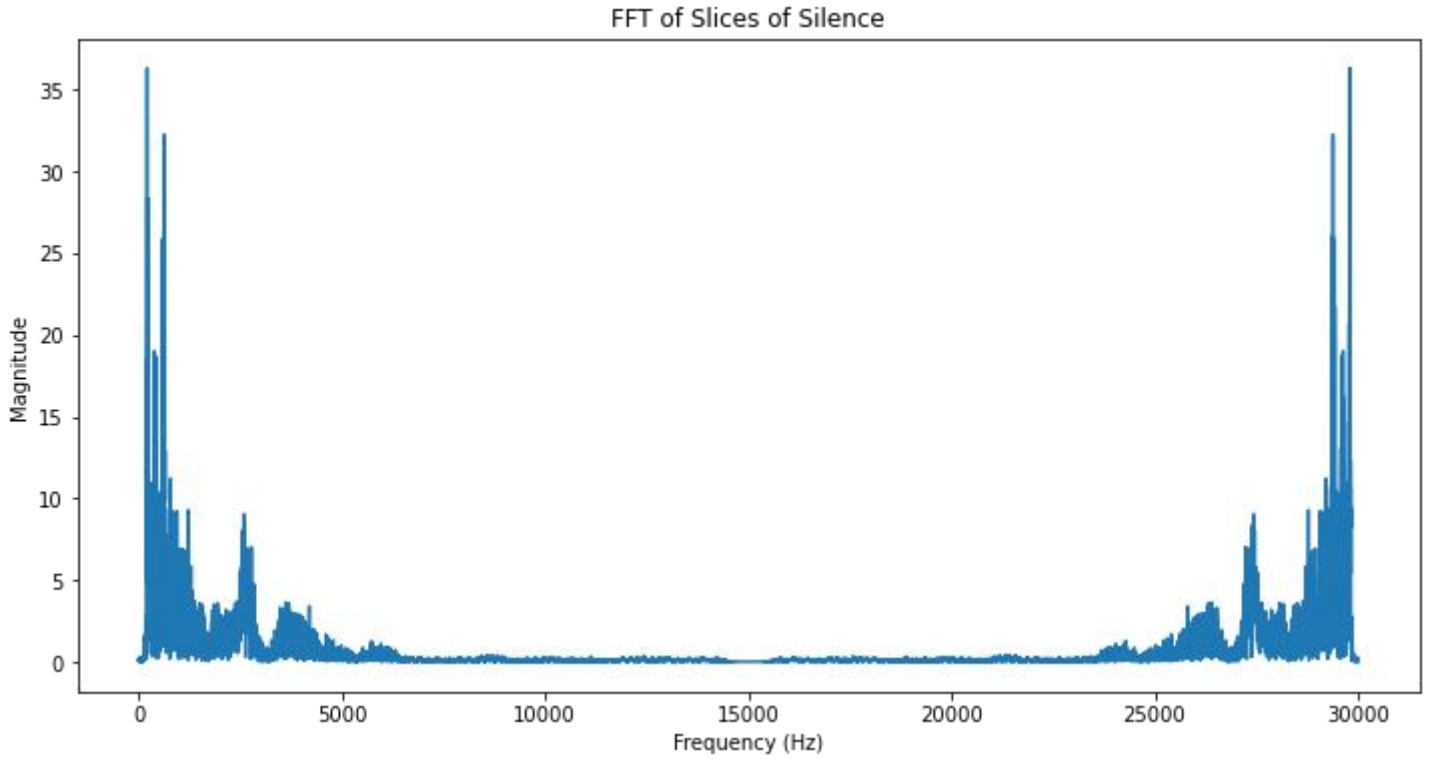

FFT of the Consonant 'H'
Magnitude
Frequency (Hz)
0
2
4
6
8
10
0
1000
2000
3000
4000
5000
6000
7000


FFT of the Consonant 'C'
Magnitude
Frequency (Hz)
0
5
10
15
20
25
0
1000
2000
3000
4000
5000
6000
7000

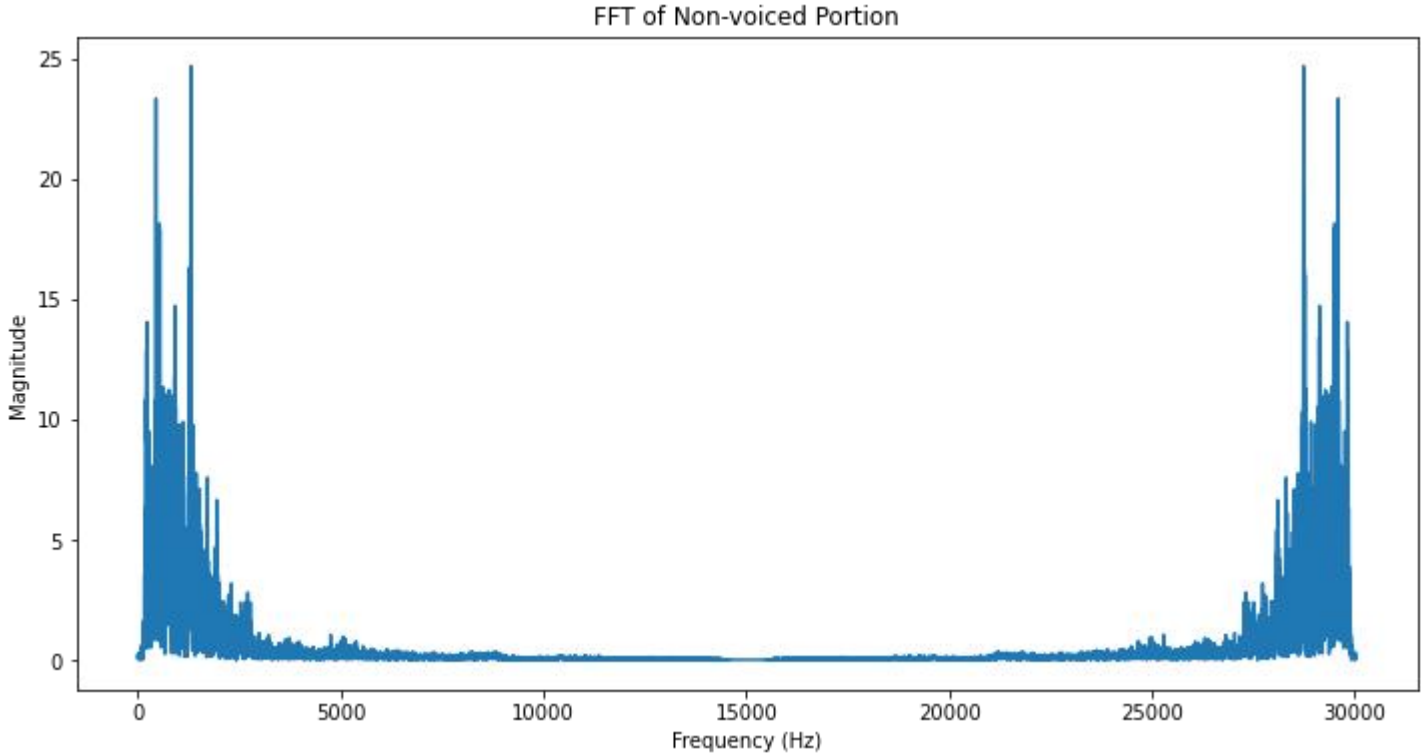

FFT of the Consonant 'N'
Magnitude
Frequency (Hz)
0
5
10
15
20
25
0
1000
2000
3000
4000
5000
6000
7000

A3. Repeat A2 for few slices of silence & non-voiced portions of the recorded speech signal.

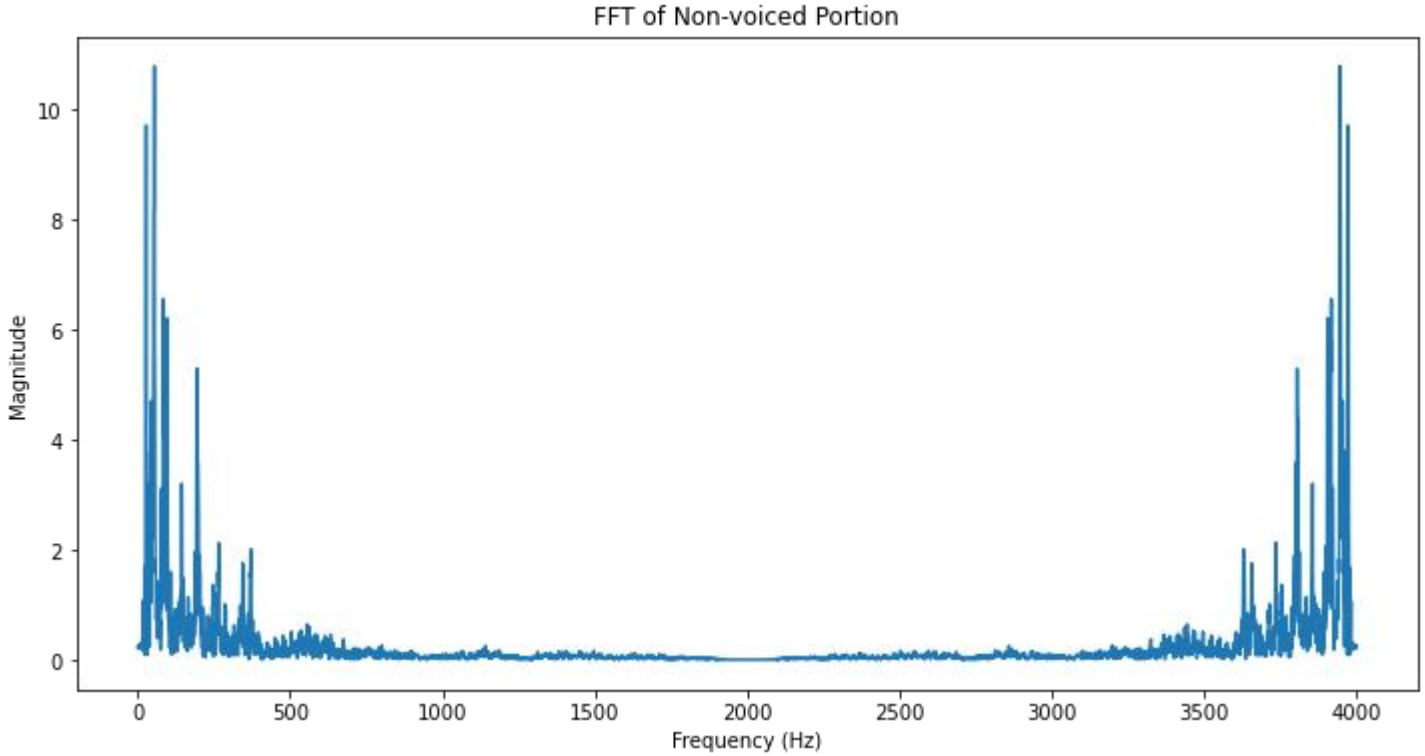
In [44]:
```
# Silence and non-voiced portions
silence = y[0:30000]
plot_fft_and_play(silence, "FFT of Slices of Silence", sr)
non_voiced = y[34000:]
plot_fft_and_play(non_voiced, "FFT of Non-voiced Portion", sr)
non_voiced2 = y[30000:34000]
plot_fft_and_play(non_voiced2, "FFT of Non-voiced Portion", sr)
```



0:00 / 0:01


FFT of Non-voiced Portion
Magnitude
Frequency (Hz)
0
5
10
15
20
25
0
5000
10000
15000
20000
25000
30000

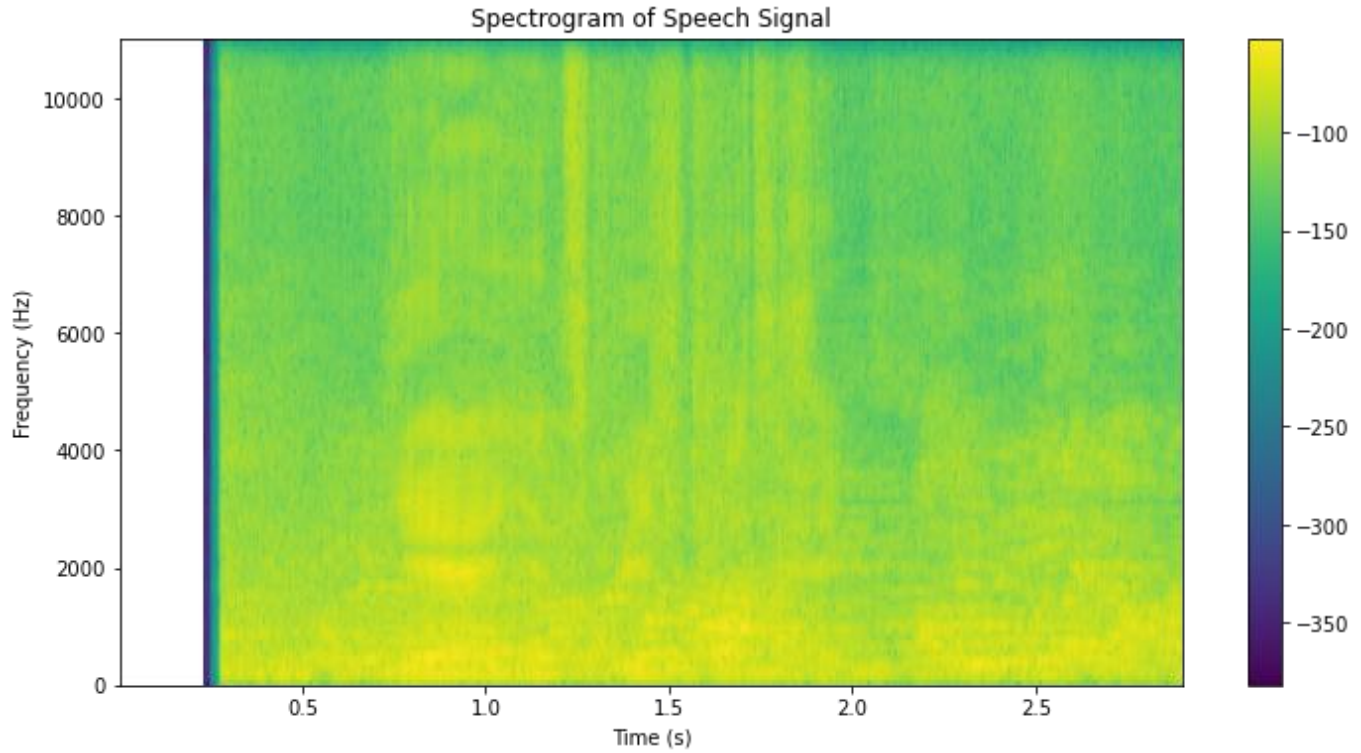
0:00 / 0:01


FFT of Non-voiced Portion
Magnitude
Frequency (Hz)
0
2
4
6
8
10
0
500
1000
1500
2000
2500
3000
3500
4000

0:00 / 0:00

A4. Now you have acquainted yourself with spectral amplitudes of various consonants and vowel-basedphonemes. Generate the spectrogram of thesignal and observe the change points of the signals with associatedspeech segments. Observe to identify the consonants and vowels from the spectrogram.

In [46]:
```
plt.figure(figsize=(12, 6))
plt.specgram(y, Fs=sr)
plt.title("Spectrogram of Speech Signal")
plt.xlabel("Time (s)")
plt.ylabel("Frequency (Hz)")
plt.colorbar()
plt.show()
# Play entire audio
ipd.display(ipd.Audio(y, rate=sr))
```



0:00 / 0:02

In [ ]: