



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02023041

Subject Name: Statistical Methods & Time Series Analysis

WEF Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

<b>Prerequisite:</b>	Must have knowledge of Basic Algebra and Functions, Calculus, sequences and series, Linear Algebra and Matrices
<b>Rationale:</b>	Statistics and time series analysis are foundational tools for solving complex problems and making data-driven decisions in engineering, science, and industry. This course equips students with the skills to analyze, interpret, and model data, enabling them to understand patterns and trends critical for forecasting, optimization, and decision-making.

## Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Gain a foundational understanding of probability theory including concepts like sample spaces, events, and probability distributions.	UN
02	Proficiency in Hypothesis Testing: Understanding the framework, conducting tests for means and proportions, interpreting p-values and significance levels, recognizing Type I and Type II errors, and applying statistical inference techniques.	AP
03	Ability to perform and interpret z-tests and confidence intervals for differences between two population means, conduct two-sample t-tests, apply ANOVA.	EL
04	Estimate and interpret trends using methods like moving averages, curve fitting, and detrending.	AP
05	Utilize statistical techniques for demand forecasting, resource optimization, and system reliability in engineering systems.	EL

\*RM: Remember, UN: Understand, AP: Apply, AN: Analyse, EL: Evaluate, CR: Create



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## Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

## Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Fundamental Probability Concepts for Statistical Analysis: Definitions and Rules of Probability, Sample Spaces and Events, Conditional Probability and Independence, Discrete Random Variables and Probability Distributions, Continuous Random Variables and Probability Distributions.	9	20
2	Sampling Distributions and the Central Limit Theorem, General Concepts of Point Estimation, Methods of Point Estimation-Method of Moments and Method of Maximum Likelihood. <b>Statistical Intervals Based on a Single Sample:</b> Basic Properties of Confidence Intervals, Large-Sample Confidence Intervals for a Population Mean and Proportion, Confidence Intervals for the Variance and Standard Deviation of a Normal Population	9	20
3	<b>Hypothesis Testing:</b> Hypotheses and Test Procedures, Large Sample Hypothesis Tests for Population Mean and Population Proportion, Small Sample Test for Population Mean, Large Sample Tests for a Difference Between Two Population Means and for a Difference Between Two Population Proportions, Small Sample Test for a Difference Between Two Population Means, Single-Factor ANOVA, Multiple Comparisons in ANOVA,	9	20
4	Fundamentals of Time Series: Definition and characteristics of time series data, Applications of time series analysis, Components of a time series: Trend, Seasonal variations, Cyclic variations, Irregular components, Decomposition of Time Series, Additive and multiplicative	9	20



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	models, Trend Analysis, Methods for estimating trend, Case studies in trend estimation		
5	Trend Analysis and Seasonal Components, Advanced Trend Analysis, Method of moving averages for trend estimation, Detrending, Seasonal Components, Definition and significance of seasonality in time series, Estimation of seasonal components, Autoregressive Integrated Moving Average (ARIMA): Understanding the components (AR, I, MA), Model identification (ACF, PACF, differencing), Parameter estimation and diagnostic checks, Seasonal ARIMA (SARIMA): Incorporating seasonality into ARIMA models, Identifying seasonal components and periodicity, Model building and validation, Real-world applications of ARIMA and SARIMA in Forecasting demand. Examples: Predicting resource utilization in engineering systems, Analyzing environmental or climatic time series	9	20
	<b>Total</b>	<b>45</b>	<b>100</b>

## Reference Book:

1. Miller and Freund's - Probability and Statistics for Engineers, Richard A. Johnson, Miller and Freund, 9th Edition , Pearson Education.
2. Probability and Statistics for Engineers and Scientists | Includes Case studies with Statistical Software coverage such as SAS & MINITAB, Updated 9th Edition Paperback – 7 March 2024, Ronald E. Walpole , Raymond H. Myers, Sharon L. Myers, Pearson Education.
3. George Casella , Roger L. Berger, Statistical Inference, Cengage Learning, 2nd Edition Paperback – 1 December 2007.
4. Peter J. Brockwell and Richard A. Davis, Introduction to Time Series and Forecasting, Springer, Second edition 2010.
5. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel and Greta M. Ljung, Time Series Analysis: Forecasting and Control, John Wiley and Sons Inc. 5th Edition, 2015, ISBN: 978-1-118-67502-1.

## Suggested Course Practical List:

N/A



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## List of Open Course wares:

- <https://oli.cmu.edu/courses/probability-statistics-open-free/>
- [https://onlinecourses.nptel.ac.in/noc21\\_ch28/preview](https://onlinecourses.nptel.ac.in/noc21_ch28/preview)
- [https://youtube.com/playlist?list=PLxaL\\_Pkhcom-ITN6odlYxQuRe4gwhknhJ&si=bTxZDd98qJ1hmqim](https://youtube.com/playlist?list=PLxaL_Pkhcom-ITN6odlYxQuRe4gwhknhJ&si=bTxZDd98qJ1hmqim)

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