IMPORT

In [1]:
```
import numpy as np
import pandas as pd
import scipy as sp
import statsmodels.api as sm
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.fftpack
from pykalman import KalmanFilter
import plotly as py
import plotly.figure_factory as ff
import plotly.graph_objects as go
from scipy.signal import butter, lfilter, freqz
from scipy import signal
%matplotlib inline
```

FUNGSI BANDPASS FILTER

In [2]:
```
#Bandpass

def butter_bandpass(lowcut, highcut, fs, order):
    nyq = 0.5 * fs
    low = lowcut / nyq
    high = highcut / nyq
    b, a = butter(order, [low, high], btype='band')
    return b, a

def butter_bandpass_filter2(data, lowcut, highcut, fs, order):
    b, a = butter_bandpass(lowcut, highcut, fs, order=order)
    y = lfilter(b, a, data)
    # y =filtfilt(b, a, data)
    return y
```

IMPORT DATA

In [3]:
```
data_raw = pd.read_excel('C:/Users/stana/Documents/UTS S2/TUGAS UTS 2021-11-17 20-13
# data_raw.columns=["Time (s)","Linear Acceleration x (m/s^2)","Linear Acceleration
waktu = data_raw['Time (s)']
Ax = data_raw['Linear Acceleration x (m/s^2)']
Ay = data_raw['Linear Acceleration y (m/s^2)']
Az = data_raw['Linear Acceleration z (m/s^2)']
Az=Az-(sum(Az)/np.size(Az))
Ay=Ay-(sum(Ay)/np.size(Ay))
Ax=Ax-(sum(Ax)/np.size(Ax))
```

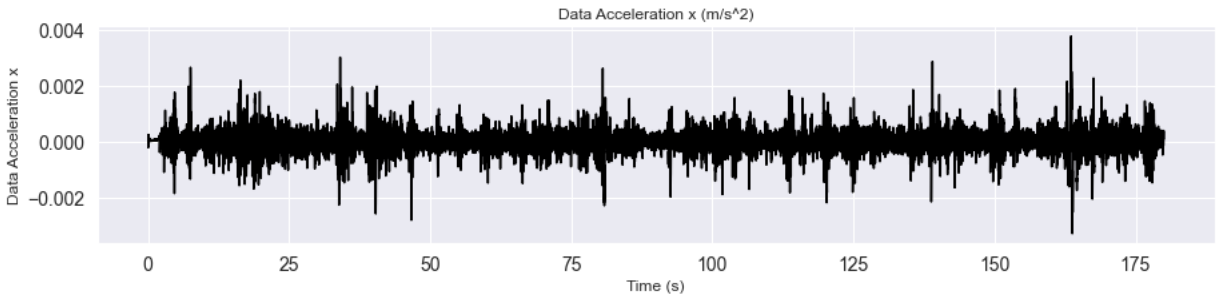
Custom Warna

In [4]:
```
colors = ["windows red", "amber", "faded green", "dusty purple"]
sns.set(rc={"figure.figsize": (20,6), "axes.titlesize" : 18, "axes.labelsize" : 12,
            "xtick.labelsize" : 14, "ytick.labelsize" : 14 })
```

ACCELERATION x

In [5]:
```
plt.subplots(figsize=(15,3))
plt.title('Data Acceleration x (m/s^2)', fontsize=12)
plt.plot(waktu,Ax,color = 'black')
plt.xlabel("Time (s)")
plt.ylabel("Data Acceleration x")
plt.show
```

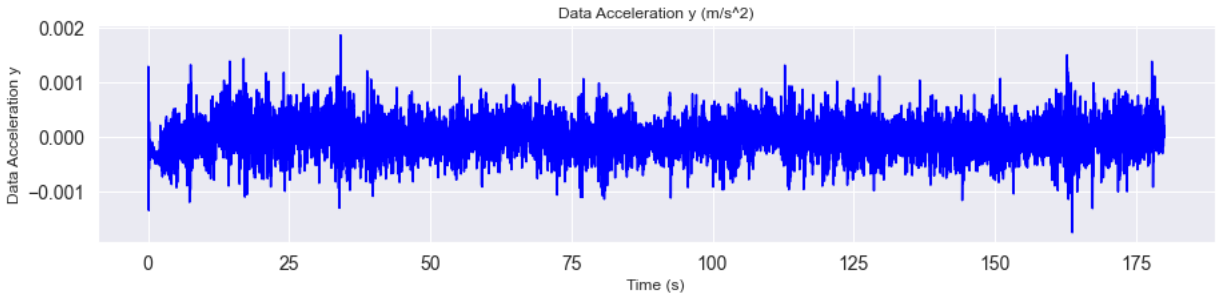
Out[5]: <function matplotlib.pyplot.show(close=None, block=None)>



ACCELERATION y

In [6]:
```
plt.subplots(figsize=(15,3))
plt.title('Data Acceleration y (m/s^2)', fontsize=12)
plt.plot(waktu,Ay,color = 'blue')
plt.xlabel("Time (s)")
plt.ylabel("Data Acceleration y")
plt.show
```

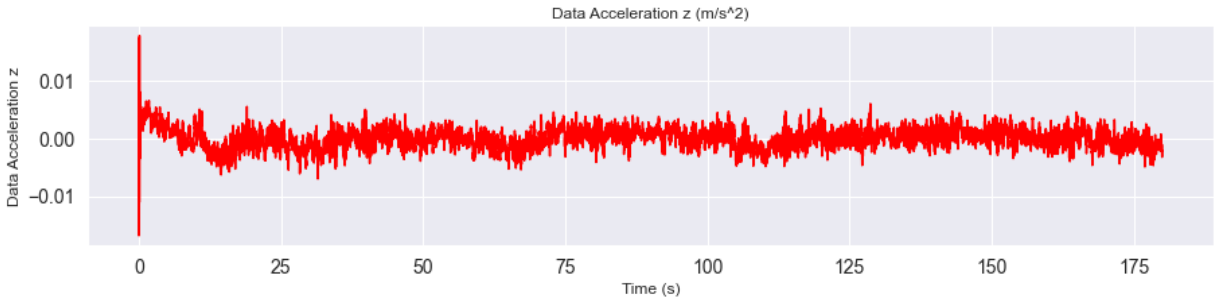
Out[6]: <function matplotlib.pyplot.show(close=None, block=None)>



ACCELERATION z

In [7]:
```
plt.subplots(figsize=(15,3))
plt.title('Data Acceleration z (m/s^2)', fontsize=12)
plt.plot(waktu,Az,color = 'red')
plt.xlabel("Time (s)")
plt.ylabel("Data Acceleration z")
plt.show
```

Out[7]: <function matplotlib.pyplot.show(close=None, block=None)>

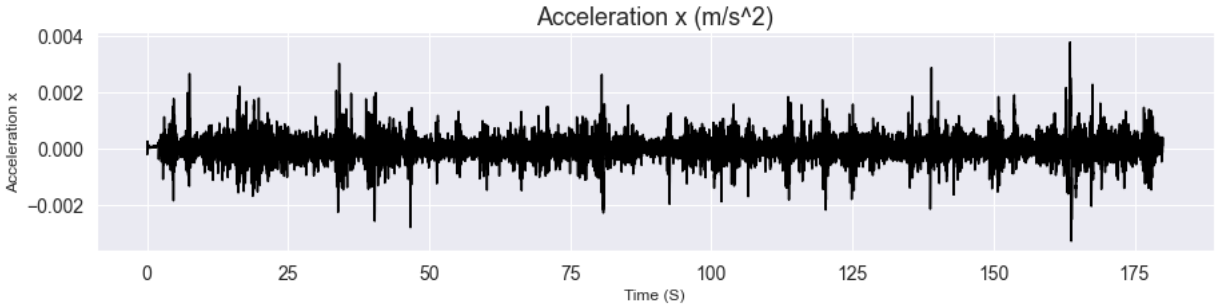


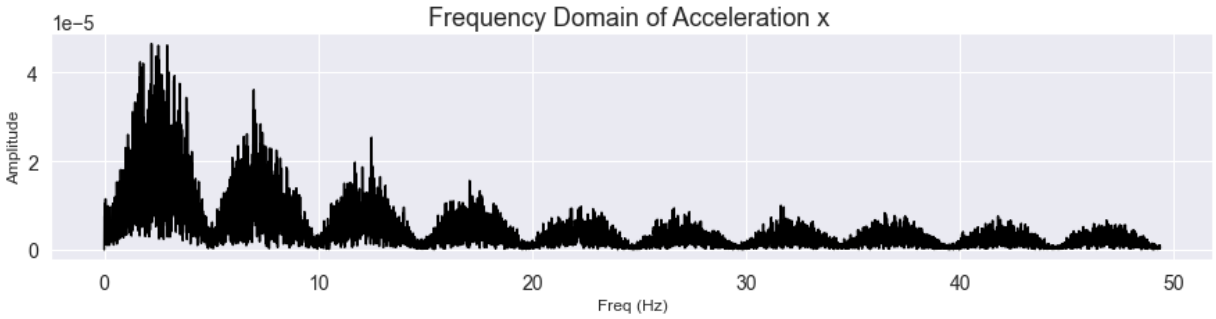
FFT ACCELERATION x Sebelum dan Sesudah FFT

In [8]:

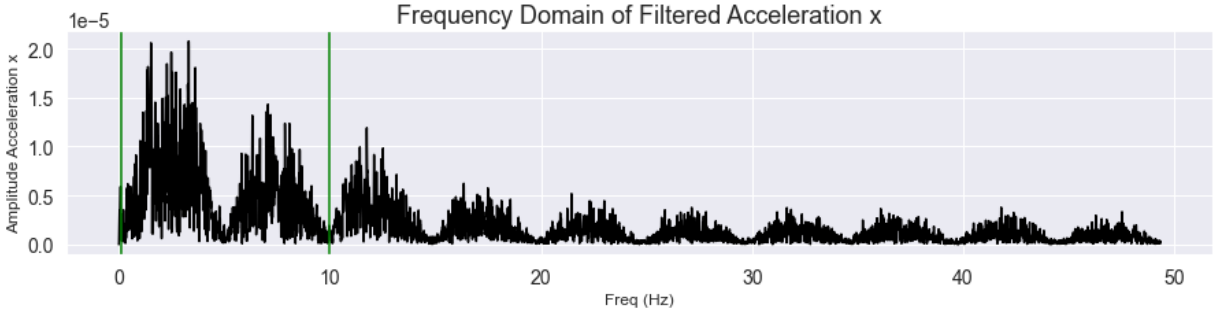
```
Tx = waktu[1]-waktu[0]
Nx = len(Ax)
yx = Ax.to_numpy()
yx = yx - np.ones_like(yx)*np.mean(yx) #Normalisasi

fft_yx = scipy.fftpack.fft(yx)
fft_xx = np.linspace(0.0, 1.0/(2.0*Tx), int(Nx/2))

plt.subplots(figsize=(15,3))
plt.plot(waktu,Ax,color = 'black')
plt.xlabel("Time (S)")
plt.ylabel("Acceleration x")
plt.title('Acceleration x (m/s^2)')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(fft_xx,2.0/Nx * np.abs(fft_yx[:Nx//2]),color = 'black')
plt.xlabel("Freq (Hz)")
plt.ylabel("Amplitude")
plt.title('Frequency Domain of Acceleration x ')
plt.show()

fft_xmax = 2.0/Nx * np.abs(fft_yx[:Nx//2])
magmax = max(fft_xmax)
# print(magmax)
for i in range(len(fft_xmax)):
    if fft_xmax[i]==magmax :
        nilaiFreq = fft_xx[i]
        nilaiMagnitude = fft_xmax[i]
        nilaiWaktu = waktu[i]
        print("Nilai Natural Frekuensi Sebelum Filter   : ",fft_xx[i],'Hz')
        print("Nilai Magnitude/Amplitude Sebelum Filter : ",fft_xmax[i])

f_low_Ax = 0.1 #Cutoff bawah
f_high_Ax =10 #Cutoff atas
fs_Ax = 1/Tx #Sampling Frequency

print("Range Frekuensi : ",f_low_Ax,"-",f_high_Ax,"Hz")

#Band pass filter
# Filtered Data
filter_fftx = butter_bandpass_filter2(fft_yx,f_low_Ax, f_high_Ax, fs_Ax, order=4)

##response
b, a = butter_bandpass(f_low_Ax,f_high_Ax, fs_Ax, order=4)
# Plot the frequency response.
w, h = freqz(b, a, worN=64)

plt.subplots(figsize=(15,3))
plt.plot(fft_xx,2.0/Nx * np.abs(filter_fftx[:Nx//2]),color = 'black')
plt.axvline(f_low_Ax,color = 'green')
```

```
plt.axvline(f_high_Ax,color ='green')
plt.xlabel("Freq (Hz)")
plt.ylabel("Amplitude Acceleration x")
plt.title('Frequency Domain of Filtered Acceleration x')
plt.show()

fft_xmax_filter = 2.0/Nx * np.abs(filter_fftx[:Nx//2])
magmax = max(fft_xmax_filter)
# print(magmax)
for i in range(len(fft_xmax_filter)):
    if fft_xmax_filter[i]==magmax :
        nilaiFreq = fft_xx[i]
        nilaiMagnitude = fft_xmax_filter[i]
        nilaiWaktu = waktu[i]
        print("Nilai Natural Frekuensi Sesudah Filter   : ",fft_xx[i],'Hz')
        print("Nilai Magnitude/Amplitude Sesudah Filter : ",fft_xmax_filter[i])

print("Range Frekuensi : ",f_low_Ax,"-",f_high_Ax,"Hz")
```






```
Nilai Natural Frekuensi Sebelum Filter   :  2.205989596264118 Hz
Nilai Magnitude/Amplitude Sebelum Filter :  4.6487493937480236e-05
Range Frekuensi :  0.1 - 10 Hz
```



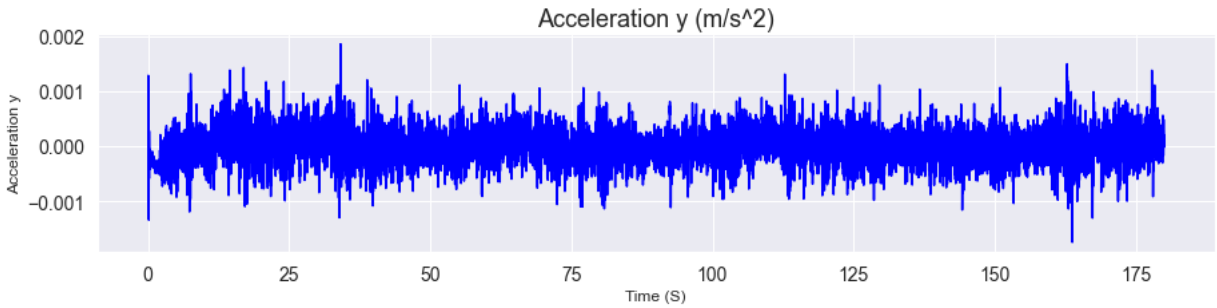

```
Nilai Natural Frekuensi Sesudah Filter   :  3.31731936768181 Hz
Nilai Magnitude/Amplitude Sesudah Filter :  2.0763661287672585e-05
Range Frekuensi :  0.1 - 10 Hz
```

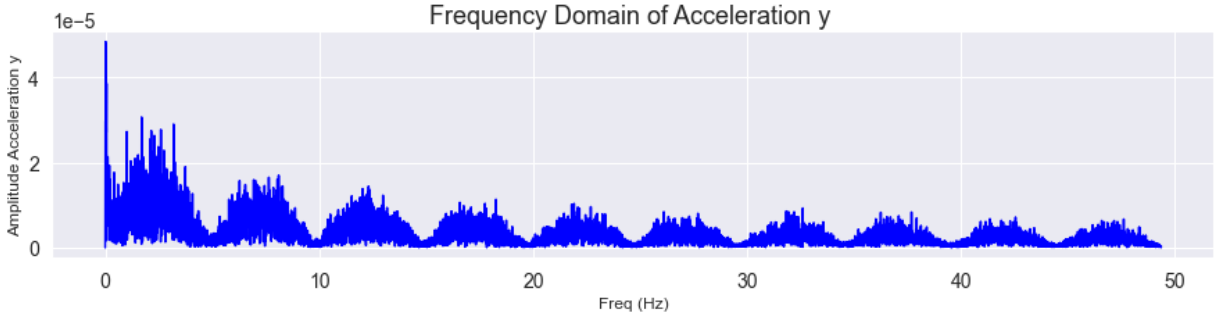
FFT ACCELERATION y Sebelum dan Sesudah FFT

In [9]:

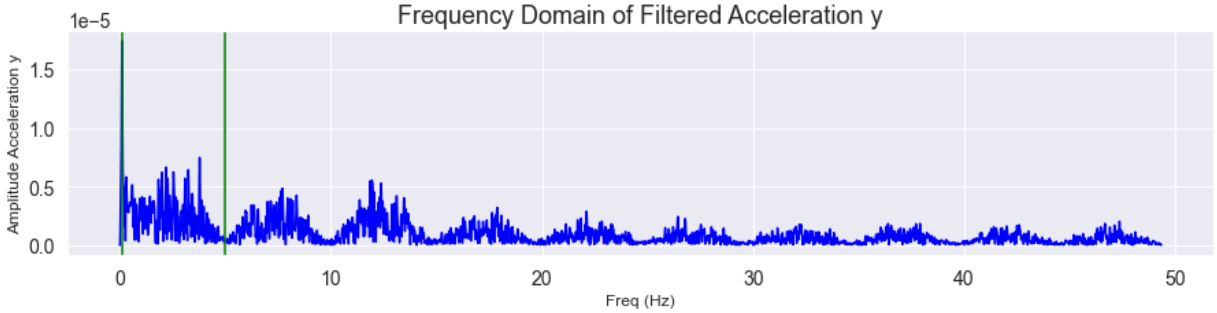
```
Ty = waktu[1]-waktu[0]
Ny= len(Ay)
yy = Ay.to_numpy()
yy = yy - np.ones_like(yy)*np.mean(yy) #Normalisasi
fft_yy = scipy.fftpack.fft(yy)
```

```
fft_xy = np.linspace(0.0, 1.0/(2.0*Ty), int(Ny/2))

plt.subplots(figsize=(15,3))
plt.plot(waktu,Ay,color = 'blue')
plt.xlabel("Time (S)")
plt.ylabel("Acceleration y")
plt.title('Acceleration y (m/s^2)')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(fft_xy,2.0/Ny * np.abs(fft_yy[:Ny//2]),color = 'blue')
plt.xlabel("Freq (Hz)")
plt.ylabel("Amplitude Acceleration y")
plt.title('Frequency Domain of Acceleration y ')
plt.show()

fft_ymax = 2.0/Ny * np.abs(fft_yy[:Ny//2])
magmax = max(fft_ymax)
# print(magmax)
for i in range(len(fft_ymax)):
    if fft_ymax[i]==magmax :
        nilaiFreq = fft_xy[i]
        nilaiMagnitude = fft_xmax[i]
        nilaiWaktu = waktu[i]
        print("Nilai Natural Frekuensi Sebelum Filter   : ",fft_xy[i],'Hz')
        print("Nilai Magnitude/Amplitude Sebelum Filter : ",fft_ymax[i])


f_low_Ay = 0.1 #Cutoff bawah
f_high_Ay =5 #Cutoff atas
fs_Ay = 1/Ty #Sampling Frequency

print("Range Frekuensi : ",f_low_Ay,"-",f_high_Ay,"Hz")

#Band pass filter
# Filtered Data
filter_ffty = butter_bandpass_filter2(fft_yy,f_low_Ay, f_high_Ay, fs_Ay, order=4)

##response
b, a = butter_bandpass(f_low_Ay,f_high_Ay, fs_Ay, order=4)
# Plot the frequency response.
w, h = freqz(b, a, worN=64)

plt.subplots(figsize=(15,3))
plt.plot(fft_xy,2.0/Ny * np.abs(filter_ffty[:Ny//2]),color = 'blue')
plt.axvline(f_low_Ay,color = 'green')
plt.axvline(f_high_Ay,color ='green')
plt.xlabel("Freq (Hz)")
plt.ylabel("Amplitude Acceleration y")
plt.title('Frequency Domain of Filtered Acceleration y')
plt.show()

fft_ymax_filter = 2.0/Ny * np.abs(filter_ffty[:Ny//2])
magmax = max(fft_ymax_filter)
# print(magmax)
for i in range(len(fft_ymax_filter)):
    if fft_ymax_filter[i]==magmax :
        nilaiFreq = fft_xy[i]
        nilaiMagnitude = fft_ymax_filter[i]
        nilaiWaktu = waktu[i]
        print("Nilai Natural Frekuensi Sesudah Filter   : ",fft_xy[i],'Hz')
        print("Nilai Magnitude/Amplitude Sesudah Filter : ",fft_ymax_filter[i])

print("Range Frekuensi : ",f_low_Ay,"-",f_high_Ay,"Hz")
```






```
Nilai Natural Frekuensi Sebelum Filter   :  0.022226595428353833 Hz
Nilai Magnitude/Amplitude Sebelum Filter :  4.839065435297858e-05
Range Frekuensi :  0.1 - 5 Hz
```



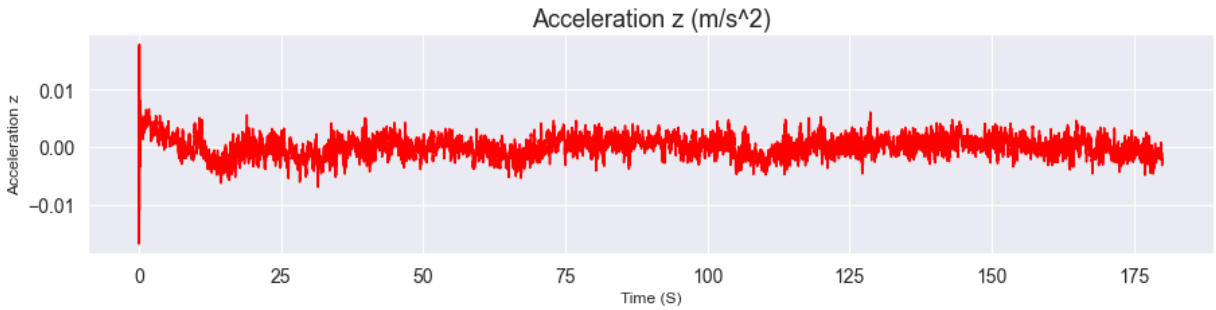

```
Nilai Natural Frekuensi Sesudah Filter   :  0.1055763282846807 Hz
Nilai Magnitude/Amplitude Sesudah Filter :  1.7374504357599193e-05
Range Frekuensi :  0.1 - 5 Hz
```

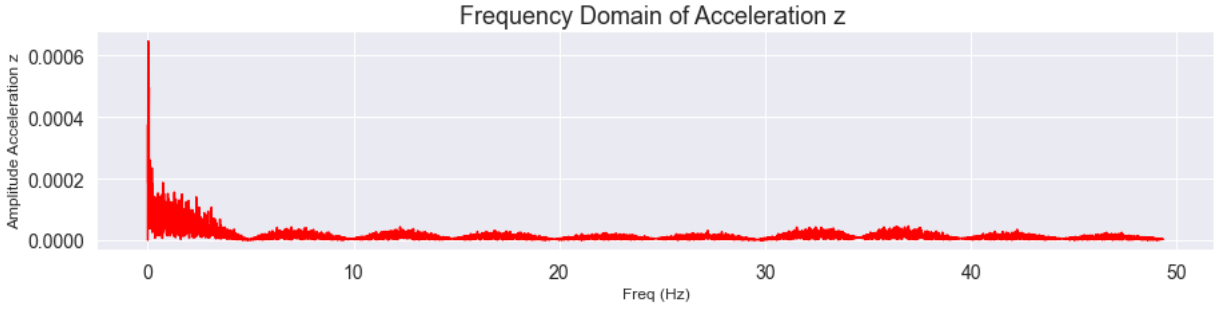
FFT ACCELERATION z Sebelum dan Sesudah FFT

In [10]:

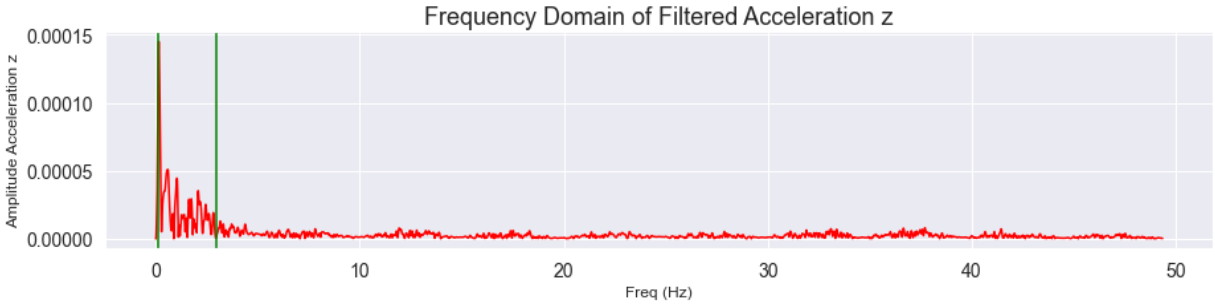
```
Tz = waktu[1]-waktu[0]
Nz= len(Az)
yz = Az.to_numpy()
yz = yz - np.ones_like(yz)*np.mean(yz) #Normalisasi
fft_yz = scipy.fftpack.fft(yz)
fft_xz = np.linspace(0.0, 1.0/(2.0*Tz), int(Nz/2))

plt.subplots(figsize=(15,3))
plt.plot(waktu,Az,color = 'red')
plt.xlabel("Time (S)")
plt.ylabel("Acceleration z")
plt.title('Acceleration z (m/s^2)')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(fft_xz,2.0/Nz * np.abs(fft_yz[:Nz//2]),color = 'red')
plt.xlabel("Freq (Hz)")
plt.ylabel("Amplitude Acceleration z")
plt.title('Frequency Domain of Acceleration z ')
plt.show()

fft_zmax = 2.0/Nz * np.abs(fft_yz[:Nz//2])
magmax = max(fft_zmax)
# print(magmax)
```

```
for i in range(len(fft_zmax)):
    if fft_zmax[i]==magmax :
        nilaiFreq = fft_xz[i]
        nilaiMagnitude = fft_zmax[i]
        nilaiWaktu = waktu[i]
        print("Nilai Natural Frekuensi Sebelum Filter   : ",fft_xz[i],'Hz')
        print("Nilai Magnitude/Amplitude Sebelum Filter : ",fft_zmax[i])

f_low_Az = 0.1 #Cutoff bawah
f_high_Az =3 #Cutoff atas
fs_Az = 1/Tz #Sampling Frequency

print("Range Frekuensi : ",f_low_Az,"-",f_high_Az,"Hz")

#Band pass filter
# Filtered Data
filter_fftz = butter_bandpass_filter2(fft_yz,f_low_Az, f_high_Az, fs_Az, order=4)

##response
b, a = butter_bandpass(f_low_Az,f_high_Az, fs_Az, order=4)
# Plot the frequency response.
w, h = freqz(b, a, worN=64)

plt.subplots(figsize=(15,3))
plt.plot(fft_xz,2.0/Nz * np.abs(filter_fftz[:Nz//2]),color = 'red')
plt.axvline(f_low_Az,color = 'green')
plt.axvline(f_high_Az,color ='green')
plt.xlabel("Freq (Hz)")
plt.ylabel("Amplitude Acceleration z")
plt.title('Frequency Domain of Filtered Acceleration z')
plt.show()

fft_zmax_filter = 2.0/Nz * np.abs(filter_fftz[:Nz//2])
magmax = max(fft_zmax_filter)
# print(magmax)
for i in range(len(fft_zmax_filter)):
    if fft_zmax_filter[i]==magmax :
        nilaiFreq = fft_xz[i]
        nilaiMagnitude = fft_zmax_filter[i]
        nilaiWaktu = waktu[i]
        print("Nilai Natural Frekuensi Sesudah Filter   : ",fft_xz[i],'Hz')
        print("Nilai Magnitude/Amplitude Sesudah Filter : ",fft_zmax_filter[i])

print("Range Frekuensi : ",f_low_Az,"-",f_high_Az,"Hz")
```





```
Nilai Natural Frekuensi Sebelum Filter   :  0.022226595428353833 Hz
Nilai Magnitude/Amplitude Sebelum Filter :  0.0006468952181878609
Range Frekuensi :  0.1 - 3 Hz
```



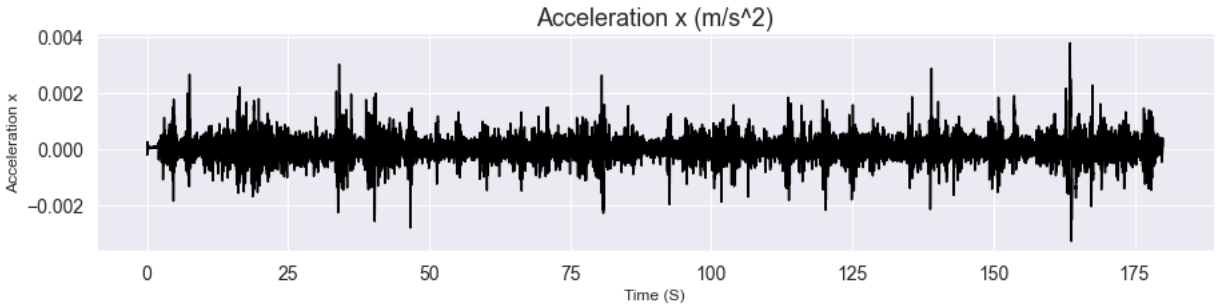

```
Nilai Natural Frekuensi Sesudah Filter   :  0.15002951914138837 Hz
Nilai Magnitude/Amplitude Sesudah Filter :  0.0001448949314022299
Range Frekuensi :  0.1 - 3 Hz
```

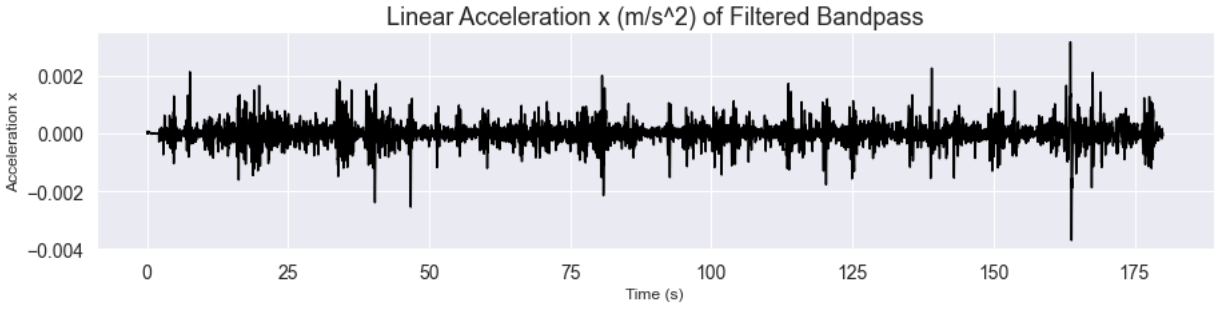
APLIKASI CLASSIFICATION Linear Acceleration X

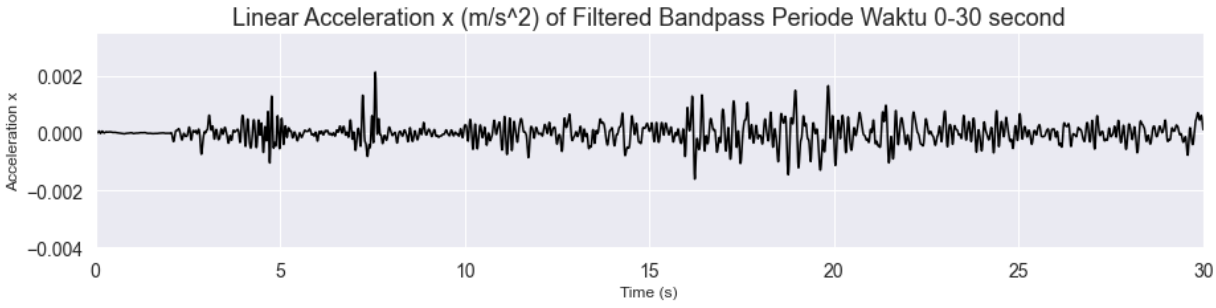
In [11]:

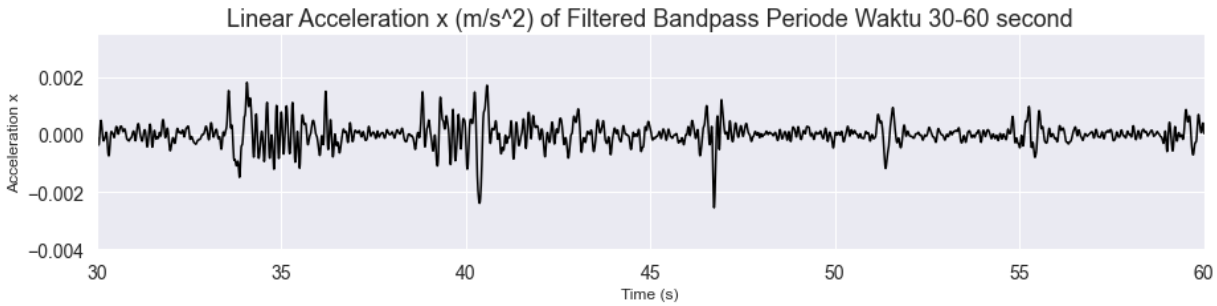
```
f_low_Ax = 0.1 #Cutoff bawah
f_high_Ax =10 #Cutoff atas
fs_Ax = 1/Tx #Sampling Frequency

#Band pass filter
# Filtered Data
filter_Ax = butter_bandpass_filter2(Ax,f_low_Ax, f_high_Ax, fs_Ax, order=4)

##response
b, a = butter_bandpass(f_low_Ax,f_high_Ax, fs_Ax, order=4)
# Plot the frequency response.
w, h = freqz(b, a, worN=64)

plt.subplots(figsize=(15,3))
plt.plot(waktu,Ax,color = 'black')
plt.xlabel("Time (S)")
plt.ylabel("Acceleration x")
plt.title('Acceleration x (m/s^2)')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ax,color = 'black')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration x")
plt.title('Linear Acceleration x (m/s^2) of Filtered Bandpass')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ax,color = 'black')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration x")
plt.title('Linear Acceleration x (m/s^2) of Filtered Bandpass Periode Waktu 0-30 sec
plt.xlim([0, 30])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ax,color = 'black')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration x")
plt.title('Linear Acceleration x (m/s^2) of Filtered Bandpass Periode Waktu 30-60 se
plt.xlim([30, 60])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ax,color = 'black')
```

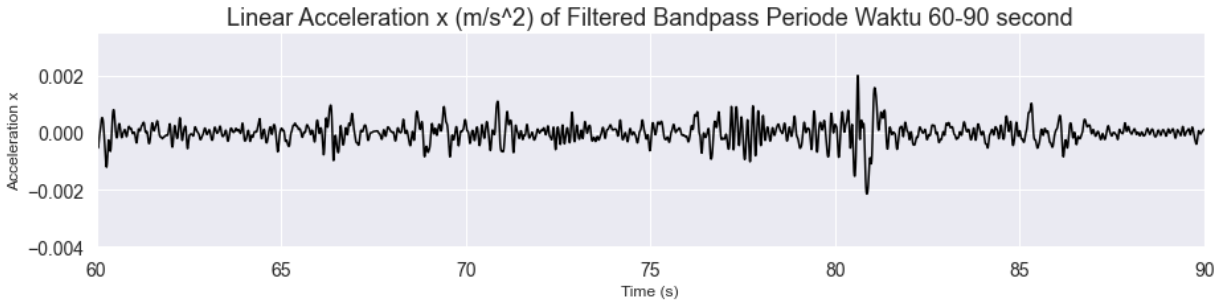
```
plt.xlabel("Time (s)")
plt.ylabel("Acceleration x")
plt.title('Linear Acceleration x (m/s^2) of Filtered Bandpass Periode Waktu 60-90 se
plt.xlim([60, 90])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ax,color = 'black')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration x")
plt.title('Linear Acceleration x (m/s^2) of Filtered Bandpass Periode Waktu 90-120 s
plt.xlim([90, 120])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ax,color = 'black')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration x")
plt.title('Linear Acceleration x (m/s^2) of Filtered Bandpass Periode Waktu 120-150
plt.xlim([120, 150])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ax,color = 'black')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration x")
plt.title('Linear Acceleration x (m/s^2) of Filtered Bandpass Periode Waktu 150-180
plt.xlim([150, 180])
plt.show()
```

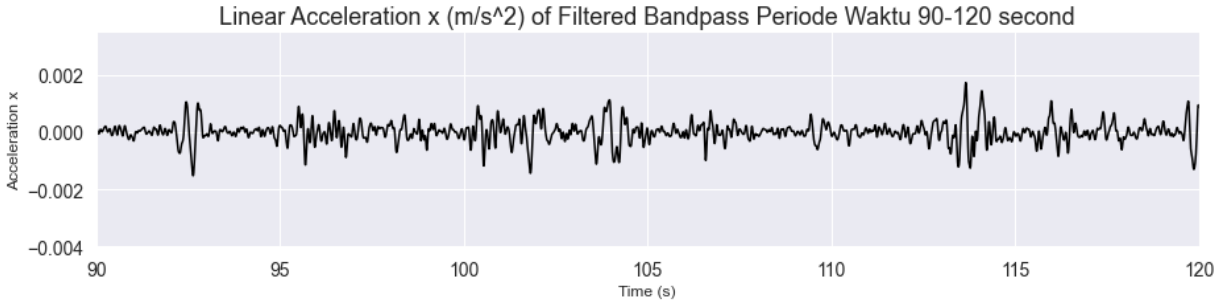


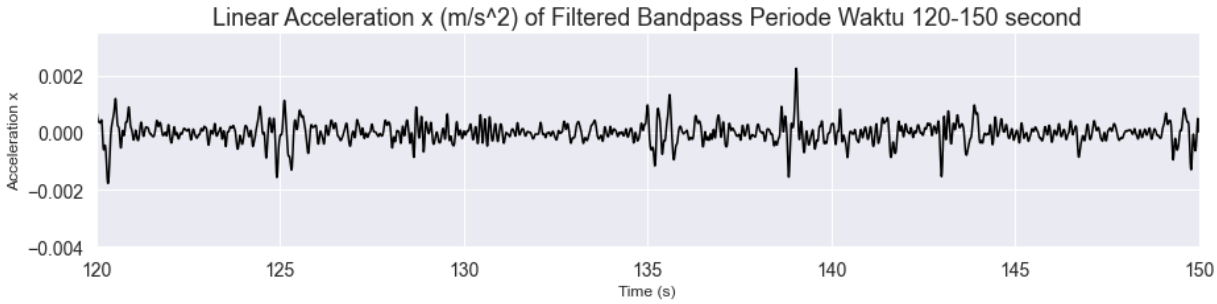


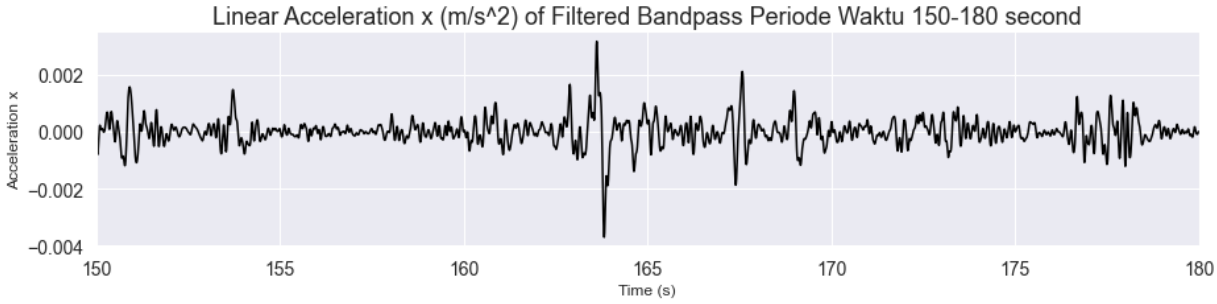












In [12]:

```
print("================== Linear Acceleration x Clasification ==================")
sumx1 = 0
ratax1 = 0
for x in range(0,3000):
    if(filter_Ax[x]>=0):
        sumx1 = sumx1 + filter_Ax[x]

ratax1 = sumx1/3000
print ("Rata-Rata Periode Ke 1 Yaitu Detik 0-30    : ",ratax1)

sumx2 = 0
ratax2 = 0
for x in range(3000,6000):
    if(filter_Ax[x]>=0):
```

```
        sumx2 = sumx2 + filter_Ax[x]

ratax2 = sumx2/3000
print ("Rata-Rata Periode Ke 2 Yaitu Detik 30-60   : ",ratax2)

sumx3 = 0
ratax3 = 0
for x in range(6000,9000):
    if(filter_Ax[x]>=0):
        sumx3 = sumx3 + filter_Ax[x]

ratax3 = sumx3/3000
print ("Rata-Rata Periode Ke 3 Yaitu Detik 60-90   : ",ratax3)

sumx4 = 0
ratax4 = 0
for x in range(9000,12000):
    if(filter_Ax[x]>=0):
        sumx4 = sumx4 + filter_Ax[x]

ratax4 = sumx4/3000
print ("Rata-Rata Periode Ke 4 Yaitu Detik 90-120  : ",ratax4)

sumx5 = 0
ratax5 = 0
for x in range(12000,15000):
    if(filter_Ax[x]>=0):
        sumx5 = sumx5 + filter_Ax[x]

ratax5 = sumx5/3000
print ("Rata-Rata Periode Ke 5 Yaitu Detik 120-150 : ",ratax5)

sumx6 = 0
ratax6 = 0
for x in range(15000,17756):
    if(filter_Ax[x]>=0):
        sumx6 = sumx6 + filter_Ax[x]

ratax6 = sumx6/(17756-15000)
print ("Rata-Rata Periode Ke 6 Yaitu Detik 150-180 : ",ratax6)
```

```
================== Linear Acceleration x Clasification ==================
Rata-Rata Periode Ke 1 Yaitu Detik 0-30    :  0.0001228585552309629
Rata-Rata Periode Ke 2 Yaitu Detik 30-60   :  0.00013105428576485345
Rata-Rata Periode Ke 3 Yaitu Detik 60-90   :  0.00011396477449184393
Rata-Rata Periode Ke 4 Yaitu Detik 90-120  :  0.00012616470121481812
Rata-Rata Periode Ke 5 Yaitu Detik 120-150 :  0.00012508102531442967
Rata-Rata Periode Ke 6 Yaitu Detik 150-180 :  0.0001536609280330769
```

Mencari Ranking Rata-Rata Periode Acceleration x

In [13]:

```
data_Rata_Rata_Ax = [ratax1,ratax2,ratax3,ratax4,ratax5,ratax6]
ranking_Ax = sorted(data_Rata_Rata_Ax)
data_klasifikasi = ['Sepeda Motor 1 Orang','Sepeda Motor 2 Orang','Mobil 1 Orang','M

for x in range(0,len(ranking_Ax)):
    if(ranking_Ax[x]==ratax1):
        print("Periode Ke - 1     =  0-30 Detik")
        print("Rata-Rata          = ",ranking_Ax[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Ax)):
```

```
    if(ranking_Ax[x]==ratax2):
        print("Periode Ke - 2     =  30-60 Detik")
        print("Rata-Rata          = ",ranking_Ax[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Ax)):
    if(ranking_Ax[x]==ratax3):
        print("Periode Ke - 3     =  60-90 Detik")
        print("Rata-Rata          = ",ranking_Ax[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Ax)):
    if(ranking_Ax[x]==ratax4):
        print("Periode Ke - 4     =  90-120 Detik")
        print("Rata-Rata          = ",ranking_Ax[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])


print("")

for x in range(0,len(ranking_Ax)):
    if(ranking_Ax[x]==ratax5):
        print("Periode Ke - 5     =  120-150 Detik")
        print("Rata-Rata          = ",ranking_Ax[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Ax)):
    if(ranking_Ax[x]==ratax6):
        print("Periode Ke - 6     =  150-180 Detik")
        print("Rata-Rata          = ",ranking_Ax[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])
```

```
Periode Ke - 1     =  0-30 Detik
Rata-Rata          =  0.0001228585552309629
Prediksi Kendaraan =  Sepeda Motor 2 Orang

Periode Ke - 2     =  30-60 Detik
Rata-Rata          =  0.00013105428576485345
Prediksi Kendaraan =  Truck Kosong

Periode Ke - 3     =  60-90 Detik
Rata-Rata          =  0.00011396477449184393
Prediksi Kendaraan =  Sepeda Motor 1 Orang

Periode Ke - 4     =  90-120 Detik
Rata-Rata          =  0.00012616470121481812
Prediksi Kendaraan =  Mobil 4-6 Orang

Periode Ke - 5     =  120-150 Detik
Rata-Rata          =  0.00012508102531442967
Prediksi Kendaraan =  Mobil 1 Orang

Periode Ke - 6     =  150-180 Detik
Rata-Rata          =  0.0001536609280330769
Prediksi Kendaraan =  Truck Full Kapasistas
```

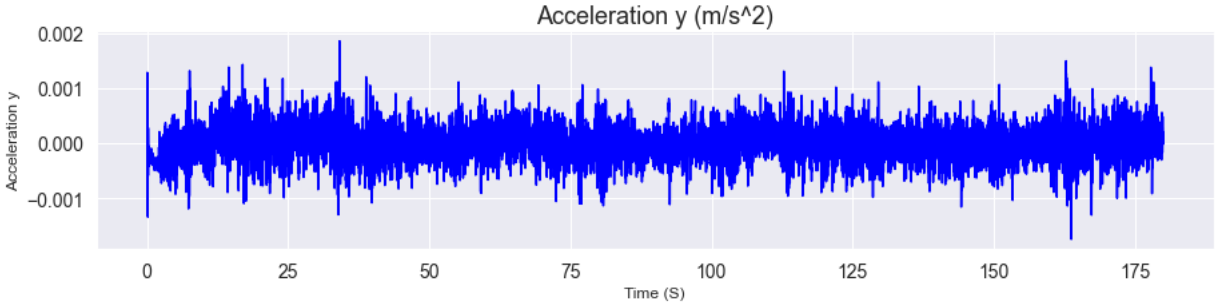
APLIKASI CLASSIFICATION Linear Acceleration Y

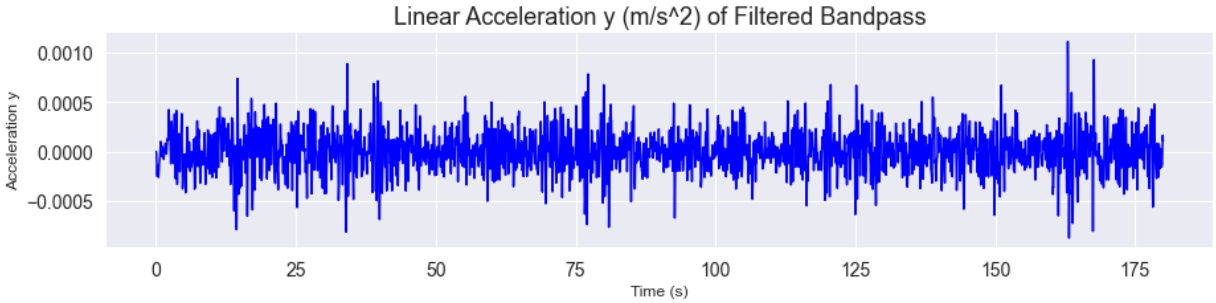
In [14]:

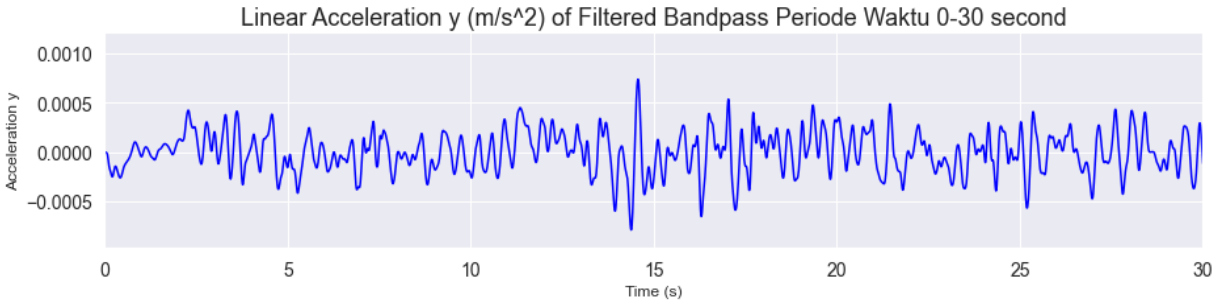
```
f_low_Ay = 0.1 #Cutoff bawah
```

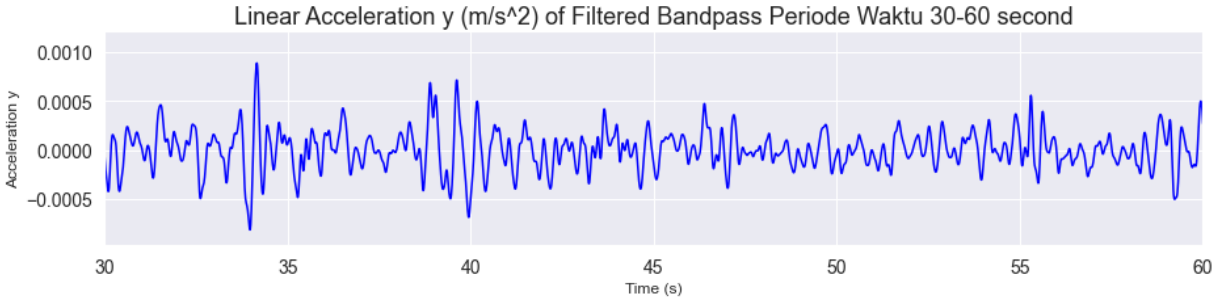
```
f_high_Ay = 5 #Cutoff atas
fs_Ay = 1/Ty #Sampling Frequency

#Band pass filter
# Filtered Data
filter_Ay = butter_bandpass_filter2(Ay,f_low_Ay, f_high_Ay, fs_Ay, order=4)

##response
b, a = butter_bandpass(f_low_Ay,f_high_Ay, fs_Ay, order=4)
# Plot the frequency response.
w, h = freqz(b, a, worN=64)

plt.subplots(figsize=(15,3))
plt.plot(waktu,Ay,color = 'blue')
plt.xlabel("Time (S)")
plt.ylabel("Acceleration y")
plt.title('Acceleration y (m/s^2)')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ay,color = 'blue')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration y")
plt.title('Linear Acceleration y (m/s^2) of Filtered Bandpass')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ay,color = 'blue')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration y")
plt.title('Linear Acceleration y (m/s^2) of Filtered Bandpass Periode Waktu 0-30 sec
plt.xlim([0, 30])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ay,color = 'blue')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration y")
plt.title('Linear Acceleration y (m/s^2) of Filtered Bandpass Periode Waktu 30-60 se
plt.xlim([30, 60])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ay,color = 'blue')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration y")
plt.title('Linear Acceleration y (m/s^2) of Filtered Bandpass Periode Waktu 60-90 se
plt.xlim([60, 90])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ay,color = 'blue')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration y")
plt.title('Linear Acceleration y (m/s^2) of Filtered Bandpass Periode Waktu 90-120 s
plt.xlim([90, 120])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ay,color = 'blue')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration y")
plt.title('Linear Acceleration y (m/s^2) of Filtered Bandpass Periode Waktu 120-150
plt.xlim([120, 150])
plt.show()
```

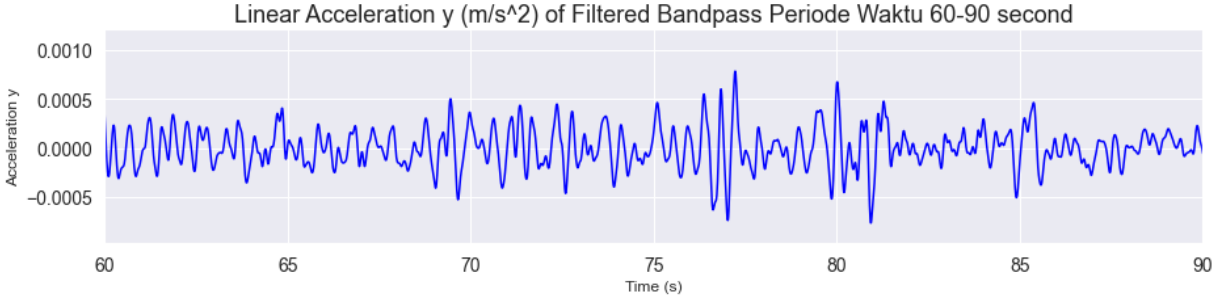
```
plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Ay,color = 'blue')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration y")
plt.title('Linear Acceleration y  (m/s^2) of Filtered Bandpass Periode Waktu 150-180
plt.xlim([150, 180])
plt.show()
```

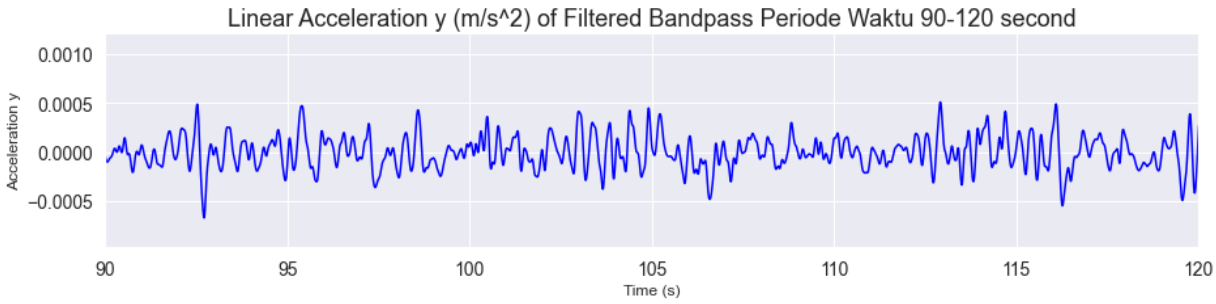


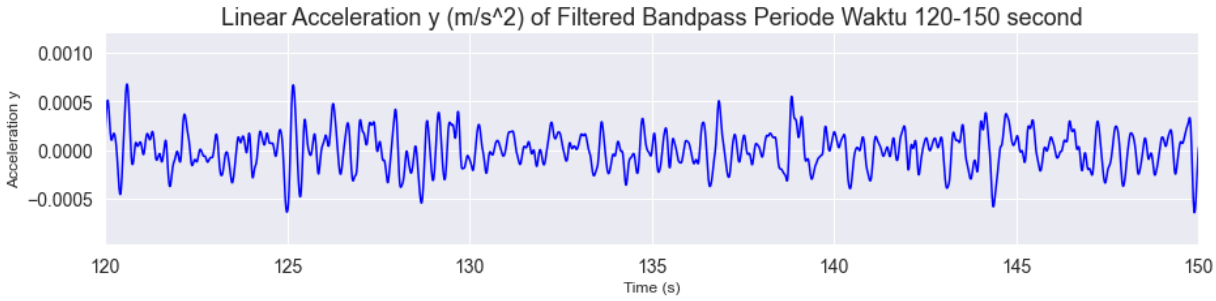


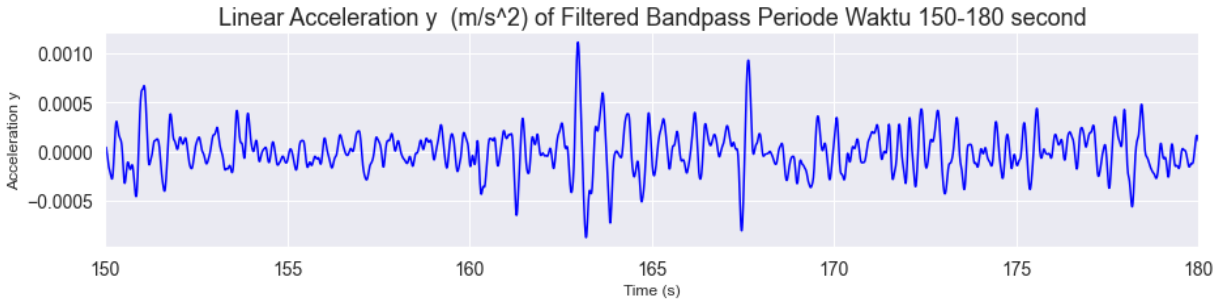












In [15]:

```
print("================== Linear Acceleration y Clasification ==================")
sumy1 = 0
ratay1 = 0
for x in range(0,3000):
    if(filter_Ay[x]>=0):
        sumy1 = sumy1 + filter_Ay[x]

ratay1 = sumy1/3000
print ("Rata-Rata Periode Ke 1 Yaitu Detik 0-30    : ",ratay1)

sumy2 = 0
ratay2 = 0
for x in range(3000,6000):
    if(filter_Ay[x]>=0):
        sumy2 = sumy2 + filter_Ay[x]

ratay2 = sumy2/3000
print ("Rata-Rata Periode Ke 2 Yaitu Detik 30-60   : ",ratay2)

sumy3 = 0
ratay3 = 0
for x in range(6000,9000):
    if(filter_Ay[x]>=0):
        sumy3 = sumy3 + filter_Ay[x]

ratay3 = sumy3/3000
print ("Rata-Rata Periode Ke 3 Yaitu Detik 60-90   : ",ratay3)

sumy4 = 0
ratay4 = 0
for x in range(9000,12000):
    if(filter_Ay[x]>=0):
        sumy4 = sumy4 + filter_Ay[x]
```

```
ratay4 = sumy4/3000
print ("Rata-Rata Periode Ke 4 Yaitu Detik 90-120  : ",ratay4)

sumy5 = 0
ratay5 = 0
for x in range(12000,15000):
    if(filter_Ay[x]>=0):
        sumy5 = sumy5 + filter_Ay[x]

ratay5 = sumy5/3000
print ("Rata-Rata Periode Ke 5 Yaitu Detik 120-150 : ",ratay5)

sumy6 = 0
ratay6 = 0
for x in range(15000,17756):
    if(filter_Ay[x]>=0):
        sumy6 = sumy6 + filter_Ay[x]

ratay6 = sumy6/(17756-15000)
print ("Rata-Rata Periode Ke 6 Yaitu Detik 150-180 : ",ratay6)
```

```
================== Linear Acceleration y Clasification ==================
Rata-Rata Periode Ke 1 Yaitu Detik 0-30    :  8.128113458674513e-05
Rata-Rata Periode Ke 2 Yaitu Detik 30-60   :  7.583868310076104e-05
Rata-Rata Periode Ke 3 Yaitu Detik 60-90   :  7.59808756217604e-05
Rata-Rata Periode Ke 4 Yaitu Detik 90-120  :  6.847801409837671e-05
Rata-Rata Periode Ke 5 Yaitu Detik 120-150 :  7.515379284917109e-05
Rata-Rata Periode Ke 6 Yaitu Detik 150-180 :  7.695744139444911e-05
```

In [16]:

```
data_Rata_Rata_Ay = [ratay1,ratay2,ratay3,ratay4,ratay5,ratay6]
ranking_Ay = sorted(data_Rata_Rata_Ay)
data_klasifikasi = ['Sepeda Motor 1 Orang','Sepeda Motor 2 Orang','Mobil 1 Orang','M

for x in range(0,len(ranking_Ay)):
    if(ranking_Ay[x]==ratay1):
        print("Periode Ke - 1     =  0-30 Detik")
        print("Rata-Rata          = ",ranking_Ay[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Ay)):
    if(ranking_Ay[x]==ratay2):
        print("Periode Ke - 2     =  30-60 Detik")
        print("Rata-Rata          = ",ranking_Ay[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Ay)):
    if(ranking_Ay[x]==ratay3):
        print("Periode Ke - 3     =  60-90 Detik")
        print("Rata-Rata          = ",ranking_Ay[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Ay)):
    if(ranking_Ay[x]==ratay4):
        print("Periode Ke - 4     =  90-120 Detik")
        print("Rata-Rata          = ",ranking_Ay[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])


print("")
```

```
for x in range(0,len(ranking_Ay)):
    if(ranking_Ay[x]==ratay5):
        print("Periode Ke - 5     =  120-150 Detik")
        print("Rata-Rata          = ",ranking_Ay[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Ay)):
    if(ranking_Ay[x]==ratay6):
        print("Periode Ke - 6     =  150-180 Detik")
        print("Rata-Rata          = ",ranking_Ay[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])
```

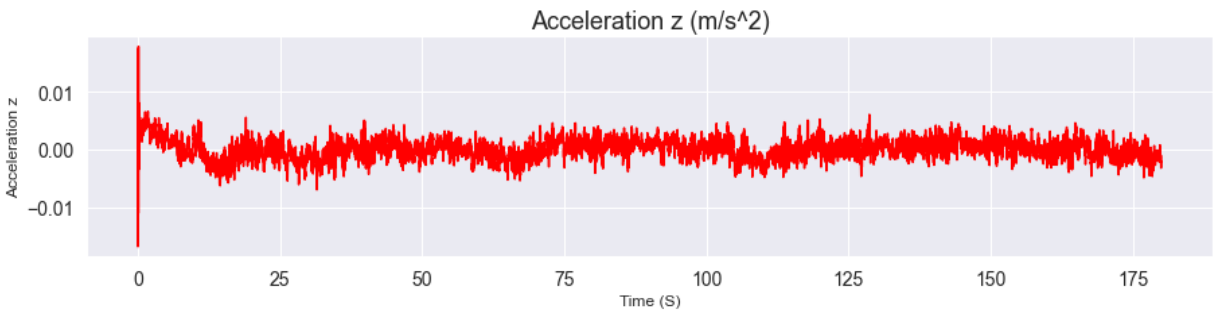
```
Periode Ke - 1     =  0-30 Detik
Rata-Rata          =  8.128113458674513e-05
Prediksi Kendaraan =  Truck Full Kapasistas

Periode Ke - 2     =  30-60 Detik
Rata-Rata          =  7.583868310076104e-05
Prediksi Kendaraan =  Mobil 1 Orang

Periode Ke - 3     =  60-90 Detik
Rata-Rata          =  7.59808756217604e-05
Prediksi Kendaraan =  Mobil 4-6 Orang

Periode Ke - 4     =  90-120 Detik
Rata-Rata          =  6.847801409837671e-05
Prediksi Kendaraan =  Sepeda Motor 1 Orang

Periode Ke - 5     =  120-150 Detik
Rata-Rata          =  7.515379284917109e-05
Prediksi Kendaraan =  Sepeda Motor 2 Orang

Periode Ke - 6     =  150-180 Detik
Rata-Rata          =  7.695744139444911e-05
Prediksi Kendaraan =  Truck Kosong
```

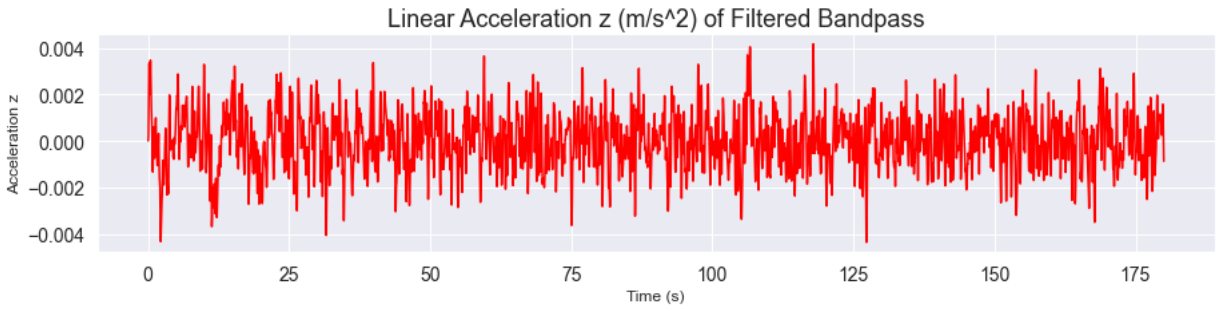
APLIKASI CLASSIFICATION Linear Acceleration Z

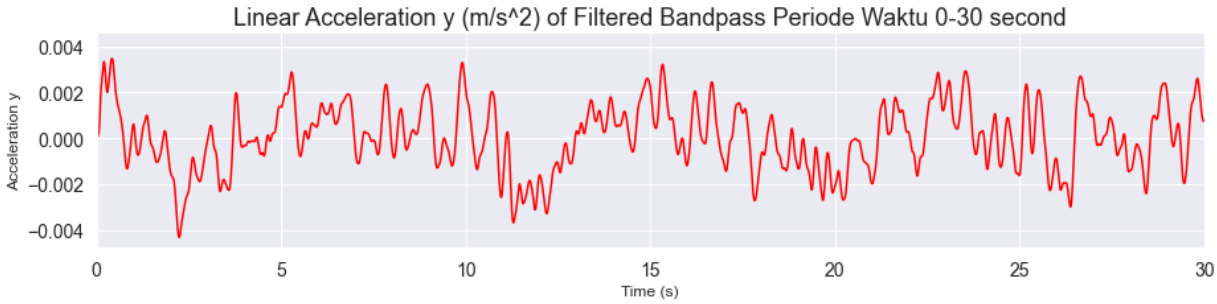
In [17]:

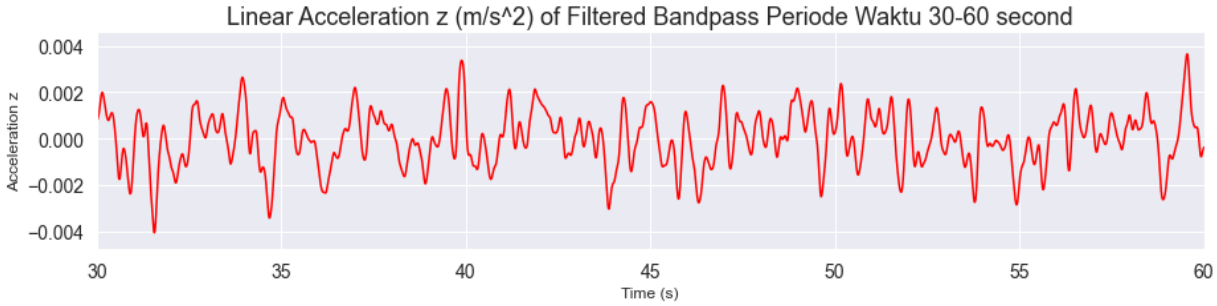
```
f_low_Az = 0.1 #Cutoff bawah
f_high_Az = 5 #Cutoff atas
fs_Az = 1/Tz #Sampling Frequency

#Band pass filter
# Filtered Data
filter_Az = butter_bandpass_filter2(Az,f_low_Az, f_high_Az, fs_Az, order=4)

##response
b, a = butter_bandpass(f_low_Az,f_high_Az, fs_Az, order=4)
# Plot the frequency response.
w, h = freqz(b, a, worN=64)

plt.subplots(figsize=(15,3))
plt.plot(waktu,Az,color = 'red')
plt.xlabel("Time (S)")
plt.ylabel("Acceleration z")
plt.title('Acceleration z (m/s^2)')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Az,color = 'red')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration z")
```

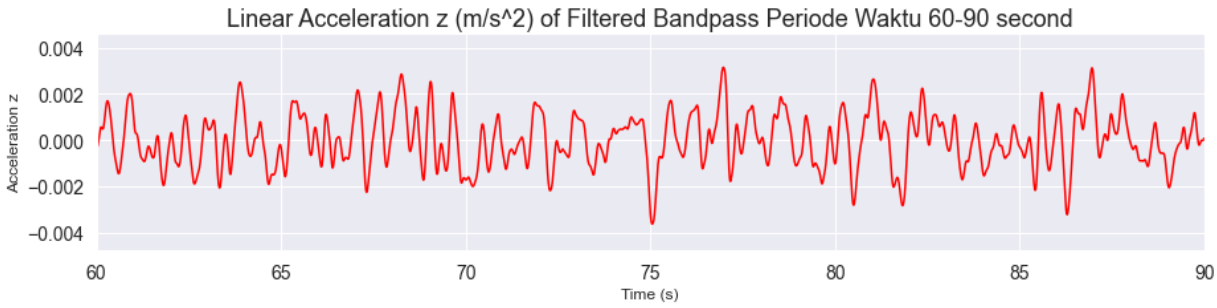
```
plt.title('Linear Acceleration z (m/s^2) of Filtered Bandpass')
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Az,color = 'red')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration y")
plt.title('Linear Acceleration y (m/s^2) of Filtered Bandpass Periode Waktu 0-30 sec
plt.xlim([0, 30])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Az,color = 'red')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration z")
plt.title('Linear Acceleration z (m/s^2) of Filtered Bandpass Periode Waktu 30-60 se
plt.xlim([30, 60])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Az,color = 'red')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration z")
plt.title('Linear Acceleration z (m/s^2) of Filtered Bandpass Periode Waktu 60-90 se
plt.xlim([60, 90])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Az,color = 'red')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration z")
plt.title('Linear Acceleration z (m/s^2) of Filtered Bandpass Periode Waktu 90-120 s
plt.xlim([90, 120])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Az,color = 'red')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration z")
plt.title('Linear Acceleration z (m/s^2) of Filtered Bandpass Periode Waktu 120-150
plt.xlim([120, 150])
plt.show()

plt.subplots(figsize=(15,3))
plt.plot(waktu,filter_Az,color = 'red')
plt.xlabel("Time (s)")
plt.ylabel("Acceleration z")
plt.title('Linear Acceleration z  (m/s^2) of Filtered Bandpass Periode Waktu 150-180
plt.xlim([150, 180])
plt.show()
```

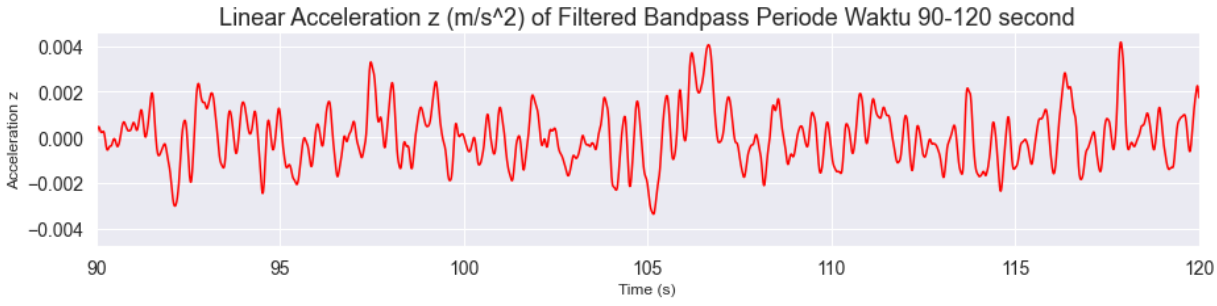


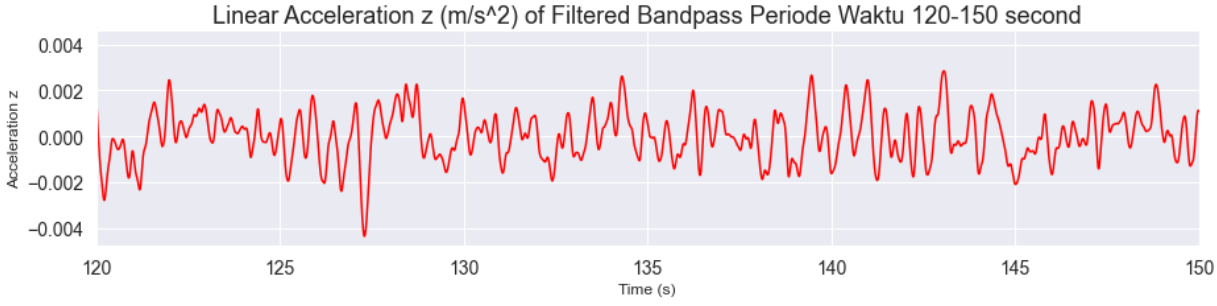

Linear Acceleration z (m/s^2) of Filtered Bandpass
Acceleration z
0.004
0.002
0.000
−0.002
−0.004
0
25
50
75
100
125
150
175
Time (s)

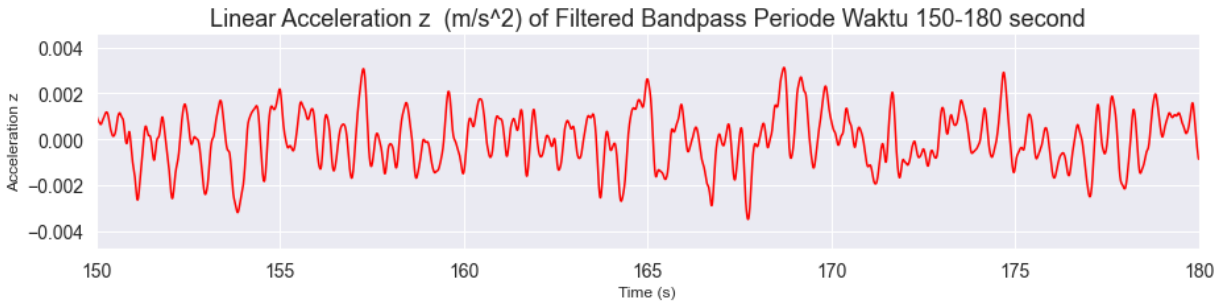

Linear Acceleration y (m/s^2) of Filtered Bandpass Periode Waktu 0-30 second
Acceleration y
0.004
0.002
0.000
−0.002
−0.004
0
5
10
15
20
25
30
Time (s)


Linear Acceleration z (m/s^2) of Filtered Bandpass Periode Waktu 30-60 second
Acceleration z
0.004
0.002
0.000
−0.002
−0.004
30
35
40
45
50
55
60
Time (s)


Linear Acceleration z (m/s^2) of Filtered Bandpass Periode Waktu 60-90 second
Acceleration z
0.004
0.002
0.000
−0.002
−0.004
60
65
70
75
80
85
90
Time (s)


Linear Acceleration z (m/s^2) of Filtered Bandpass Periode Waktu 90-120 second
Acceleration z
0.004
0.002
0.000
−0.002
−0.004
90
95
100
105
110
115
120
Time (s)


Linear Acceleration z (m/s^2) of Filtered Bandpass Periode Waktu 120-150 second
Acceleration z
0.004
0.002
0.000
−0.002
−0.004
120
125
130
135
140
145
150
Time (s)



In [18]:

```
print("================== Linear Acceleration z Clasification ==================")
sumz1 = 0
rataz1 = 0
for x in range(0,3000):
    if(filter_Az[x]>=0):
        sumz1 = sumz1 + filter_Az[x]

rataz1 = sumz1/3000
print ("Rata-Rata Periode Ke 1 Yaitu Detik 0-30    : ",rataz1)

sumz2 = 0
rataz2 = 0
for x in range(3000,6000):
    if(filter_Az[x]>=0):
        sumz2 = sumz2 + filter_Az[x]

rataz2 = sumz2/3000
print ("Rata-Rata Periode Ke 2 Yaitu Detik 30-60   : ",rataz2)

sumz3 = 0
rataz3 = 0
for x in range(6000,9000):
    if(filter_Az[x]>=0):
        sumz3 = sumz3 + filter_Az[x]

rataz3 = sumz3/3000
print ("Rata-Rata Periode Ke 3 Yaitu Detik 60-90   : ",rataz3)

sumz4 = 0
rataz4 = 0
for x in range(9000,12000):
    if(filter_Az[x]>=0):
        sumz4 = sumz4 + filter_Az[x]

rataz4 = sumz4/3000
print ("Rata-Rata Periode Ke 4 Yaitu Detik 90-120  : ",rataz4)

sumz5 = 0
rataz5 = 0
for x in range(12000,15000):
    if(filter_Az[x]>=0):
        sumz5 = sumz5 + filter_Az[x]

rataz5 = sumz5/3000
print ("Rata-Rata Periode Ke 5 Yaitu Detik 120-150 : ",rataz5)

sumz6 = 0
rataz6 = 0
for x in range(15000,17756):
    if(filter_Az[x]>=0):
        sumz6 = sumz6 + filter_Az[x]

rataz6 = sumz6/(17756-15000)
print ("Rata-Rata Periode Ke 6 Yaitu Detik 150-180 : ",rataz6)
```

```
================== Linear Acceleration z Clasification ==================
Rata-Rata Periode Ke 1 Yaitu Detik 0-30    :  0.0005987225828874627
Rata-Rata Periode Ke 2 Yaitu Detik 30-60   :  0.0004513411494919367
Rata-Rata Periode Ke 3 Yaitu Detik 60-90   :  0.0004424020849218419
Rata-Rata Periode Ke 4 Yaitu Detik 90-120  :  0.0004755507285605102
Rata-Rata Periode Ke 5 Yaitu Detik 120-150 :  0.00042573827997504596
Rata-Rata Periode Ke 6 Yaitu Detik 150-180 :  0.0004743693941934892
```

In [19]:

```
data_Rata_Rata_Az = [rataz1,rataz2,rataz3,rataz4,rataz5,rataz6]
ranking_Az = sorted(data_Rata_Rata_Az)
data_klasifikasi = ['Sepeda Motor 1 Orang','Sepeda Motor 2 Orang','Mobil 1 Orang','M

for x in range(0,len(ranking_Az)):
    if(ranking_Az[x]==rataz1):
        print("Periode Ke - 1     =  0-30 Detik")
        print("Rata-Rata          = ",ranking_Az[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Az)):
    if(ranking_Az[x]==rataz2):
        print("Periode Ke - 2     =  30-60 Detik")
        print("Rata-Rata          = ",ranking_Az[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Az)):
    if(ranking_Az[x]==rataz3):
        print("Periode Ke - 3     =  60-90 Detik")
        print("Rata-Rata          = ",ranking_Az[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Az)):
    if(ranking_Az[x]==rataz4):
        print("Periode Ke - 4     =  90-120 Detik")
        print("Rata-Rata          = ",ranking_Az[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])


print("")

for x in range(0,len(ranking_Az)):
    if(ranking_Az[x]==rataz5):
        print("Periode Ke - 5     =  120-150 Detik")
        print("Rata-Rata          = ",ranking_Az[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Az)):
    if(ranking_Az[x]==rataz6):
        print("Periode Ke - 6     =  150-180 Detik")
        print("Rata-Rata          = ",ranking_Az[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])
```

```
Periode Ke - 1     =  0-30 Detik
Rata-Rata          =  0.0005987225828874627
Prediksi Kendaraan =  Truck Full Kapasistas

Periode Ke - 2     =  30-60 Detik
```

```
Rata-Rata          =  0.0004513411494919367
Prediksi Kendaraan =  Mobil 1 Orang

Periode Ke - 3     =  60-90 Detik
Rata-Rata          =  0.0004424020849218419
Prediksi Kendaraan =  Sepeda Motor 2 Orang

Periode Ke - 4     =  90-120 Detik
Rata-Rata          =  0.0004755507285605102
Prediksi Kendaraan =  Truck Kosong

Periode Ke - 5     =  120-150 Detik
Rata-Rata          =  0.00042573827997504596
Prediksi Kendaraan =  Sepeda Motor 1 Orang

Periode Ke - 6     =  150-180 Detik
Rata-Rata          =  0.0004743693941934892
Prediksi Kendaraan =  Mobil 4-6 Orang
```

HASIL RATA RATA Acceleration X,Y,Z dan Klasifikasi Data

In [21]:

```
data_Rata_Rata_Axyz = [(sum([ratax1,ratay1,rataz1])/3),(sum([ratax2,ratay2,rataz2])/
                      (sum([ratax4,ratay4,rataz4])/3),(sum([ratax5,ratay5,rataz5])/3)
ranking_Axyz = sorted(data_Rata_Rata_Axyz)
data_klasifikasi = ['Sepeda Motor 1 Orang','Sepeda Motor 2 Orang','Mobil 1 Orang','M

for x in range(0,len(ranking_Axyz)):
    if(ranking_Axyz[x]==(sum([ratax1,ratay1,rataz1])/3)):
        print("Periode Ke - 1     =  0-30 Detik")
        print("Rata-Rata          = ",ranking_Axyz[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Axyz)):
    if(ranking_Axyz[x]==(sum([ratax2,ratay2,rataz2])/3)):
        print("Periode Ke - 2     =  30-60 Detik")
        print("Rata-Rata          = ",ranking_Axyz[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Axyz)):
    if(ranking_Axyz[x]==(sum([ratax3,ratay3,rataz3])/3)):
        print("Periode Ke - 3     =  60-90 Detik")
        print("Rata-Rata          = ",ranking_Axyz[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Axyz)):
    if(ranking_Axyz[x]==(sum([ratax4,ratay4,rataz4])/3)):
        print("Periode Ke - 4     =  90-120 Detik")
        print("Rata-Rata          = ",ranking_Axyz[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])

print("")

for x in range(0,len(ranking_Axyz)):
    if(ranking_Axyz[x]==(sum([ratax5,ratay5,rataz5])/3)):
        print("Periode Ke - 5     =  120-150 Detik")
        print("Rata-Rata          = ",ranking_Axyz[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])
```

```
print("")

for x in range(0,len(ranking_Axyz)):
    if(ranking_Axyz[x]==(sum([ratax6,ratay6,rataz6])/3)):
        print("Periode Ke - 6     =  150-180 Detik")
        print("Rata-Rata          = ",ranking_Axyz[x])
        print("Prediksi Kendaraan = ",data_klasifikasi[x])
```

```
Periode Ke - 1     =  0-30 Detik
Rata-Rata          =  0.0002676207575683902
Prediksi Kendaraan =  Truck Full Kapasistas

Periode Ke - 2     =  30-60 Detik
Rata-Rata          =  0.00021941137278585037
Prediksi Kendaraan =  Mobil 1 Orang

Periode Ke - 3     =  60-90 Detik
Rata-Rata          =  0.00021078257834514875
Prediksi Kendaraan =  Sepeda Motor 2 Orang

Periode Ke - 4     =  90-120 Detik
Rata-Rata          =  0.00022339781462456837
Prediksi Kendaraan =  Mobil 4-6 Orang

Periode Ke - 5     =  120-150 Detik
Rata-Rata          =  0.00020865769937954888
Prediksi Kendaraan =  Sepeda Motor 1 Orang

Periode Ke - 6     =  150-180 Detik
Rata-Rata          =  0.00023499592120700507
Prediksi Kendaraan =  Truck Kosong
```

In [ ]: