

**EXP : No.7**

**DATE: 10/4/25**

**Implement Program for decomposing time series data into trend and seasonality.**

### **AIM:**

To analyze and visualize the underlying trend, seasonal pattern, and residual noise in synthetic Air Quality Index (AQI) data for India using time series decomposition.

### **ALGORITHM:**

1. Load the Dataset
2. Generate Synthetic AQI Data
3. Create a DataFrame
4. Filter and Prepare Time Series
5. Apply Time Series Decomposition
6. Visualize the Components

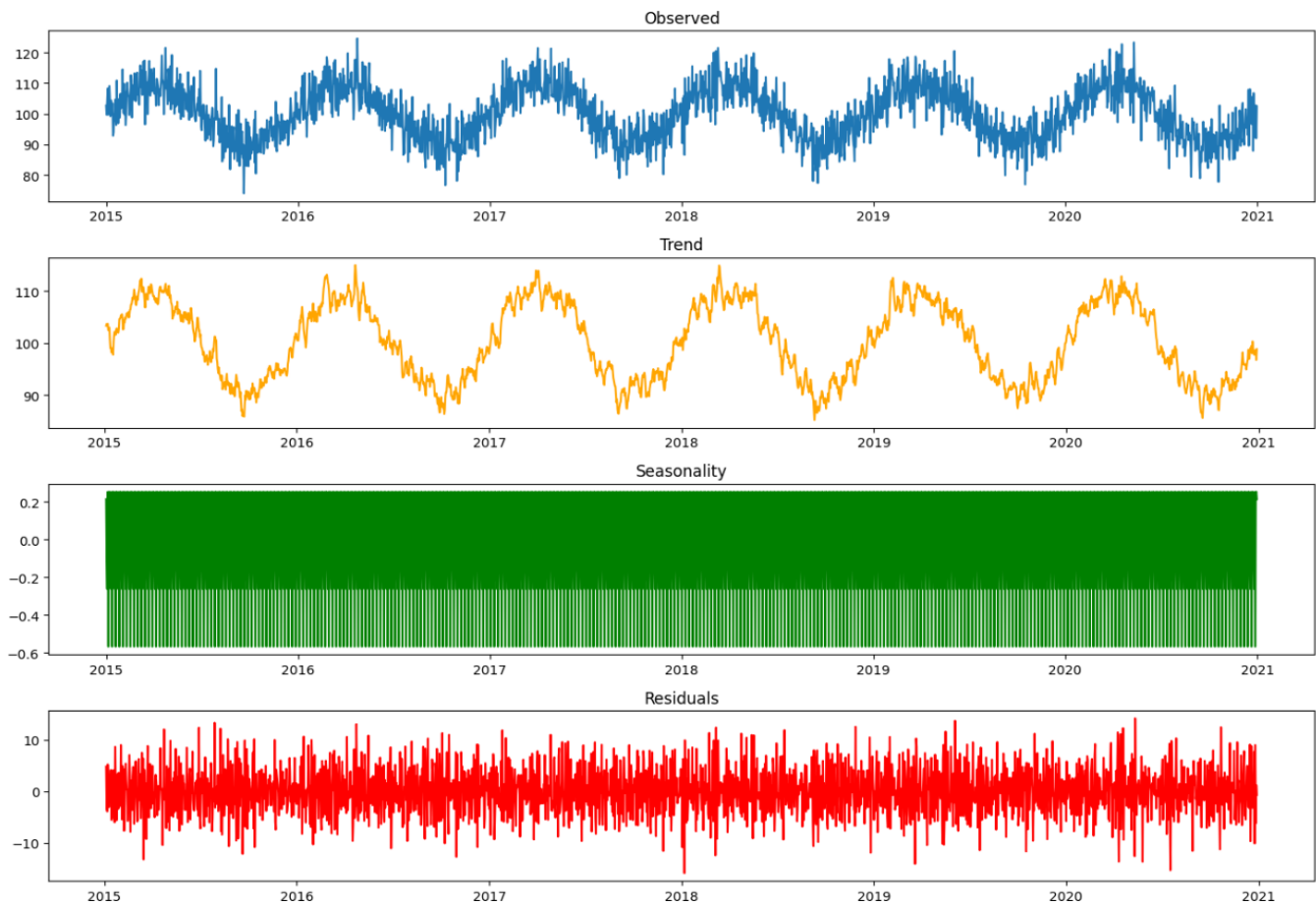
### **CODE:**

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from statsmodels.tsa.seasonal import seasonal_decompose
np.random.seed(42)

date_range = pd.date_range(start='2015-01-01', end='2020-12-31', freq='D')
aqi_values = 100 + 10 * np.sin(2 * np.pi * date_range.dayofyear / 365.25) + np.random.normal(0, 5, len(date_range))
df = pd.DataFrame({
    'Date': date_range,
    'Country': 'India',
    'AQI Value': aqi_values
})
```

```
df_country = df[df['Country'] == 'India'].groupby("Date")['AQI Value'].mean()
df_country = df_country.asfreq('D')
df_country = df_country.interpolate()
decomposition = seasonal_decompose(df_country, model='additive')
plt.figure(figsize=(14, 10))
plt.subplot(4, 1, 1)
plt.plot(decomposition.observed)
plt.title('Observed')
plt.subplot(4, 1, 2)
plt.plot(decomposition.trend, color='orange')
plt.title('Trend')
plt.subplot(4, 1, 3)
plt.plot(decomposition.seasonal, color='green')
plt.title('Seasonality')
plt.subplot(4, 1, 4)
plt.plot(decomposition.resid, color='red')
plt.title('Residuals')
plt.tight_layout()
plt.show()
```

## OUTPUT:



## RESULT:

Thus the program has been completed and verified successfully.

