Course Title:	Time Series Analysis
Course Code:	STAT- 403
Semester:	VII
Credit Hours:	3 Credit Hours
Pre-requisites:	N / A

Learning Outcomes

By the end of this course, students will be able to:

1. Get the key concepts of time series, its objectives, components and special features.
2. Learn the descriptive techniques of transforming, differencing and analyzing the seasonal and irregular variations.
3. Develop the probability models of time series along with their theoretical framework.

Course Outline

Unit 1

1.1 Descriptive Statistics of time series

Calculation and interpretation of the mean, variance, auto-covariance, auto-correlation and partial auto-correlation for sample time series data.

Unit 2

2.1 Probability Models for Time Series

Stochastic processes and stationary processes, useful stochastic processes, purely random process, random walk, moving average process, Stationarity and Invertibility of moving average models, auto-regressive process, Stationarity and invertibility of auto-regressive models, Duality between moving average and auto-regressive models, Principle of parsimony, GARCH models

Unit 3

3.1 Model Building

Various stages of model building, Identification of model from sample time series, steps for model identification, estimating the auto-covariance, auto-correlation function and partial auto-correlation function, pattern of theoretical ACF and PACF as a tool of model identification.

Unit 4

4.1 Computer-based Analysis and Modeling of time series Data

Hands-on experience with software tools (e.g., R, Python, SPSS, Eviews) for time series analysis, Implementation of descriptive statistics and probability models, Visualization techniques for time series data.

Unit 5

5.1 Parameter Estimation

Estimating the parameters of an auto-regressive model, estimating the parameters of moving average, Back casting, dual estimation, mixed ARMA model and integrated model. The Box-Jenkins seasonal model. Model diagnostics; Residual analysis, over fitting and parameter redundancy, portmanteau tests. Model selection criteria, AIC, BIC.

5.2 Forecasting

Univariate procedures, Minimum mean square estimate of forecast, forecast weights, analysis of forecast error, Exponential Smoothing techniques

Unit 6

6.1 Introduction to Multivariate Time Series

Overview of multivariate time series analysis, Key concepts and techniques for analyzing multiple time series simultaneously.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Text Book

1. Chatfield, C. (2003). *The analysis of time series: An introduction* (6th ed.). Chapman & Hall, London.

Suggested Readings

1. Box, G.E.P., Jenkins, G.M., & Reinsel, G.C. (2008). *Time series analysis: Forecasting and control* (4th ed.). Holden-dayk, San Francisco.
2. Brockwell, P.J. & Davis, R.A. (2010). *Introduction to time series and forecasting* (2nd ed.). Springer, New York.
3. Wei, W. (2005). *Time series analysis: Univariate and multivariate methods* (2nd ed.). Addison-Wesley publishing company, Inc.