School of Computer Science Engineering and Technology

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| Course- B. Tech | Type- Specialization Elective |
| Course Code- CSET369 | Course Name- Time Series Analysis |
| Year- 3rd Year | Semester- V |
| Date- Week 3 |  |

**Lab Assignment -3**

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| Experiment | CO1 | CO2 | CO3 |
| Statistical tests for identifying trends, seasonality, and stationarity of time series data |  |  |  |

**Objective:** Convert a non‑stationary time series into a stationary series using appropriate transformations.

Apply the learned concepts and check the nature of autocorrelation in the transformed (stationary) series.

Download the following time series dataset and read them as a python dataframe and print the heads.

* Air quality Data (<https://www.kaggle.com/datasets/fedesoriano/air-quality-data-in-india)>)

**Perform all the following tasks on the above dataset.**

**Task 1 — Identify Non‑Stationarity**

1. Plot the time series with a rolling mean and rolling standard deviation (window = 12 months).
2. Perform the **Augmented Dickey‑Fuller (ADF)** test and the **KPSS** test on the raw monthly PM2.5 series.

**Task 2 — Transform to Stationary**

Using the same series from Task 1:

1. Apply a **log transform** (if values > 0) and show the transformed series.
2. Apply **first‑order differencing** on the (log) series. If seasonality appears strong, apply **seasonal differencing** (lag = 12) as needed.
3. For each transformation step, plot the series and re‑run ADF and KPSS tests until stationarity is achieved.

### Task 3 — Autocorrelation Analysis on Stationary Series

Using the final stationary series obtained in Task 2:

1. Plot the **ACF** and **PACF** up to lag 36 (or 3× seasonal period).
2. Identify significant lags and discuss whether the pattern suggests AR, MA, or seasonal components.