In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:
```
df = pd.read_csv('Hourly.csv', index_col='_time', parse_dates=True)
df.index.freq='H'
```

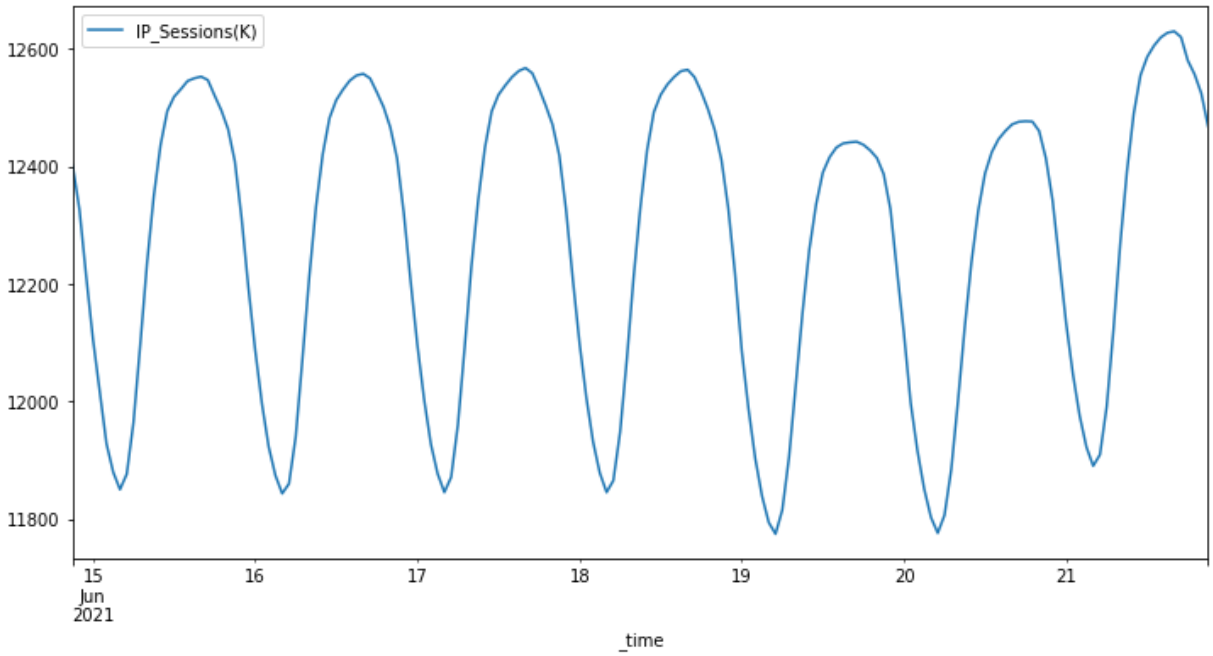
In [3]:
```
df.head()
```

Out[3]:

_time	IP_Sessions(K)
2021-06-14 21:00:00-04:00	12401.270
2021-06-14 22:00:00-04:00	12326.789
2021-06-14 23:00:00-04:00	12212.849
2021-06-15 00:00:00-04:00	12106.474
2021-06-15 01:00:00-04:00	12016.950

In [4]:
```
df.plot(figsize=(12,6))
```

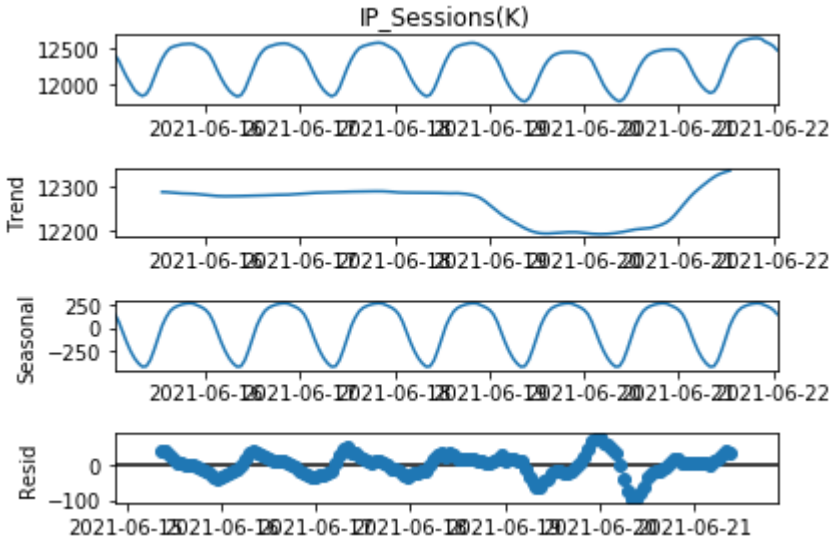
Out[4]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x20852360ba8>
```

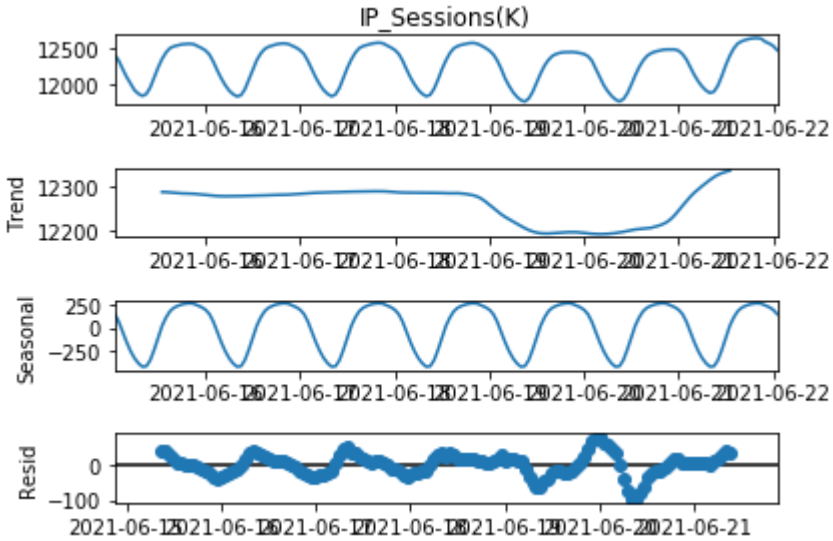


In [5]:
```
from statsmodels.tsa.seasonal import seasonal_decompose
```

In [6]:
```
results=seasonal_decompose(df['IP_Sessions(K)'])
results.plot()
```

Out[6]:





In [7]:
```
len(df)
```

Out[7]: 169

In [8]:
```
train = df.iloc[:145]
test = df.iloc[145:]
```

In [9]:
```
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
```

In [10]:
```
df.head(),df.tail()
```

Out[10]:
```
(                          IP_Sessions(K)
 _time
 2021-06-14 21:00:00-04:00       12401.270
 2021-06-14 22:00:00-04:00       12326.789
 2021-06-14 23:00:00-04:00       12212.849
 2021-06-15 00:00:00-04:00       12106.474
 2021-06-15 01:00:00-04:00       12016.950,
                           IP_Sessions(K)
 _time
 2021-06-21 17:00:00-04:00       12619.655
 2021-06-21 18:00:00-04:00       12579.974
 2021-06-21 19:00:00-04:00       12556.612
 2021-06-21 20:00:00-04:00       12524.127
 2021-06-21 21:00:00-04:00       12468.349)
```

In [11]:
```
scaler.fit(train)
scaled_train = scaler.transform(train)
scaled_test = scaler.transform(test)
```

In [12]:
```
scaled_test[:10]
```

Out[12]:
```
array([[0.71516662],
       [0.58231887],
       [0.45224117],
       [0.34335048],
       [0.25365195],
       [0.18670096],
       [0.14601246],
       [0.16999351],
       [0.27292997],
       [0.43737958]])
```

In [13]:
```
from keras.preprocessing.sequence import TimeseriesGenerator
```

In [14]:
```
#define generator
n_input = 48
n_features = 1
generator = TimeseriesGenerator(scaled_train, scaled_train, length=n_input, batch
```

In [15]:
```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import LSTM
```

In [16]:
```
model = Sequential()
model.add(LSTM(100, activation='relu',input_shape=(n_input, n_features)))
model.add(Dense(1))
model.compile(optimizer='adam', loss='mse')
```

In [17]:
```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm (LSTM)                  (None, 100)               40800
_________________________________________________________________
dense (Dense)                (None, 1)                 101
=================================================================
Total params: 40,901
Trainable params: 40,901
Non-trainable params: 0
_________________________________________________________________
```

In [18]:
```
model.fit(generator, epochs=50)
```

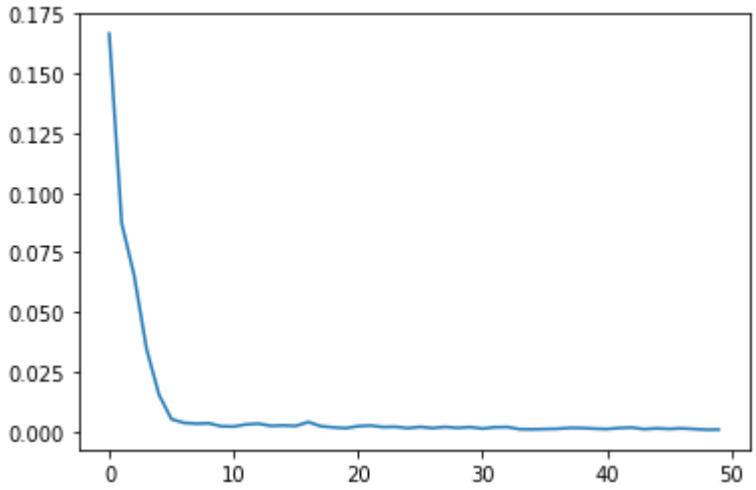
```
Epoch 1/50
97/97 [==============================] - 25s 11ms/step - loss: 0.2388
Epoch 2/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0897
Epoch 3/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0815
Epoch 4/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0485
Epoch 5/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0262
Epoch 6/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0054
Epoch 7/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0041
Epoch 8/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0037
Epoch 9/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0026
Epoch 10/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0024
Epoch 11/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0026
Epoch 12/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0029
Epoch 13/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0029
Epoch 14/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0021
Epoch 15/50
97/97 [==============================] - 1s 13ms/step - loss: 0.0041
Epoch 16/50
97/97 [==============================] - 1s 14ms/step - loss: 0.0025
Epoch 17/50
97/97 [==============================] - 1s 13ms/step - loss: 0.0039
Epoch 18/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0017
Epoch 19/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0016
Epoch 20/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0018
Epoch 21/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0029
Epoch 22/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0021
Epoch 23/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0014
Epoch 24/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0018
Epoch 25/50
97/97 [==============================] - 1s 13ms/step - loss: 0.0015
Epoch 26/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0025
Epoch 27/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0015
```

```
Epoch 28/50
97/97 [==============================] - 1s 13ms/step - loss: 0.0016
Epoch 29/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0016
Epoch 30/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0014
Epoch 31/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0013
Epoch 32/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0020
Epoch 33/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0025
Epoch 34/50
97/97 [==============================] - 1s 12ms/step - loss: 8.6430e-04
Epoch 35/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0015
Epoch 36/50
97/97 [==============================] - 1s 12ms/step - loss: 9.1658e-04
Epoch 37/50
97/97 [==============================] - 1s 11ms/step - loss: 9.8932e-04
Epoch 38/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0016
Epoch 39/50
97/97 [==============================] - 1s 13ms/step - loss: 0.0013
Epoch 40/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0011
Epoch 41/50
97/97 [==============================] - 1s 11ms/step - loss: 9.6221e-04
Epoch 42/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0010
Epoch 43/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0025
Epoch 44/50
97/97 [==============================] - 1s 14ms/step - loss: 0.0012
Epoch 45/50
97/97 [==============================] - 1s 13ms/step - loss: 8.6529e-04
Epoch 46/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0012
Epoch 47/50
97/97 [==============================] - 1s 11ms/step - loss: 0.0014
Epoch 48/50
97/97 [==============================] - 1s 12ms/step - loss: 0.0011
Epoch 49/50
97/97 [==============================] - 1s 12ms/step - loss: 7.1484e-04
Epoch 50/50
97/97 [==============================] - 1s 11ms/step - loss: 5.2891e-04
```

Out[18]: <keras.callbacks.History at 0x20869dcceb8>

In [19]:
```
loss_per_epoch = model.history.history['loss']
plt.plot(range(len(loss_per_epoch)),loss_per_epoch)
```

Out[19]:
```
[<matplotlib.lines.Line2D at 0x2087103e438>]
```



In [20]:
```
last_train_batch = scaled_train[-48:]
```

In [21]:
```
last_train_batch = last_train_batch.reshape((1, n_input, n_features))
```

In [22]:
```
model.predict(last_train_batch)
```

Out[22]:
```
array([[0.72383904]], dtype=float32)
```

In [23]:
```
scaled_test[0]
```

Out[23]:
```
array([0.71516662])
```

In [24]:
```
test_predictions = []
first_eval_batch = scaled_train[-n_input:]
current_batch = first_eval_batch.reshape((1, n_input, n_features))

for i in range(len(test)):

    current_pred = model.predict(current_batch)[0]
    test_predictions.append(current_pred)
    current_batch = np.append(current_batch[:,1:,:],[[current_pred]],axis=1)
```

In [25]:
```
test_predictions
```

Out[25]:
```
[array([0.72383904], dtype=float32),
 array([0.6237947], dtype=float32),
 array([0.50450146], dtype=float32),
 array([0.37723696], dtype=float32),
 array([0.25770193], dtype=float32),
 array([0.16007438], dtype=float32),
 array([0.09537002], dtype=float32),
 array([0.07395219], dtype=float32),
 array([0.10503799], dtype=float32),
 array([0.19089332], dtype=float32),
 array([0.32579434], dtype=float32),
 array([0.48459643], dtype=float32),
 array([0.6258188], dtype=float32),
 array([0.73322654], dtype=float32),
 array([0.80714375], dtype=float32),
 array([0.8534145], dtype=float32),
 array([0.8792583], dtype=float32),
 array([0.8941537], dtype=float32),
 array([0.90420246], dtype=float32),
 array([0.90778893], dtype=float32),
 array([0.8982212], dtype=float32),
 array([0.8729669], dtype=float32),
 array([0.8294558], dtype=float32),
 array([0.7638344], dtype=float32)]
```

In [26]:
```
test.head()
```

Out[26]:

_time	IP_Sessions(K)
2021-06-20 22:00:00-04:00	12341.698
2021-06-20 23:00:00-04:00	12236.477
2021-06-21 00:00:00-04:00	12133.450
2021-06-21 01:00:00-04:00	12047.204
2021-06-21 02:00:00-04:00	11976.159

In [27]:
```
true_predictions = scaler.inverse_transform(test_predictions)
```

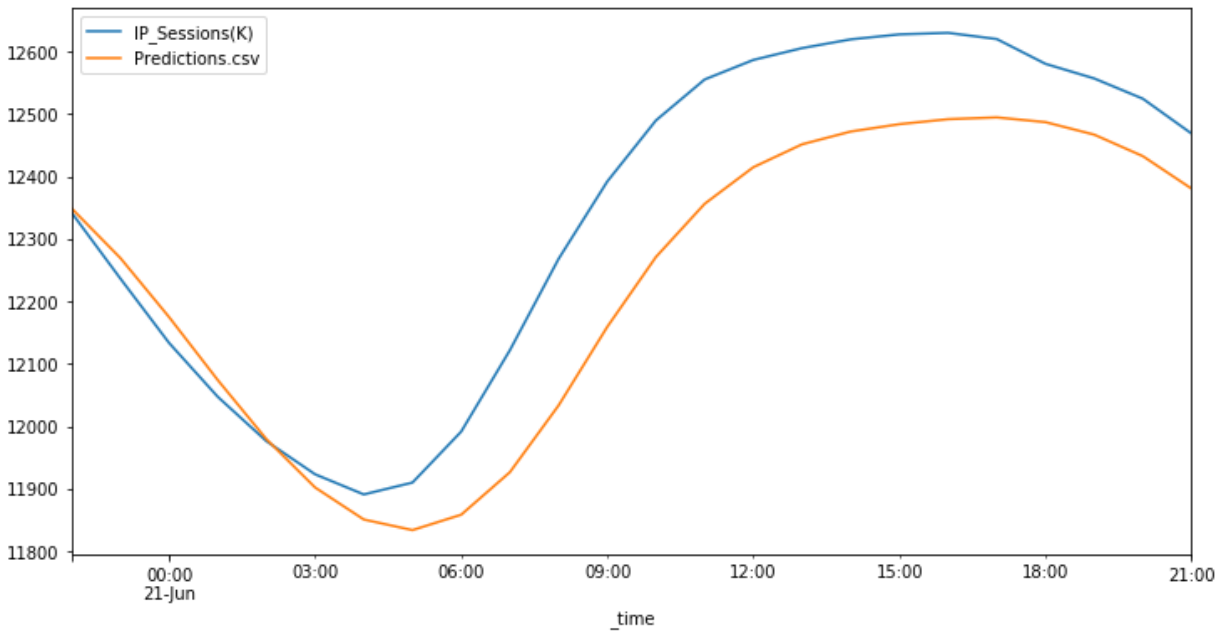
In [28]:
```
test['Predictions.csv'] = true_predictions
```

```
C:\Users\karir\Documents\ana\lib\site-packages\ipykernel_launcher.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  """Entry point for launching an IPython kernel.
```

In [29]:
```
test.plot(figsize=(12,6))
```

Out[29]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x208717889b0>
```



In [30]:
```
test_predictions
```

Out[30]:
```
[array([0.72383904], dtype=float32),
 array([0.6237947], dtype=float32),
 array([0.50450146], dtype=float32),
 array([0.37723696], dtype=float32),
 array([0.25770193], dtype=float32),
 array([0.16007438], dtype=float32),
 array([0.09537002], dtype=float32),
 array([0.07395219], dtype=float32),
 array([0.10503799], dtype=float32),
 array([0.19089332], dtype=float32),
 array([0.32579434], dtype=float32),
 array([0.48459643], dtype=float32),
 array([0.6258188], dtype=float32),
 array([0.73322654], dtype=float32),
 array([0.80714375], dtype=float32),
 array([0.8534145], dtype=float32),
 array([0.8792583], dtype=float32),
 array([0.8941537], dtype=float32),
 array([0.90420246], dtype=float32),
 array([0.90778893], dtype=float32),
 array([0.8982212], dtype=float32),
 array([0.8729669], dtype=float32),
 array([0.8294558], dtype=float32),
 array([0.7638344], dtype=float32)]
```

In [ ]:
```

```