1. **Course Title:** PROBABILITY AND STATISTICS
2. **Course Code:** MA 21001
3. **L-T-P Structure:** 3-1-0
4. **Course Faculty:** Dr. Utkal Keshari Dutta
5. **Course Coordinator:** Dr. Prasanta Kumar Das

Pre-mid :	**22 July – 14 Sept**
Midsem:	**17 Sept - 21 Sept**
Post-mid:	**23 Sept – 16 Nov**
Endsem:	**22 Nov -30 Nov**

6. **COURSE OBJECTIVE**

The objective of this course is to familiarize the students with the foundation of probability and statistics and to use it in solving the problems arises in engineering and real life applications.

7. **COURSE OUTCOMES**

At the end of the course, the students will be expected to:

CO1: understand basic probability and its applications
CO2: study probability distributions and can use it in real life data analysis
CO3: have a knowledge on univariate and bivariate distributions and their properties
CO4: measure the central tendency and dispersion of a data set to draw conclusion from the data and interpret the data with the appropriate pictorial representation.
CO5: have good understanding of the Central Limit Theorem and its applications
CO6: analyze the statistical inference

8. **COURSE DETAILS**

Probability and random variables:

Basic concepts of sample space, events (with example), Axiom of Probability, Conditional Probability, Bayes' Theorem and its applications. Discrete random variable, probability mass function, cumulative distribution function and Moment Generating function for discrete random variable, some special distributions like Uniform distribution, Geometric distribution, Binomial distribution, Negative Binomial distribution, Poisson distribution, Hypergeometric distribution, mean and variance. Continuous random variable, density function, cumulative distribution function and Moment Generating function. Uniform distribution, normal distribution, mean, variance, percentile and critical value of normal distribution, normal approximation of the binomial distribution and exponential distribution.

Joint probability and distributions:

Joint probability mass function and marginal probability mass function, joint probability density function and marginal probability density function, concept of independent random variable (joint probability), conditional probability mass function and conditional probability density function. Expected value, covariance and correlation for jointly distributed random variable(both continuous and discrete). Sum of two independent random variables, and weak law of large number.

Descriptive Statistics:

Frequency distribution, pictorial and tabular representation of data, stem and leaf display, dot plots, histogram, box plots and comparative box plots. Basic concepts on mean, median and mode, Skewness, Kurtosis, Correlation, Coefficient of Correlation, rank correlation, Regression Analysis (Least square method).

Inferential statistics:

Population, sample, random sample, sampling distribution, distribution of sample mean, central limit theorem, point estimator, point estimation of parameter using method of maximum likelihood estimation, confidence interval, confidence interval for the mean of a normal population with known and unknown variance, confidence interval for the variance of a normal population, hypothesis testing, one sided and two sided alternatives, Tests for mean of the normal distribution with known variance, Tests for mean of the normal distribution with unknown variance, tests for variance of the normal distribution.

Text books:

T1. Probability and Statistics for Engineers and Sciences by J. L. Devore, CENGAGE Learning, 9th Edition.

T2. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition.

Reference Books:

R1. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross, Elsevier/AP, 6th Edition.

R2. Introduction to Probability and Statistics by J.S. Milton & J.C. Arnold, McGraw Hill, 4th Edition.

R3. Introduction to Probability Theory and Statistical Inference by H.J. Larson, John Wiley & Sons Inc, 3rd Edition.

R4. Fundamental of Mathematical Statistics by S.C. Gupta & V. K. Kapoor, S. Chand, 12th Edition.

9. LESSON PLAN AND ACTIVITIES

Unit Name	Lect. No.	Learning Topics to be covered	Article No. / Text Book	CO Mapping
	1.	Introduction to course		
	2.	Sample spaces, Events	2.1 (T1)	CO1
	3.	Axiom of Probability, properties of probability	2.2 (T1)	CO1
	4.	Tutorial (Problem Solving)	2.1—2.2 (T1)	
	5.	Conditional Probability, Bayes' Theorem	2.4 (T1)	CO1
	6.	Independent events	2.5 (T1)	CO1
	7.	Random variable, Discrete random variable, Continuous random variable	3.1 (T1)	CO2
Probability and random variables	8.	Tutorial (Problem Solving)	2.4—2.5, 3.1 (T1)	CO1, CO2
	9.	Probability mass function of discrete random variable, Parameter of distribution	3.2 (T1)	CO2
	10.	Geometric distribution, Cumulative distribution function	3.2 (T1)	CO2
	11.	Expected values, Variance, Standard deviation, Expected values and variance of Linear function	3.3 (T1)	CO2
	12.	Tutorial (Problem Solving) Discrete Uniform distribution,	3.2 -- 3.3 (T1)	CO2

		Mean and Variance of discrete uniform, geometric distribution Chebyshev Inequality		
	13.	Moments, Central moments, Moment Generating function	24.6, 24.7 (T2)	CO2
	14.	Binomial distribution, Mean and variance of Binomial distribution	3.4(T1)	CO2
	15.	Moment Generating function of Binomial distribution	24.7 (T2)	
	16.	Tutorial (Problem Solving)	24.5 (T2), 3.4 (T1)	CO2
	17.	Hypergeometric distribution, Negative Binomial distribution	3.5 (T1)	CO2
	18.	Poisson distribution, Mean and variance of Poisson distribution	3.6 (T1)	CO2
	19.	Moment Generating function of Poisson distribution, Poisson process	24.7 (T2) 3.6 (T1)	CO2
	20.	Tutorial (Problem solving)		
		Quiz Test-1 Assignment-I		
	21.	Probability density function of Continuous random variable, Continuous Uniform distribution	4.1(T1)	CO2
	22.	Cumulative distribution function of Continuous random variable, mean, variance of Continuous Uniform distribution	4.2(T1)	CO2
	23.	percentile and median of Continuous Uniform distribution	4.2(T1)	CO2
	24.	Tutorial (Problem solving)	4.1-- 4.2 (T1)	CO2
	25.	Normal distribution, percentile and critical value of normal distribution	4.3(T1)	CO2
	26.	Normal approximation of the binomial distribution, Applications	4.3(T1)	CO2
	27.	Exponential distribution, Mean, variance and median	4.4(T1)	CO2
	28.	Tutorial (Problem solving)	4.3-- 4.4 (T1)	CO2
Joint probability and distributions	29.	Joint probability mass function and marginal probability mass functions	5.1(T1)	CO3
	30.	Joint probability density function and marginal probability density function	5.1(T1)	CO3
	31.	Independent random variables, Conditional distribution	5.1(T1)	CO3
	32.	Tutorial (Problem solving)	5.1(T1)	CO3
	33.	Expected values, covariance and Correlation coefficient for jointly distribution	5.2(T1)	CO3
	34.	Statistics, Random Sample	5.3(T1)	CO3
	35.	The distribution of Sample mean. Mean Random variable, mean and variance of mean random variable of the identically	5.4(T1)	CO3

		independent random variables, Central limit theorem		
	36.	Tutorial (Problem solving)	5.2—5.4 (T1)	CO3
		Quiz Test-II, Assignment-II		
Descriptive Statistics	37.	Stem and leaf display, Dotplots, Frequency distribution, pictorial and tabular representation of data, Histogram	1.2(T1)	CO4
	38.	Basic concepts on mean, median and mode	1.3(T1)	CO4
	39.	Sample variance and sample standard deviation, box plots and comparative box plots	1.4 (T1)	CO4
	40.	Tutorial (Problem solving)	1.1--1.4 (T1)	CO4
	41.	Skewness, Kurtosis Correlation	24.6 (T2)	CO4
	42.	Coefficient of Correlation, rank correlation	25.9 (T2)	CO4
	43.	Regression Analysis: Least square method	20.5 (T2)	CO4
	44.	Tutorial (Problem solving)	24.6, 25.9, 20.5 (T2)	
	45.	Linear regression	20.5 (T2)	CO4
	46.	Problems solving on Linear regression	20.5 (T2)	CO4
	47.	Regression: Fitting straight line using correlation coefficient of the data	25.9 (T2)	CO4
	48.	Tutorial (Problem solving)	25.9, 20.5 (T2)	CO4
		Assignment-III		
Inferential statistics	49.	Population, sample, random sample,	25.1(T2)	CO5
	50.	Sampling distribution, distribution of sample mean	25.1(T2)	CO5
	51.	Point estimator, point estimation of parameter using method of maximum likelihood estimation Estimation of parameter of normal distribution	25.2(T2)	CO5
	52.	Tutorial (Problem solving) Estimation of parameter of binomial, geometric, poison, exponential	25.1-- 25.2 (T2)	CO5
	53.	Confidence interval, confidence interval for the mean of a normal population with known variance	25.3 (T2)	CO6
	54.	t-distribution, confidence interval for the mean of a normal population with unknown variance	25.3(T2)	CO6
	55.	χ^2-distribution, confidence interval for the variance of a normal population	25.3(T2)	CO6
	56.	Tutorial (Problem solving)	25.3(T2)	CO6
	57.	Hypothesis testing, one sided and two-sided alternatives	25.4(T2)	CO6
	58.	Tests for mean of the normal distribution with known or unknown variance	25.4(T2)	CO6

	59.	Tests for variance of the normal distribution	25.4(T2)	CO6
	60.	Tutorial (Problem solving)	25.4(T2)	CO6
	61.	Previous Year's question & answer discussion		
		Assignment-IV (Critical Q. Sets), Quiz Test-III		

N.B: The problems in the tutorial classes may be solved by touching the specific parts taught in the previous classes.

10. ASSESSMENT COMPONENTS

Sl. No.	Assessment Component	Duration	Weightage / Marks	Nature of the Component
1	Mid Semester Examination	90 min	20	Closed Book
2	End Semester Examination	2.5 Hours	50	Closed Book
3	Problem Solving (Assignment)	3 days/ Assignment	15	Open Book
4	Quiz Test	30 min	10	Closed Book
5	Critical Thinking	5 days	05	Open Book

11. ACTIVITIES CALENDAR

Sl. No.	Type of Activity/ Nature of the Component	Marks	Schedule for Activities	Duration For Submission	Publication of result	Mapping with COs
1	Assignment-I (Open Book)	5	2nd week of August	7 days	3rd week of August	CO1 & CO2
2	Quiz -I (Closed Book)	5	2nd week of August	30min	Same day	CO1 & CO2
3	Assignment-II (Open Book)	5	4th week of August	7 days	1st week of September	CO3 & CO4
4	Quiz -II (Closed Book)	5	4th week of August	30min	Same day	CO3 & CO4
5	Assignment-III (Open Book)	5	4th week of September	7 days	1st week of October	CO3 & CO4
5	Critical Thinking (Open Book)	5	4th week of October	15 days	2nd week of November	CO1, CO2, CO3, CO4, CO5 & CO6
6	Defaulter Quiz Test (Closed Book)		1st week of November	1 hour (Teacher specific)	Same day	CO1, CO2, CO3, CO4, CO5 & CO6

12. CHAMBER CONSULTATION: Cabin No. 608 (6th Floor), D-Block, Campus-3, Day and Time: Thursday, 4:00pm-6:00pm.

Dr. Prasanta Kumar Das
Course Coordinator

Dr. Mrutyunjay Das   **DEAN, SAS**
Asso. Dean
Department of Mathematics