NATIONAL UNIVERSITY BANGLADESH



Syllabus
Bachelor of Science (Honours) Second Year
Department of Statistics

PROVISIONAL

Effective from the Academic Year: 2024-2025 and onward

I. UNIVERSITY VISION

We expect that the hundredth anniversary of the National University, our commitment to "Progress for Everyone" will be evident in all areas of our operations and stakeholder engagements.

We leverage our core strength in education, research, and community engagement to address pressing global issues and foster sustainable development.

By 2042, National University aims to strengthen its position as Bangladesh's top academic institution and rank among the world's leading universities. Our focus will be on expanding expertise, building strategic partnerships, and increasing our global influence. Our services will be measured by the achievements of the individuals and communities we serve.

II. UNIVERSITY MISSION

To promote "Progress for Everyone" by fostering transformative education, conducting pioneering research, and encouraging meaningful collaboration with individuals, communities, and partners both in Bangladesh and around the world.

III. NAME OF THE PROGRAM

Bachelor of Science with Honours in Statistics

IV. DEGREE AWARDING ENTITY

Dean, School of Undergraduate Studies
National University Bangladesh

V. CURRICULUM EFFECTIVE FROM

2024-2025 Session onwards

VI. PROGRAM VISION

To be a center of excellence in Statistics education, research, and professional development that produces competent, ethical, and innovative graduates capable of addressing real-world challenges through statistical reasoning, data analysis, and evidence-based decision-making for the betterment of society and sustainable development.

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VII. PROGRAM MISSION

The mission of the BSc Honours in Statistics program is to:

1. Provide students with strong theoretical and applied knowledge in statistics and data science.
2. Develop skills in data collection, analysis, interpretation, and presentation using modern statistical tools and software.
3. Promote research culture and critical thinking through project work, internships, and collaboration with industry and research institutions.
4. Prepare graduates for careers in data management, research, teaching, government, and non-government organizations, as well as for advanced studies.
5. Instill ethical values, leadership, teamwork, and lifelong learning skills for professional and societal development.

VIII. PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO 1: Core Statistical Competence

Graduates will demonstrate strong foundational and advanced knowledge in statistics and apply it to solve academic, professional, and real-life problems.

PEO 2: Analytical and Research Excellence

Graduates will be able to design research, collect and analyze data, interpret results, and communicate findings effectively using statistical methods and modern tools.

PEO 3: Professional and Technological Preparedness

Graduates will be prepared for careers in data science, research, teaching, government, and NGOs, and will be able to use modern statistical software and tools efficiently.

PEO 4: Ethical and Social Responsibility

Graduates will exhibit strong ethical principles, social responsibility, and leadership qualities in professional and community settings.

PEO 5: Lifelong Learning and Adaptability

Graduates will continue to learn and adapt to evolving statistical technologies and methodologies for personal and professional growth.

IX. PROGRAM LEARNING OUTCOMES (PLO'S)

PLO 1: Statistical Knowledge: Understand and use basic to advanced statistics, and apply this acquired knowledge to solve real-life, academic, and professional problems.

PLO 2: Problem-Solving Ability: Recognize, formulate, and solve statistical problems using logic, formulas, and statistical techniques; and draw accurate conclusions in both pure and applied statistics.

PLO 3: Designing Solutions: Design and conduct scientific research to solve the problems that meet the specified needs of human welfare, public health and safety, and environmental considerations for sustainable living.

PLO 4: Research Skills: Collect, analyze, and interpret relevant data using statistical methods; perform calculations, draw graphs, and present results confidently with logical conclusions.

PLO 5: Use of Modern Tools: Understand the statistical tools and techniques that are available in Mathematics, Economics, Bioinformatics, Computer Programming, and so on.

PLO 6: Health and Society: Apply statistical knowledge to practical activities, societal functions, public health, and overall development.

PLO 7: Career and Academic Readiness: Demonstrate readiness for careers in data management, research institutions, teaching, government and nongovernment organizations, and qualify for admission to advanced studies in statistics and related fields such as engineering, medical sciences, economics, and education.

PLO 8: Ethics and Responsibility: Develop strong moral and ethical principles and apply them to professional work for the betterment of society.

PLO 9: Teamwork and Leadership: Communicate effectively, work as a team and demonstrate high leadership qualities for handling any problems in professional settings.

PLO 10: Communication Skills: Share statistical ideas clearly through writing, speaking, and presenting. Be able to write reports, give presentations, and explain concepts.

PLO 11: Project and Time Management: Plan and manage time, tasks, and projects well. Use statistics in real-world situations, whether working alone or in a team.

PLO 12: Lifelong Learning: Keep learning new statistical knowledge, tools, and skills beyond graduation for personal and professional growth in an ever-evolving technological world.

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X. PEO – PLO MAPPING MATRIX

PLO	Description	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PLO 1	Statistical Knowledge	✓	✓			
PLO 2	Problem-Solving Ability	✓	✓			
PLO 3	Designing Solutions		✓	✓		
PLO 4	Research Skills		✓	✓		
PLO 5	Use of Modern Tools		✓	✓		
PLO 6	Health and Society			✓	✓	
PLO 7	Career and Academic Readiness			✓		✓
PLO 8	Ethics and Responsibility		✓		✓	
PLO 9	Teamwork and Leadership			✓	✓	
PLO 10	Communication Skills		✓	✓		
PLO 11	Project and Time Management		✓	✓		
PLO 12	Lifelong Learning			✓		✓

XI. COURSES AND MARKS DISTRIBUTION: SECOND YEAR

Course Code	Course Title	Marks	Credits
	Core Courses		
8223651	Probability Distribution	100	4
8223653	Sampling Technique	100	4
8223655	Mathematical Methods	100	4
8223656	Lab-3: Numerical Analysis, Probability Distribution, and Sampling Technique	50	2
8223658	Lab-4: Microsoft Excel and SPSS	50	2
8223662	Viva-Voce	50	2
	Allied Courses		
8223757	Calculus- II and Ordinary Differential Equations	100	4
8223758	Math Lab (Mathematica)	50	2
8222261	Money, Banking and Public Finance	100	4
8222263	Bangladesh Economy	50	2
	Compulsory Courses		
8226601	Applied Information and Communication Technology (Applied ICT)	75	3
8226602	Practical: Applied ICT	25	1
8221171	Functional English	100	4
	Total =	950	38

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XII. DETAILED SYLLABUS: SECOND YEAR

Course Code: 8223651	**Marks: 100**	**Credits:4**	**Class Hours: 56**
Course Title: Probability Distribution			**Exam Duration: 4 Hours**

I. COURSE DESCRIPTION

This course offers a rigorous and comprehensive exploration of the fundamental probability distributions that form the bedrock of modern statistical theory and its applications. It is designed to provide students with a deep, mathematical understanding of both univariate and multivariate probability models, which are indispensable for data analysis, statistical modeling, and inference across a multitude of disciplines.

The course begins with a detailed study of crucial discrete distributions, including the **Geometric, Hypergeometric,** and **Multinomial** distributions, focusing on their mathematical properties and real-world applications. It then transitions to an in-depth examination of continuous distributions, such as the **Uniform, Exponential, Normal, Beta, Gamma, Cauchy, Weibull, Laplace,** and **Maxwell** distributions. For each distribution, students will rigorously derive and interpret its probability mass/density functions, moment generating functions, moments (mean, variance), and characteristic properties.

A significant and distinctive component of this course is the dedicated study of **Bivariate Distributions**. Students will delve into the **Bivariate Binomial, Bivariate Poisson, Bivariate Normal,** and **Bivariate Beta** distributions. This module enables students to understand and model the dependence between two random variables, derive marginal and conditional distributions, and calculate measures of association. By the end of this course, students will possess a formidable theoretical foundation, preparing them for advanced studies in statistical inference, multivariate analysis, and for practical applications in fields such as engineering, bioinformatics, finance, and the medical sciences.

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II. COURSE LEARNING OUTCOMES (CLOs)

Upon successful completion of this course, students will be able to:

CLO #	Course Learning Outcomes	Bloom's Level
CLO-1	**Define** and **recall** the properties, probability functions, and parameters of major discrete and continuous probability distributions.	Level 1: Remember
CLO-2	**Derive** the mathematical properties (e.g., moment generating functions, moments) of various univariate and bivariate probability distributions.	Level 4: Analyze
CLO-3	**Apply** appropriate probability distributions to model and solve real-world problems involving uncertainty and random phenomena.	Level 3: Apply
CLO-4	**Analyze** and **evaluate** the interrelationships among distributions (e.g., special cases, limiting forms, and transformations).	Level 4, 5: Analyze, Evaluate
CLO-5	**Differentiate** between univariate and bivariate distributions and **interpret** the concepts of joint, marginal, conditional distributions, and dependence (correlation).	Level 2, 3: Understand, Apply
CLO-6	**Construct** bivariate distributions and **derive** their marginal and conditional distributions for analyzing relationships between variables.	Level 4, 6: Analyze, Create

III. MAPPING OF COURSE LEARNING OUTCOMES (CLOs) WITH PROGRAM LEARNING OUTCOMES (PLOs)

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes.

Indication: ✓ = Mapped / Aligned

CLOs / PLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO 1	✓						✓					
CLO 2	✓	✓					✓					
CLO 3	✓	✓		✓		✓	✓					
CLO 4	✓	✓					✓					
CLO 5	✓	✓		✓		✓	✓					
CLO 6	✓	✓	✓	✓			✓					

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IV. DETAILED SYLLABUS (MODULE-WISE WITH TEACHING-LEARNING APPROACH & ASSESSMENT)

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessmen	CLOs Mapped
Module 1: Introduction & Review of Discrete Distributions (8 Hours)	- **Review:** Basic probability concepts, random variables (discrete & continuous). - **Discrete Probability Distributions:** - **Geometric Distribution:** PMF, CDF, MGF, CGF, graphical representation, mean, variance, memoryless property, and applications. - **Hypergeometric Distribution:** PMF, CDF, MGF, CGF, graphical representation, mean, variance, relationship with Binomial distribution, and applications. - **Multinomial Distribution:** PMF, CDF, MGF, CGF, graphical representation, mean, variance, covariance, and applications.	- **Lecture:** Rigorous derivation of PMF, MGF, and moments. - **Problem Solving:** Worked-out examples on applying each distribution. - **Discussion:** Real-world scenarios (e.g., quality control for Hypergeometric, waiting times for Geometric).	- In-class exercises and quizzes on deriving moments. - Questions in the in-course Exam.	CLO 1, CLO 2, CLO 3
Module 2: Continuous Distributions I (10 Hours)	- **Continuous Probability Distributions:** - **Uniform Distribution:** PDF, CDF, MGF, CGF, graphical representations, mean, variance, and properties with applications. - **Exponential Distribution:** PDF, CDF, MGF, CGF, graphical representation, mean, variance, memoryless property, properties, relationship with the Poisson process, and applications. - **Normal Distribution:** PDF, CDF, MGF, CGF, graphical representation, properties, mean, variance, standard normal distribution, and importance. - **Beta Distribution:** PDF, CDF, MGF, CGF, mean, variance, properties, shape parameters (α, β), special cases (Uniform), and applications.	- **Lecture:** Theoretical derivation of properties. - **Visualization:** Plotting PDFs for different parameter values to understand shape.	- Homework on comparing Exponential and Uniform distributions. - Questions in the in-course Exam	CLO 1, CLO 2, CLO 3, CLO 4

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 3: Continuous Distributions II (10 Hours)	- **Continuous Probability Distributions (Contd.):** - **Gamma Distribution:** PDF, CDF, MGF, CGF, graphical representations, mean, variance, shape and scale parameters, properties, and its relationship with Exponential and Chi-square. - **Weibull Distribution:** PDF, CDF, MGF, CGF, graphical representations, mean, variance, reliability function, properties, and applications in survival analysis and engineering. - **Cauchy Distribution:** PDF, CDF, MGF, CGF, graphical representations, properties, mean undefined, applications. - **Laplace (Double Exponential) Distribution:** PDF, CDF, MGF, MGF, CGF, graphical representations, mean, variance, and applications.	- **Lecture:** Detailed mathematical derivations. - **Comparative Analysis:** Discuss the relationships - **Case Study:** Application of Weibull in failure time data.	- Group task on deriving relationships between distributions. - Question in Final Exam	CLO 1, CLO 2, CLO 3, CLO 4
Module 4: Maxwell & Advanced Univariate Distributions (6 Hours)	- **Continuous Probability Distributions (Contd.):** - **Maxwell Distribution:** PDF, CDF, MGF, CGF, graphical representations, mean, variance, relationship with Normal (speed of molecules), and applications in physics. - **Limiting and Special Cases:** Explore how one distribution arises from another (e.g., Binomial → Poisson, Gamma → Chi-square, t, F).	- **Lecture:** Explanation of the derivation and physical significance of the Maxwell distribution. - **Problem Solving:** Exercises on transformations of random variables. - **Discussion:** Importance of limiting distributions in statistical inference.	- Short quiz on the key properties of all distributions covered so far. - Question in Final Exam	CLO 1, CLO 2, CLO 3, CLO 4

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 5: Introduction to Bivariate Distributions (8 Hours)	- **Introduction to Bivariate Distributions:** Joint, marginal, and conditional probability distributions. - **Dependence and Independence:** Covariance and Correlation (Pearson's ρ). - **Bivariate Discrete Distributions:** - **Bivariate Binomial Distribution:** Joint PMF, marginal and conditional distributions, mean, variance, and correlation. - **Bivariate Poisson Distribution:** Joint PMF, marginal and conditional distributions, mean, variance, covariance, and applications.	- **Lecture:** Concept of joint distribution and how it describes relationships between variables. - **Derivation:** Step-by-step derivation of marginal and conditional distributions from joint PMF. - **Numerical Examples:** Calculating covariance and correlation for bivariate discrete data.	Worksheets on deriving marginal/conditional distribution - Question in Final Exam	CLO 5, CLO 6
Module 6: Bivariate Normal & Beta Distributions (10 Hours)	- **Bivariate Continuous Probability Distributions:** - **Bivariate Normal Distribution:** Joint PDF, marginal and conditional distributions (including formulas for conditional mean and variance), and applications. - **Bivariate Beta Distribution:** Joint PDF, marginal and conditional distributions, covariance structure, and applications.	- **Lecture:** In-depth explanation of the Bivariate Normal PDF and its parameters. - **Visualization:** Plotting the bivariate normal surface for different correlation values. - **Problem Solving:** Exercises on calculating conditional expectations and variances. - **Discussion:** Importance of the Bivariate Normal in regression and correlation analysis.	- Problem set on calculating conditional mean and variance for Bivariate Normal. - Problem in Final Exam	CLO 5, CLO 6

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 7: Review and Comprehensive Applications (4 Hours)	- **Revision:** Comprehensive review of all univariate and bivariate distributions. - **Comparative Analysis:** Summary of properties, relationships, and applications of all distributions. - **Integrative Problem Solving:** Complex problems that require selecting and applying the correct distribution and deriving its properties.	- **Lecture/Workshop:** Interactive review and problem-solving session. - **Group Activity:** Teams solve complex, multi-step problems and present their solutions. - **Q&A Session:** Addressing student queries and clarifying concepts.	- In-class group challenges. - Comprehensive questions in the Final Exam covering all topics.	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5, CLO 6

V. COURSE EVALUATION

Evaluation will be done using the grading system, as per the university guidelines.

A. Continuous Assessment: 20 Marks

i. In-course – 10 Marks
ii. Assignments/quiz – 5 Marks
iii. Class attendance – 5 Marks

B. Final Examination: 80 Marks.

The question paper should contain 12 (twelve) theoretical questions, and students must answer 8 (eight). Each question may contain maximum 3 sub-sections (e.g., a, b, c)

VI. REFERENCES

Johnson, N. L., Kotz, S., & Balakrishnan, N. (1994). *Continuous Univariate Distributions.* Vol. 1 & Vol. 2 (2nd ed.). John Wiley & Sons.

Kotz, S., Balakrishnan, N., & Johnson, N. L. (2000). *Continuous Multivariate Distributions* (2nd ed.). John Wiley & Sons.

Mood, A.M., Graybill, F.A., & Boes, D.C. (1973). Introduction to the Theory of Statistics. International Student edition. McGraw-Hill

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Ross, S. M. (2019). *Introduction to Probability Models* (12th ed.). Academic Press. (Excellent for applications and includes a detailed chapter on bivariate distributions).

Ross, S. M. (2020). *A First Course in Probability* (10th ed.). Pearson Education Limited. Harlow, United Kingdom.

Roy, M.K. & Roy, D.C. (2014). Fundamentals of Probability & Probability Distributions. Romax Publications.

Course Code: 8223653	**Marks: 100**	**Credits:4**	**Class Hours: 56**
Course Title: Sampling Technique			**Exam Duration: 4 Hours**

I. COURSE DESCRIPTION

This course provides a comprehensive and practical introduction to the theory and application of sample surveys, a cornerstone methodology for efficient data collection in research, industry, and government. It begins by establishing the fundamental rationale for sampling, critically comparing complete enumeration (census) with sample surveys by analyzing their relative advantages, disadvantages, and contextual suitability. Students will learn the essential role of sampling theory in making reliable inferences about populations from samples.

The course systematically guides students through the entire survey process, from defining the target population and constructing a robust sampling frame to selecting an appropriate sampling design. It covers both non-probability methods (like convenience and snowball sampling) and, more extensively, the core probability sampling techniques that form the basis of statistical inference. A significant portion is dedicated to the mathematical and practical exploration of **Simple Random Sampling (SRS)**, **Stratified Random Sampling**, **Systematic Sampling**, and **Cluster Sampling**. For each method, students will learn how to draw samples, estimate population parameters (means, totals, proportions), and calculate the standard errors of these estimates. A key practical skill developed is the determination of the optimal sample size for a desired level of precision.

Beyond the mechanics of selection and estimation, the course addresses critical methodological issues, including sampling and non-sampling errors, the design of effective questionnaires, and the practical steps involved in conducting a pilot survey. The course culminates in a comparative analysis of different sampling schemes, enabling students to evaluate and select the most efficient and cost-effective design for a given research problem. By the end, students will be well-prepared to

design, implement, and analyze sample surveys for real-world problem-solving in academic, professional, and research settings.

II. COURSE LEARNING OUTCOMES (CLOs)

CLO #	Course Learning Outcomes	Bloom's Level
CLO-1	**Define and Explain** the fundamental concepts, principles, and sequential steps involved in designing and executing a scientific sample survey.	Level 1, 2: Remember, Understand
CLO-2	**Apply** various probability (SRS, Stratified, Systematic, Cluster) and non-probability sampling techniques to select representative samples from a given population.	Level 3: Apply
CLO-3	**Calculate** and **interpret** unbiased estimates of population parameters (means, totals, proportions) and their associated standard errors for different sampling designs.	Level 3, 4: Apply, Analyze
CLO-4	**Analyze** the key factors influencing precision and accuracy, and **determine** the required sample size to achieve a specified level of precision under different sampling schemes.	Level 4: Analyze
CLO-5	**Evaluate** the relative efficiency of different sampling methods and **select** the most appropriate design for a given research problem, balancing cost and precision.	Level 5: Evaluate
CLO-6	**Design** a comprehensive sampling plan, including questionnaire construction and data collection strategy, for a real-world research problem addressing societal needs.	Level 6: Create

III. MAPPING OF COURSE LEARNING OUTCOMES (CLOs) WITH PROGRAM LEARNING OUTCOMES (PLOs)

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes.

Indication: ✓ = Mapped / Aligned

CLOs / PLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO 1	✓					✓	✓					
CLO 2	✓	✓		✓			✓					
CLO 3	✓	✓		✓			✓					

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CLO 4	✓	✓		✓			✓					
CLO 5	✓	✓	✓	✓		✓	✓					
CLO 6	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓

IV. DETAILED SYLLABUS (MODULE-WISE WITH TEACHING-LEARNING APPROACH & ASSESSMENT)

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 1: Introduction and Basic Concepts (6 Hours)	- **Introduction:** Basic concept of a sample survey. - **Comparative Analysis:** Relative advantages, disadvantages, and suitability of complete and sample enumeration. - Uses of sample surveys**.** Role of sampling theory. - **Requirements of a good sample design.** - **Principles of Sample Survey** - **Principal Steps in Sample Survey** **-Sampling and Non-sampling Error** - **Advantages of Sampling over Census**	- **Lecture:** Interactive lecture explaining core concepts and principles. - **Discussion:** Group discussion on the advantages and disadvantages of sampling vs. census with real-world examples. - **Case Study:** Analysis of a published survey to identify its design and objectives.	- In-class Q&A sessions and short quizzes. - Question in Midterm Exam	CLO 1

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 2: Preliminaries and Types of Sampling (8 Hours)	- **Preliminaries:** Units, Population, Sampling units, Sampling frame. - **Sampling Types:** Random (probability) and Non-random (purposive) sampling. - **Specific Non-Probability Methods:** Quota sampling, Judgement Sampling, Convenience sampling, Snowball sampling. - **Questionnaire Design:** Questionnaire and Schedule. Preparation of questionnaire. Open and closed questionnaires.	- **Lecture:** Detailed explanation of sampling methods and data collection techniques. - **Workshop:** Hands-on activity on designing a questionnaire for a specific research topic. - **Practical:** Differentiating between bias, precision, and accuracy using illustrative examples.	Homework assignment on constructing a questionnaire for a given problem. - Question in Midterm Exam	CLO 1, CLO 6
Module 3: Simple Random Sampling (SRS) (10 Hours)	- **Definition, properties, advantages, and disadvantages of Simple Random Sampling** - **Drawing samples:** With and without replacement (SRSWR & SRSWOR). - **Estimation:** Estimates of population mean, total, and proportion. - **Precision:** Standard errors of the estimates. - **Sample Size Determination:** Determination of sample size for specified precision.	- **Lecture:** Mathematical derivation of estimators and their standard errors. - **Demonstration:** Using random number tables/statistical software to draw an SRS. - **Practice:** Numerical problems in calculating estimates, standard errors, and sample size.	- Problem sets on SRS calculations. -Problems in the Midterm Exam.	CLO 2, CLO 3, CLO 4

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 4: Stratified Random Sampling (10 Hours)	- **Definition, properties, advantages, and disadvantages of Stratified Random Sampling** - **Reasons for stratification.** - **Formation and number of strata.** - **Stratified random sampling:** Estimator of mean, total, and proportion. - **Standard error** of the estimators. - **Allocation of samples to strata:** Equal, Proportional, and Optimum (Neyman). - **Comparison with Simple Random Sampling.**	- **Lecture:** Theoretical framework and derivations. - **Problem Solving:** Worked-out examples on different allocation methods.	Group work on allocation strategies for a given dataset - Question in Final Exam.	CLO 2, CLO 3, CLO 5, CLO 6
Module 5: Systematic Sampling (8 Hours)	- **Definition, properties, advantages, and disadvantages of Systematic Sampling** - **Use and limitations** of systematic sampling. - Estimates, bias, standard error, and efficiency. - Comparisons with Simple Random Sampling. - Systematic sampling for populations with a linear trend. - Methods for dealing with populations with a linear trend or periodic variation.	- **Lecture:** Explanation of the method and its statistical properties. - **Exercise:** Selecting a systematic sample from a given population list. - **Discussion:** Situations where systematic sampling is preferred and its potential pitfalls.	- Small group exercise comparing systematic and SRS. - Question in Final Exam.	CLO 2, CLO 3, CLO 5

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 6: Cluster Sampling (8 Hours)	- **Definition, properties, advantages, and disadvantages of Cluster Sampling** - **Reasons for clustering**, formation of clusters, and size of clusters. - **Simple cluster sampling with equal-sized clusters:** Estimates and standard error. - **Comparison with Simple Random Sampling.** - **Two-stage sampling:** Introduction and concept.	- **Lecture:** Explanation of the concept of clustering and its practical use in field surveys. - **Demonstration:** Using a practical example (e.g., households in a city) to show cluster sampling. - **Discussion:** Potential situations and pitfalls of cluster sampling	- Calculation exercise on estimating the mean from cluster sample data. - Problem in Final Exam.	CLO 2, CLO 3, CLO 5
Module 7: Sample Survey and Comparative Analysis (6 Hours)	- **Estimation using Auxiliary Variables:** Ratio, Regression and their Differences, Method of Estimation and their Comparative Analysis. - **Review and comparison of all sampling methods.**	- **Lecture:** Mathematical derivation of estimators and their standard errors - **Lecture/ Workshop:** Integrated review and hands-on practice of all sampling methods.	- Project proposal and draft report. - Question in Final Exam comparing methods	CLO 2, CLO 3, CLO 4, CLO 5, CLO 6

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V. COURSE EVALUATION

Evaluation will be done using the grading system, as per the university guidelines.

A. Continuous Assessment: 20 Marks

i. In-course – 10 Marks
ii. Assignments/quiz – 5 Marks
iii. Class attendance – 5 Marks

B. Final Examination: 80 Marks.

The question paper should contain 12 (twelve) theoretical questions, and students must answer 8 (eight). Each question may contain maximum 3 sub-sections (e.g., a, b, c)

VI. REFERENCES

Cochran, W. G. (1977). *Sampling Techniques* (3rd ed.). John Wiley & Sons.

Islam, M. N. (2005). An introduction to sampling methods. Dhaka: Mullick & Brothers.

Lohr, S. L. (2021). *Sampling: Design and Analysis* (3rd ed.). CRC Press.

Sarndal, C. E., Swensson, B., & Wretman, J. (2003). *Model-Assisted Survey Sampling*. Springer.

Scheaffer, R. L., Mendenhall, W., Ott, R. L., & Gerow, K. G. (2011). *Elementary Survey Sampling* (7th ed.).

Singh, D., & Chaudhary, F.S. (1986). Theory and Analysis of Sample Survey Designs, Wiley

Thompson, S. K. (2012). *Sampling* (3rd ed.). John Wiley & Sons.

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Course Code: 8223655	Marks: 100	Credits:4.0	Class Hours: 56
Course Title: Mathematical Methods			Exam Duration: 4 Hours

I. COURSE DESCRIPTION

This course provides a comprehensive foundation in essential mathematical tools required for advanced study and application in statistics. **Part A: Numerical Mathematics** covers finite differences, interpolation (both equal and unequal intervals), numerical differentiation, and numerical integration, along with the solution of algebraic and simultaneous equations. **Part B: Advanced Calculus** focuses on Beta and Gamma functions, Jacobian transformations, Lagrange multipliers, Fourier series, and an in-depth introduction to Laplace and Inverse Laplace transforms with their applications. The course emphasizes both the theoretical understanding and practical computational skills necessary for data analysis and statistical modeling.

II. COURSE LEARNING OUTCOMES (CLOs)

CLO #	Course Learning Outcomes	Bloom's Level
CLO-1	**Remember** and **understand** the fundamental concepts of finite differences, factorial notation, difference equations, and various interpolation formulae.	Remembering & Understanding (Level 1 & 2)
CLO-2	**Apply** Newton's forward/backward, Gauss's, Stirling's, Bessel's, and Lagrange's interpolation methods to solve practical problems involving missing data or function estimation.	Applying (Level 3)
CLO-3	**Analyze** and apply numerical differentiation and integration techniques (Newton-Cotes, quadrature formulae) to approximate derivatives and definite integrals for equal and unequal intervals.	Analyzing (Level 4)
CLO-4	**Evaluate** the convergence and accuracy of numerical methods (e.g., iteration, Newton-Raphson) for solving equations and systems, while identifying inherent errors.	Evaluating (Level 5)
CLO-5	**Understand** and **apply** Beta/Gamma functions, Jacobians, and Lagrange multipliers in statistical contexts such as transformations and optimization.	Understanding & Applying (Level 3)
CLO-6	**Analyze** periodic functions using Fourier series (odd/even functions, Dirichlet conditions) and **apply** Laplace transforms (forward and inverse) using properties and the convolution theorem to solve differential and integral equations.	Analyzing (Level 4)
CLO-7	**Create** and **interpret** solutions to statistical/mathematical problems by synthesizing techniques from both numerical and calculus domains.	Creating & Interpreting (Level 6)

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III. MAPPING OF COURSE LEARNING OUTCOMES (CLOs) WITH PROGRAM LEARNING OUTCOMES (PLOs)

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes

Indication: ✓ = Mapped / Aligned

CLOs / PLOs	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO-1	✓											
CLO-2	✓	✓		✓			✓					
CLO-3	✓	✓	✓	✓	✓		✓					
CLO-4	✓	✓		✓			✓					
CLO-5	✓	✓			✓		✓					✓
CLO-6	✓	✓	✓		✓		✓					✓
CLO-7	✓	✓		✓		✓	✓					

Note: Only PLOs relevant to the technical and cognitive skills of this course have been mapped.)

IV. DETAILED SYLLABUS (MODULE-WISE WITH TEACHING-LEARNING APPROACH & ASSESSMENT)

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 1: Numerical Analysis I (Finite Differences) (12 Hrs)	Differences of a polynomial, Finite difference operator (Δ, ∇, E), Factorial notation, Difference equations. Newton's forward and backward interpolation formulae (equal intervals). Central difference formulae: Gauss's, Stirling's, and Bessel's.	Lectures, Chalk & Talk, Derivation of formulae, Problem-solving sessions, Use of scientific calculators.	Quiz-1, Tutorial Sheet-1, Problem-solving questions.	CLO-1, CLO-2

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Module 2: Numerical Analysis II (Interpolation & Inverse) (12 Hrs)	Lagrange's interpolation formulae (unequal intervals). Interpolation with unequal intervals of the argument. Inverse interpolation. Accuracy of interpolation formulae. Double interpolation (functions of two variables) using a single interpolation formula.	Interactive lectures, Group problem-solving, Comparative analysis of methods, and demonstration of error estimation.	Tutorial Sheet-2, Assignment on real-world data interpolation.	CLO-2, CLO-3, CLO-4
Module 3: Numerical Differentiation & Integration (10 Hrs)	Numerical differentiation: forward, backward, and central difference formulas. Numerical integration: General quadrature formula, Newton-Cotes formulae (Trapezoidal, Simpson's 1/3, 3/8 rules). Accuracy of quadrature formulae. Numerical integration for unequal intervals of arguments. Stirling's formula for factorial N.	Lectures, Derivation of error terms, Comparison of methods, Practical computational exercises.	Quiz-2, Practical exercise on approximating integrals, In course 1: application problems.	CLO-3, CLO-4
Module 4: Equation Solving & Calculus Introduction (10 Hrs)	Numerical solution of equations: Iteration, Newton-Raphson, Regula-Falsi, and Secant methods. Convergence and inherent errors. Simultaneous equations in several unknowns. Beta and Gamma functions: properties, relations, incomplete functions. Jacobian of transformation and its uses in statistics. Lagrange's multipliers and uses in statistics (optimization).	Projector-based derivations, Step-by-step algorithm demonstration, Real-world application examples in statistics.	Tutorial Sheet-3, Assignment on convergence analysis, In course 2: theory/derivation questions.	CLO-4, CLO-5, CLO-7
Module 5: Fourier Series (6 Hrs)	Periodic functions, Dirichlet conditions, Odd and even functions. Fourier series expansion for functions over a range. Half-range series. Introduction to complex form.	Lectures, Graphical representation of functions, Analysis of function symmetry.	Quiz-3, Class participation.	CLO-6

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Module 6: Laplace Transforms & Applications (6 Hrs)	Definition of integral transformation, Laplace transform of elementary functions. Sufficient conditions for existence. Properties (linearity, shifting, scaling). Laplace transforms of special functions (step, impulse). Inverse Laplace transform: definition and properties. Convolution theorem. Application of Laplace transform to solve ODEs and integral equations.	Lectures, Derivation of transforms, Use of transform tables, Application-focused problem solving.	Quiz-4, Tutorial Sheet-4, Problem-solving and application questions.	CLO-6, CLO-7

V. COURSE EVALUATION

Evaluation will be done using the grading system, as per the university guidelines.

A. Continuous Assessment: 20 Marks

i. In-course – 10 Marks
ii. Assignments/quiz – 5 Marks
iii. Class attendance – 5 Marks

B. Final Examination: 80 Marks.

The question paper should contain 12 (twelve) theoretical questions covering Part A and Part B equally. Students must answer 8 (eight) questions, taking 4 (four) from each Part. Each question may contain maximum 3 sub-sections (e.g., a, b, c)

VI. REFERENCES

Agarwal, D. (2014). Advanced Integral Calculus. 19th ed., Krishna Prakashan Media

Gerald, C. F., & Wheatley, P. O. (2004). *Applied Numerical Analysis* (7th ed.). Pearson Education.

Sastry, S. S. (2012). *Introductory Methods of Numerical Analysis* (5th ed.). PHI Learning Private Limited.

Scarborough, J. B. (1966). Numerical Mathematical Analysis, 6th ed., Johns Hopkins Press, Baltimore.

Wrede, R., & Speigel, M. R. (2010). Schaum's outlines of Advanced Calculus, 3rd ed. McGraw-Hill.

Zill, D. G., & Cullen, M. R. (2013). *Advanced Engineering Mathematics* (5th ed.). Jones & Bartlett Learning.

PROVISIONAL

Course Code: 8223656	Marks: 50	Credits: 2	Class Hours: 42
Course Title: Lab-3: Probability distributions, numerical analysis, and sampling techniques			Exam Duration: 5 Hours

I. COURSE DESCRIPTION

This laboratory course, "Lab 2 – Probability Distributions, Numerical Analysis, and Sampling Techniques," is a hands-on, practical extension of theoretical statistical concepts. It is designed to equip students with the computational and analytical skills necessary to apply complex statistical methods to real-world data. The course is divided into three core modules. **Part A** focuses on the practical fitting of continuous probability distributions to empirical data and calculating areas under the normal curve. **Part B** introduces essential numerical analysis techniques for interpolation and equation solving, which are fundamental for data approximation and modeling. **Part C** provides a comprehensive overview of key sampling techniques, from simple random to cluster sampling, enabling students to design efficient surveys, estimate population parameters, and assess the precision and efficiency of different sampling designs. Through hands-on computations and problem-solving, this course bridges the gap between theory and application, preparing students for advanced research and professional practice.

II. COURSE LEARNING OUTCOMES (CLOs)

CLO #	Course Learning Outcomes	Bloom's Level
CLO-1	**Remember** the fundamental concepts and formulae for various probability distributions, interpolation, and sampling techniques.	Level 1: Remember
CLO-2	**Understand** and explain the principles behind numerical methods (e.g., Newton-Raphson) and the rationale for choosing different sampling schemes.	Level 2: Understand
CLO-3	**Apply** appropriate probability distributions, interpolation methods, and sampling formulas to solve given statistical and numerical problems.	Level 3: Apply
CLO-4	**Analyze** numerical data to fit distributions, evaluate the efficiency of sampling designs, and compare the accuracy of different numerical methods.	Level 4: Analyze
CLO-5	**Evaluate** the suitability of different sampling techniques, interpolation formulas, and numerical integration methods for specific datasets and research objectives.	Level 5: Evaluate

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CLO-6	**Create** comprehensive reports based on the analysis of sampled data, including parameter estimation, precision analysis, and recommendations for optimal sample design.	Level 6: Create

III. MAPPING OF COURSE LEARNING OUTCOMES (CLOs) WITH PROGRAM LEARNING OUTCOMES (PLOs)

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes.

Indication: ✓ = Mapped / Aligned

CLOs / PLOs	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PLO 11**	**PLO 12**
CLO-1	✓											
CLO-2	✓											
CLO-3	✓	✓										
CLO-4	✓	✓		✓								
CLO-5	✓	✓	✓									
CLO-6	✓		✓	✓	✓		✓		✓	✓	✓	✓

IV. DETAILED SYLLABUS (MODULE-WISE WITH TEACHING-LEARNING APPROACH & ASSESSMENT)

Module & Class Hours	**Contents**	**Teaching-Learning Approach**	**Module Assessment**	**CLOs Mapped**

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 1: Probability Distributions (8 Hours)	- Fitting of Normal, Poisson, and Exponential distributions to given datasets. - Calculation of expected frequencies. - Problems based on area under the normal curve (e.g., finding probabilities, percentiles). - Problems based on ordinate for a specified area. - Applications of the normal distribution in real-life scenarios (e.g., quality control, natural phenomena).	- **Lecture:** Brief review of theoretical concepts and formulae. - **Demonstration:** Step-by-step solution of fitting problems on the board. - **Hands-on Practice:** Students solve problems using given datasets and calculators.	- In-class problem-solving exercises. - Quiz 1 on distribution fitting and area calculations.	CLO-1, CLO-2, CLO-3, CLO-4
Module 2: Numerical Analysis – Interpolation (8 Hours)	- Newton's Forward and Backward Interpolation Formulae (for equal intervals). - Lagrange's Formula (for unequal intervals). - Newton's General Interpolation (Divided Differences). - Selection of appropriate interpolation method based on data characteristics.	- **Lecture:** Derivation and explanation of each formula. - **Demonstration:** Numerical examples for each method, highlighting their differences and applications. - **Hands-on Practice:** Students work on problem sets, choosing the correct method for given data.	- Worksheet on different interpolation problems. - Quiz 2 on interpolation methods.	CLO-1, CLO-2, CLO-3, CLO-4

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 3: Numerical Analysis – Integration & Equations (8 Hours)	- **Numerical Integration:** Trapezoidal Rule, Simpson's 1/3 Rule, Weddle's Rule, Euler's Rule (for approximating definite integrals). - **Solution of Numerical Equations:** Bisection Method, Method of Iteration, Method of False Position (Regula-Falsi), Newton-Raphson Method, Muller's Method. - Graphical method as a preliminary step. - Comparison of convergence rates and accuracy of different methods.	- **Lecture:** Explanation of algorithms for integration and root-finding. - **Demonstration:** Comparative analysis of methods on the same problem to illustrate efficiency. - **Hands-on Practice:** Students solve problems using manual iterative computations.	- In-class assignments comparing different methods. - Quiz 3 on numerical integration and equation solving.	CLO-2, CLO-3, CLO-4, CLO-5
Module 4: Sampling Techniques – Part 1 (9 Hours)	- Drawing a random sample from a finite population using Random Number Tables. - **Simple Random Sampling (SRS):** Estimation of population mean and standard error. - **Stratified Random Sampling:** Estimation of mean, standard error, and allocation methods (Proportional and Neyman). - **Systematic Sampling:** Estimation of mean and standard error.	- **Lecture:** Conceptual framework and derivation of estimators for each design. - **Demonstration:** Working through a detailed example for each sampling method using a common dataset. - **Group Activity:** Students work in groups to design sampling schemes for a hypothetical population, draw samples, and calculate estimates.	- Group exercises on designing and implementing SRS and Stratified sampling. - Quiz 4 on SRS, Stratified, and Systematic sampling estimators.	CLO-2, CLO-3, CLO-4, CLO-5

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 5: Sampling Techniques – Part 2 (9 Hours)	- **Cluster Sampling:** Estimation of population mean and standard error (equal clusters). - **Estimation of Variance of Estimates** for all sampling schemes. - **Determination of Precision of Estimates** (Confidence Intervals). - **Relative Efficiency** of different sampling schemes for a given population. - **Determination of optimum sample size** and optimum cost.	- **Lecture:** Detailed derivation of variance estimators and efficiency calculations. - **Case Study:** Analysis of a real survey report to demonstrate the concepts of precision and efficiency. - **Hands-on Practice:** Problems involving the calculation of relative efficiency and optimal allocation.	- Problem set on calculating variance, efficiency, and sample size. - Quiz 5 on Cluster sampling, efficiency, and sample size determination. - Submit a project report on a comprehensive sampling design.	CLO-3, CLO-4, CLO-5, CLO-6

V. COURSE EVALUATION

Evaluation will be done in the grading system as per university guidelines.

Continuous Assessment (Lab attendance): 5 Marks

Final Examination: 45 Marks.

i. **Problem solving – 40 marks.** [The question paper should contain 6 (six) practical problems covering Part A, Part B, and Part C equally. Students have to solve 3 problems, taking one from each Part.]
ii. **Practical Notebook – 5 marks.**

VI. REFERENCES

Cochran, W. G. (1977). *Sampling Techniques* (3rd ed.). John Wiley & Sons.

Gerald, C. F., & Wheatley, P. O. (2004). *Applied Numerical Analysis* (7th ed.). Pearson.

Lohr, S. L. (2022). *Sampling: Design and Analysis* (3rd ed.). CRC Press.

Schaum's Outlines: *Statistics*, *Numerical Analysis* (for supplemental problems and practice).

Singh, D., & Chaudhary, F.S. (1986). Theory and Analysis of Sample Survey Designs, Wiley

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Snedecor, G. W., & Cochran, W. G. (1989). *Statistical Methods* (8th ed.). Iowa State University Press.

Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2016). *Probability & Statistics for Engineers & Scientists* (9th ed.). Pearson.

PROVISIONAL

Course Code: 8223658	**Marks: 50**	**Credits:2**	**Class Hours: 42**
Course Title: Lab 4 - Microsoft Excel and SPSS			**Exam Duration: 5 Hours**

I. COURSE DESCRIPTION

This is a 2-credit, hands-on laboratory course designed to equip students with the practical skills necessary for data management, analysis, and presentation using two industry-standard software packages: Microsoft Excel and SPSS (Statistical Package for the Social Sciences). The course bridges the gap between theoretical statistical knowledge and its real-world application. Students will learn to enter, clean, and manipulate data; create frequency distributions and graphical representations; and compute essential descriptive statistics. The curriculum progresses from basic spreadsheet operations to advanced data handling in SPSS, including correlation and regression analysis. The course emphasizes problem-solving, accurate interpretation of results, and effective data communication, preparing students for careers in research, data management, and various professional fields.

II. COURSE LEARNING OUTCOMES (CLOs)

CLO #	Course Learning Outcome	Bloom's Level
CLO 1	**Remember** the fundamental concepts of data types, variable properties, and cell referencing in Excel and SPSS.	Level 1: Remember
CLO 2	**Understand** and explain the purpose and application of various statistical tools, data cleaning techniques, and graphical methods.	Level 2: Understand
CLO 3	**Apply** appropriate data transformation, sorting, filtering, and recoding techniques to prepare raw data for analysis using Excel and SPSS.	Level 3: Apply
CLO 4	**Analyze** data sets by computing and interpreting descriptive statistics (central tendency, dispersion, skewness, kurtosis) and bivariate relationships (correlation and simple regression).	Level 4: Analyze
CLO 5	**Create** and interpret professional, publication-quality charts, tables, and graphs (e.g., Pie, Bar, Histogram, Boxplot, Ogive) for effective data presentation.	Level 6: Create
CLO 6	**Evaluate** statistical output to draw accurate, logical conclusions and make evidence-based recommendations for real-world problems in society and health.	Level 5: Evaluate

III. MAPPING OF COURSE LEARNING OUTCOMES (CLOs) WITH PROGRAM LEARNING OUTCOMES (PLOs)

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes. **Indication:** ✓ = Mapped / Aligned

CLOs / PLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO 1	✓				✓							✓
CLO 2	✓	✓			✓							✓
CLO 3	✓	✓	✓	✓	✓		✓	✓			✓	
CLO 4	✓	✓	✓	✓	✓	✓	✓			✓		
CLO 5	✓		✓	✓	✓		✓			✓		
CLO 6	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

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IV. DETAILED SYLLABUS (MODULE-WISE WITH TEACHING-LEARNING APPROACH & ASSESSMENT)

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 1: Introduction to EXCEL & SPSS (8 Hours)	**Excel:** Interface overview, entering raw data, understanding data types (qualitative/quantitative, discrete/continuous), cell positions and references (absolute vs. relative). **SPSS:** Data Editor interface, creating variables, defining variable types (Numeric, String, Date), assigning variable properties (Labels, Values, Missing Data).	Interactive lecture, live software demonstration, and hands-on guided practice.	In-class practical exercises (e.g., creating a data entry template). Quiz on software navigation and variable definitions.	CLO 1, CLO 2
Module 2: Data Transformation & Management (8 Hours)	**Excel:** Conditional formatting, sorting (single/multi-level), filtering (custom filters), Insert/Delete, Format Cells; Data Tools (Remove Duplicates, Wrapping, Merging, Alignments, Splitting, Hiding operations). **SPSS:** Selecting and sorting cases, splitting and merging files (add variables/add cases), computing new variables, and recoding existing variables (into same/different variables). Transpose data; insert variables/cases.	Flipped classroom (watch pre-recorded tutorials at home) followed by instructor-led problem-solving session. Group discussion on data cleaning scenarios.	Practical assignment: Clean and prepare a "messy" dataset (e.g., patient records) using both Excel and SPSS.	CLO 2, CLO 3

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 3: Data Presentation (Graphs) (8 Hours)	**Excel & SPSS:** Generating and customizing Pie Diagrams, Bar Diagrams, Line Diagrams, Histograms (with normal curve), Boxplots, and Ogives (Cumulative Frequency Curves). Interpreting these graphs for data storytelling.	Demonstration followed by "draw and compare" lab exercises. Students will create identical graphs in both Excel and SPSS and contrast their features.	Lab task: Prepare a one-page infographic of key variables from a given dataset using multiple chart types.	CLO 4, CLO 5
Module 4: Descriptive Statistics (8 Hours)	**Frequency Tables:** Transforming raw data to frequency tables (Discrete & Continuous), Cumulative Frequency Tables. **Measures of Central Tendency:** Mean (Arithmetic, Geometric, Harmonic), Median, Mode. **Measures of Dispersion:** Range, Mean Deviation, Quartile Deviation, Standard Deviation. **Distribution Shape:** Skewness and Kurtosis (interpretation).	Problem-based learning. Students solve numerical problems manually and then verify/calculate using Excel's Analysis ToolPak and SPSS's "Frequencies" & "Descriptives" procedures.	Assignment: Analyze a dataset, compute all descriptive measures, and interpret the results.	CLO 2, CLO 4

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 5: Bivariate Data Analysis (10 Hours)	**Correlation:** Scatter plots for bivariate data, Karl Pearson's Coefficient of Correlation (interpretation, assumptions, limitations), Spearman's Rank Correlation (for non-normal data). **Regression:** Simple Linear Regression analysis (finding the equation, interpreting the slope, intercept, and R-squared). Hypothesis testing for the regression coefficient.	Case-study approach. Students work in pairs on a research problem (e.g., relationship between study hours and exam scores). They perform the analysis in SPSS and write a mini-report.	Group project: A comprehensive analysis of a bivariate dataset including scatter plot, correlation, and regression. Final report and 5-minute presentation.	CLO 4, CLO 5, CLO 6

V. COURSE EVALUATION

Evaluation will be done in the grading system as per university guidelines.

Continuous Assessment (Lab attendance): 5 Marks

Final Examination: 45 Marks.

i. Problem solving – 40 marks.

[There will be a hands-on problem-solving test in the computer lab. The question paper should contain 5 (five) practical problems, and students have to solve 3 (three) problems. Students must write the problem-solving steps/procedures and obtained results in the answer script.]

ii. Practical Notebook – 5 marks.

VI. REFERENCES

De Veaux, R. D., Velleman, P. F., & Bock, D. E. (2021). *Stats: Data and Models* (5th ed.). Pearson.

Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th ed.). SAGE Publications.

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George, D., & Mallery, P. (2020). *IBM SPSS Statistics 27 Step by Step: A Simple Guide and Reference* (17th ed.). Routledge.

Pollock, P. H., & Edwards, B. C. (2019). *An SPSS Companion for Political Science* (5th ed.). CQ Press.

Triola, M. F. (2018). *Elementary Statistics Using Excel* (7th ed.). Pearson.

Wegner, T. (2016). *Applied Business Statistics: Methods and Excel-Based Applications* (4th ed.). Juta & Company.

PROVISIONAL

Course Code: 8223757	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Calculus II and Ordinary Differential Equations			

Course Description

This course introduces the fundamental concepts of multivariable calculus and ordinary differential equations. It develops students' analytical and problem-solving skills through the study of vector-valued functions, functions of several variables, multiple integrals, and ordinary differential equations. The course emphasizes the application of calculus and differential equations to mathematical modelling and problems arising in science, engineering, and related disciplines.

Course Objectives (COs):

This course aims to

- Develop a sound understanding of multivariable calculus and ordinary differential equations.
- Develop analytical and problem-solving skills for vector functions, partial differentiation, multiple integration, and differential equations.
- Enable students to apply calculus and differential equation techniques to mathematical models and problems in science, engineering, and related disciplines.

Course Learning Outcomes (CLOs)

After completing this course, students will be able to

CLO	Course Learning Outcome	Bloom's Level
CLO1	Explain and analyze vector-valued functions of a single variable, including limits, derivatives, integrals, and geometric properties such as tangent lines and arc length.	Analyze
CLO2	Determine the curvature and radius of curvature, and identify properties of space curves using Cartesian and parametric equations.	Apply
CLO3	Compute limits, partial derivatives, and differentials of functions of several variables, and apply optimization techniques including Lagrange multipliers.	Apply
CLO4	Evaluate double and triple integrals over different regions and coordinate systems to compute areas, volumes, and other applications.	Apply
CLO5	Classify ordinary differential equations and interpret their solutions using direction fields and basic existence and uniqueness concepts.	Analyze

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CLO6	Apply appropriate methods to solve first-order differential equations, including separable, linear, exact, homogeneous, Bernoulli, Riccati, and Clairaut's forms.	Apply
CLO7	Solve higher-order linear differential equations, both homogeneous and non-homogeneous, using linear operators, reduction of order, and constant coefficient methods.	Apply

Mapping of CLOs with PLOs

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	√	√										
CLO2	√	√										
CLO3	√	√										
CLO4	√	√								√		
CLO5	√	√								√		
CLO6	√	√								√		
CLO7	√	√										

Course Contents

Week	**Topic**	**Teaching Learning Strategy**	**Assessment**	**CLOs**
1–3 (3 weeks)	**Vector-valued functions of a single variable:** Limits. Derivatives and integrals. Tangent lines to graphs of such functions. Arc length from the vector viewpoint. Arc length parametrization.	Lecture; Whiteboard Teaching; Worked Examples	Written Quiz; Tutorial Exercise; Class Test	CLO1
4–6 (3 weeks)	**Curvature of space curves:** Definition. Curves of zero curvature. Curves of constant non-zero curvature. Cartesian equations and parametric equations. Radius of curvature. Centre of curvature.	Lecture; Worked Examples; Tutorial	Tutorial Exercise; Problem Solving; Class Test	CLO2
7–11 (5 weeks)	**Functions of several variables:** Limits and continuity. Partial derivatives. Differentiability, linearization, and differentials. The chain rule.	Lecture; Whiteboard	Assignment; Problem Solving; Class	CLO3

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Week	Topic	Teaching Learning Strategy	Assessment	CLOs
	Partial derivatives with constrained variables. Extreme values and saddle points of functions of several variables. Lagrange multipliers.	Teaching; Problem Solving	Test	
12–15 (4 weeks)	**Multiple Integration:** Double integrals and iterated integrals. Double integrals over nonrectangular regions. Double integrals in polar coordinates. Area by double integrals. Triple integrals and iterated integrals: Volume as a triple integral.	Lecture; Worked Examples; Tutorial	Tutorial Exercise; Problem Solving; Class Test	CLO4
16–18 (3 weeks)	**Ordinary differential equations and their solutions:** Classification of differential equations. Solutions. Implicit solutions. Singular solutions. Initial value problems. Boundary value problems. Basic existence and uniqueness theorems (statement and illustration only). Direction fields. Phase plane.	Lecture; Whiteboard Teaching; Interactive Discussion	Written Quiz; Tutorial Exercise; Class Test	CLO5
19–23 (5 weeks)	**Solution of first-order differential equations:** Separable equations. Linear equations. Exact equations. Special integrating factors. Substitutions and transformations. Homogeneous equations. Bernoulli equation. Ricatti equation. First-order higher degree equation solvable for x, y, and p. Clairaut's equation.	Lecture; Worked Examples; Problem Solving	Assignment; Problem Solving; Class Test	CLO6
24–28 (5 weeks)	**Solution of higher-order linear equations:** Linear differential operators. Basic theory of linear differential equations. Solution space of homogeneous linear equations. Fundamental solutions of homogeneous solutions. Reduction of orders, Homogeneous linear equations with constant coefficients. Non-homogeneous equation.	Lecture; Worked Examples; Problem Solving	Problem Solving; Tutorial Exercise; Class Test	CLO7

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Course Assessment Framework

Total Course Marks: 100 Examination Duration: 4 Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Anton, H. (1995). *Calculus* (5th ed.). Wiley.

Ayres, F., & Ayres, J. R. (1999). *Theory and problems of differential equations* (Schaum's Outline Series). McGraw-Hill.

Braun, M. (1983). *An introduction to differential equations and their applications*. Springer-Verlag.

Gill, D. (1986). *Introduction to differential equations*. McGraw-Hill.

Ross, S. L. (1984). *Differential equations*. John Wiley & Sons.

Zill, D. G. (2009). *A first course in differential equations with applications*. Brooks/Cole, Cengage Learning.

PROVISIONAL

Course Code: 8223758	Marks: 50	Credits: 2	Class Hours: 42
Course Title: Math Lab (Mathematica)			

Course Description

This course introduces students to the use of Mathematica, a powerful Computer Algebra System (CAS), for solving mathematical problems. Students will perform symbolic, numerical, and graphical computations. Emphasis is placed on applying these skills to topics from first-year mathematics courses.

Course Objectives

The main objectives of the course are as follows:

- Familiarize students with Mathematica software.
- Teach students how to use Mathematica for symbolic and numerical calculations, data analysis, visualization, and problem-solving in mathematics and scientific research.
- Enhance students' proficiency in utilizing Mathematica to improve their understanding and problem-solving abilities in various mathematical domains.

Course Learning Outcomes (CLOs)

After completing this course, students will be able to

CLO	Course Learning Outcome	Bloom's Level
CLO1	Demonstrate fundamental skills in operating the Mathematica software interface and executing basic commands.	Apply
CLO2	Apply Mathematica for symbolic and numerical computation, including operations with expressions, equations, and matrices.	Apply
CLO3	Apply Mathematica to compute and verify derivatives, integrals, limits, and series solutions for problems drawn from Calculus and related mathematical courses.	Apply
CLO4	Create 2D and 3D graphical representations of mathematical functions and data using Mathematica's visualization tools.	Apply
CLO5	Solve problems from first- and second-year allied math courses (e.g., Foundations of Mathematics, Calculus I, Calculus II, and Ordinary Differential Equations) using Mathematica's built-in functions and packages.	Apply

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CLO6	Utilize Mathematica to explore mathematical patterns, test conjectures, and support experimental mathematics.	Analyze
CLO7	Integrate Mathematica into scientific or mathematical reporting, presentations, and research-oriented tasks.	Create

Mapping of CLOs with PLOs

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√									√		
CLO2	√				√					√		
CLO3	√				√					√		
CLO4	√				√					√		√
CLO5	√									√		
CLO6	√				√					√		
CLO7	√			√	√					√		√

Course Contents

Problem-solving using the Computer Algebra System (CAS) Mathematica: Running the package. Numerical computation. Algebraic computation. Mathematical functions. Derivatives and integrals. Limits and series. Lists and matrices. Graphics. Standard packages. Solving problems in Foundations of Mathematics, Calculus I, Calculus II, and Ordinary Differential Equations that students studied in the first and second years.

Teaching Learning Activities:

Class Lecture Lab-based 21 (Each 2-hour lab class covers first- and second-year problems of allied Mathematics courses)

Class Test 1

Lab Notebook 1 (Instructors will assign at least 15 lab tasks)

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Assessment Strategy:

Type of evaluation	Time	Marks	Guideline
Final Exam	2 hours	30	Three questions have to be answered out of the five questions
Continuous Assessment (Class Test)	1 hour	10	Internal Assessment: Conducted during the academic year
Continuous Assessment (Lab Performance & Notebook)	-----	5	Internal Assessment: Based on laboratory performance and completion of at least 15 laboratory exercises
Continuous Assessment (Class attendance)	-----	5	Internal Assessment: Assessed according to the University's attendance policy

List of Books

Don, E. (2009). *Schaum's outline of Mathematica and the Wolfram language* (2nd ed.). McGraw-Hill Education.

Mangano, S. (2009). *Mathematica cookbook: Building blocks for science, engineering, finance, music, and more*. O'Reilly Media.

Wolfram Research, Inc. (2024). *Mathematica (Student Edition)* [Software]. Wolfram Research, Inc.

PROVISIONAL

Detailed Syllabus

Course Code: 8222261	**Marks:** 100	**Credits:** 4	**Class Hours**: 56
Course Title: Money, Banking and Public Finance		**Course Type:** Allied	**Exam Hours:** 4

Course Descriptions

This course provides a comprehensive introduction to the theories, institutions, and policies of money, banking, and public finance. It explores the nature and functions of money, monetary standards, and the quantity theory of money, alongside the structure and operations of commercial and central banking systems, with particular emphasis on Bangladesh. The course also delves into specialized banking institutions, public expenditure, public revenue, taxation, fiscal policy, and budget formulation. Students will develop the analytical skills necessary to understand monetary and fiscal policy frameworks and their applications in developing economies like Bangladesh.

Course Objective

Upon completion of this course, students will be able to:

1. Understand the fundamental concepts of money, its functions, classification, and role in different economic systems.
2. Comprehend the Quantity Theory of Money and Keynesian approaches to analyze inflation, deflation, and money supply determinants.
3. Analyze the structure, functions, and credit creation process of commercial banks, with special reference to Bangladesh.
4. Evaluate the role of central banking, monetary policy instruments, and the Bangladesh Bank's objectives and limitations.
5. Assess the objectives and roles of specialized banking institutions in Bangladesh.
6. Explain the nature, scope, and principles of public finance, including public goods, market failure, and the principle of maximum social advantage.
7. Analyze public expenditure patterns, taxation principles, and the characteristics of a good tax system.
8. Evaluate fiscal policy components, instruments, objectives, and their role in developed and developing countries.
9. Analyze the budget formulation process and study the budgets of Bangladesh over the last five years.
10. Develop effective communication, teamwork, and research skills through presentations, reports, and group projects.

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcomes	Bloom's Level	PLO
CLO1	Explain the meaning, functions, and classification of money, and describe various monetary standards and the role of money in different economic systems.	Understand, Level 2	PLO2, PLO7
CLO2	Apply the Quantity Theory of Money and Keynesian	Apply,	PLO1, PLO2,

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	approaches to analyze inflation, deflation, and determinants of money supply.	Level 3	PLO4, PLO5, PLO7
CLO3	Analyze the functions and credit creation process of commercial banks, and evaluate the evolution and reforms of the banking sector in Bangladesh.	Analyze, Level 4	PLO1, PLO2, PLO5, PLO7, PLO8
CLO4	Evaluate the role and functions of central banking, monetary policy instruments, and the Bangladesh Bank's objectives and limitations.	Evaluate, Level 5	PLO1, PLO2, PLO5, PLO7, PLO8
CLO5	Assess the objectives and roles of specialized banking institutions in Bangladesh, including BSB, BSRS, BKB, Islamic Banking, and Grameen Bank.	Evaluate, Level 5	PLO2, PLO5, PLO7, PLO8
CLO6	Explain the nature, scope, and principles of public finance, including public goods, market failure, and the principle of maximum social advantage.	Understand, Level 2	PLO2, PLO6, PLO7, PLO8
CLO7	Analyze the classification, canons, effects, and growth trends of public expenditure in Bangladesh.	Analyze, Level 4	PLO1, PLO2, PLO3, PLO4, PLO6, PLO7
CLO8	Evaluate various sources of public revenue, taxation principles, tax burden division, and the characteristics of a good tax system.	Evaluate, Level 5	PLO1, PLO2, PLO4, PLO6, PLO7, PLO8
CLO9	Analyze fiscal policy components, instruments, and objectives, and assess the study of Bangladesh's budgets over the last five years.	Analyze, Level 4	PLO1, PLO2, PLO3, PLO4, PLO5, PLO6
CLO10	Communicate statistical and economic ideas effectively through written reports, presentations, and team-based projects related to money, banking, and public finance.	Create, Level 6	PLO3, PLO4, PLO5, PLO7, PLO9, PLO10

Course Content

Week	**Topics**	**Teaching-Learning Strategy**	**Assessment Strategy**	**CLOs**
1–2	**Module 1: Money and Value of Money** — Money: Meaning, Functions and Classification; Gresham's Law; Role of Money in Capitalist, Socialist and Mixed Economies; Monetary Standards: Metallic and Paper Systems of Note Issue.	Lecture, Discussion, Case Studies	Quiz, Class Participation	CLO 1
3–4	**Module 2: Quantity Theory of Money —** Cash Transaction and Cash Balance Approaches; The Keynesian Approach; Concept of Inflation and Deflation.	Lecture, Problem-solving Sessions, Group Discussion	Assignment, Midterm Exam	CLO 2

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Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLOs
5–6	**Module 3: Supply of Money —** Definitions; Determinants of Money Supply; High Powered Money and Money Multiplier; Currency System of Bangladesh.	Lecture, Data Analysis, Case Study on Bangladesh	Quiz, Presentation	CLO 2
7–9	**Module 4: Commercial Banking** — Meaning and Types; Functions of Commercial Banks; The Process of Credit Creation: Purpose and Limitations; Liabilities and Assets of Banks; Evolution of Commercial Banking in Bangladesh; A Critical Appraisal of the Progress of Commercial Banking after Nationalization; Recent Reforms in Banking Sector in Bangladesh.	Lecture, Group Discussion, Case Study, Video Documentary	Group Assignment, Class Test	CLO 3
10–12	**Module 5: Central Banking** — Functions of a Central Bank; Quantitative and Qualitative Methods of Credit Control: Bank Rate Policy, Open Market Operations, Variable Reserve Ratio and Selective Methods; Role and Functions of the Bangladesh Bank; Objectives and Limitations of Monetary Policy with Special Reference to Bangladesh.	Lecture, Policy Analysis, Debate	Midterm Exam, Report	CLO 4
13–14	**Module 6: Specialized Banking** — Objective, Importance; Role of Bangladesh Shilpa Bank (BSB), Bangladesh Shilpa Rin Shangstha (BSRS), Bangladesh Krishi Bank (BKB), Islamic Banking, Grameen Bank.	Lecture, Case Studies, Field Visit (if possible), Guest Lecture	Presentation, Assignment	CLO 5
15–16	**Module 7: Public Finance** — Definition; Nature and Scope of Public Finance; Distinction between Private and Public Finance; Public Goods Vs. Private Goods; The Principle of Maximum Social Advantage; Market Failure; Role of Public Finance in Developing Countries.	Lecture, Discussion, Comparative Analysis	Quiz, Class Participation	CLO 6
17–19	**Module 8: Public Expenditure** — Meaning, Classification and Principle of Public Expenditure; Canons and Effects of Public Expenditure; Trends in Public Expenditure and Causes of Growth of	Lecture, Data Analysis, Group Discussion	Assignment, Presentation	CLO 7

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Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLOs
	Public Expenditure in Bangladesh.			
20–22	**Module 9: Public Revenue** — Sources of Public Revenue; Taxation: Meaning, Canons and Classification of Taxes; Division of Tax Burden; The Benefit and Ability-To-Pay Approaches; Impact and Incidence of Taxes; Taxable Capacity; Effects of Taxation; Characteristics of A Good Tax System; Direct & Indirect Taxes; Value Added Tax.	Lecture, Problem-solving, Case Study on VAT in Bangladesh	Midterm Exam, Quiz	CLO 8
23–25	**Module 10: Fiscal Policy** — Components, Instruments, Objectives; Role of Fiscal Policy in Developed and Developing Countries.	Lecture, Policy Analysis, Debate	Assignment, Class Test	CLO 9
26–28	**Module 11: Budget** — Concept of Budget; Distinction between Revenue and Capital Budget, Public Debt; Sectoral Allocation; Study of the Budgets of Bangladesh (Last Five Years).	Lecture, Data Analysis, Group Project	Group Project Report, Presentation	CLO 9, CLO 10

Course Assessment Framework

Total Course Marks: 100 Examination Duration: 4 Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain a maximum of 3 sub-sections (e.g., a, b, c)	80%

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List of Books

Ali, M. M. (2020). *Monetary Policy and Central Banking in Bangladesh*. University Press Limited.

Bangladesh Bank. (2023). *Annual Report 2022-2023*. Bangladesh Bank.

Hyman, D. N. (2019). *Public Finance: A Contemporary Application of Theory to Policy* (12th ed.). Cengage Learning.

Ministry of Finance, Government of Bangladesh. (2024). *Budget Speech 2024-2025*. Government of Bangladesh.

Mishkin, F. S. (2022). *The Economics of Money, Banking, and Financial Markets* (13th ed.). Pearson.

Ritter, L. S., Silber, W. L., & Udell, G. F. (2020). *Principles of Money, Banking, and Financial Markets* (13th ed.). Pearson.

Rosen, H. S., & Gayer, T. (2018). *Public Finance* (10th ed.). McGraw-Hill Education.

Siddiqui, K. A. (2021). *Money, Banking and Public Finance*. Royal Publishers.

Stiglitz, J. E., & Rosengard, J. K. (2015). *Economics of the Public Sector* (4th ed.). W. W. Norton & Company.

World Bank. (2023). *Bangladesh Development Update*. World Bank Group.

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Course Code: 8222263	**Marks: 50**	**Credits: 2**	**Class Hours**: 28
Course Title: Bangladesh Economy		**Course Type:** Allied	**Exam Hours: 2**

Course Descriptions

This course introduces Political Science Honours students to the structure, performance, and policy management of the Bangladesh economy, with emphasis on how economic decisions are shaped by, and in turn shape, political and administrative processes. It begins with an overview of macroeconomic trends in growth, savings, and investment before moving into the fiscal, monetary, and external sectors that underpin national economic management. Particular attention is given to the agriculture and industrial sectors, the role of state-owned enterprises, and the ongoing shift toward private sector-led development. The course also examines employment, wages, and poverty trends alongside government efforts in human development and social protection, and closes with a look at infrastructure, environmental challenges, and Bangladesh's climate vulnerability. Rather than treating economics as a technical subject in isolation, the course consistently draws out its political dimensions: budget-making as a political act, regulatory reform as a contest of interests, and development planning as a reflection of governance priorities. By the end, students should be able to follow Bangladesh's economic policy debates with confidence and understand economic performance as part of the larger picture of governance.

Course Objective

Upon successful completion of this course, students will be able to:

1. Build a working understanding of Bangladesh's macroeconomic structure, growth performance, and the institutional framework within which economic policy is formulated and implemented.
2. Examine the role and performance of the agriculture, industrial, and external sectors in Bangladesh's development, along with the government policies that shape them.
3. Analyze trends in employment, wages, prices, and poverty in Bangladesh, and evaluate the effectiveness of government programs addressing these areas.
4. Develop the ability to critically connect Bangladesh's economic performance with questions of governance, public policy, and political decision-making, so that economic issues can be read through a political science lens.

Course Learning Outcomes (CLOs)

CLO	Course Learning Outcomes	Bloom's Level	PLO
CLO1	Demonstrate a clear and working understanding of Bangladesh's macroeconomic performance, national income, savings, and investment trends, and the institutional structure guiding economic policy.	Understand, Apply, Level 2, 3	PLO1, PLO6, PLO7,PLO12
CLO2	Analyze the contribution, performance, and challenges of the agriculture, industrial, and external (trade) sectors to Bangladesh's overall economic development.	Analyze, Level 4	PLO1, PLO2, PLO4, PLO6, PLO7
CLO3	Evaluate the fiscal and monetary management systems of Bangladesh, including public finance, taxation, budgetary practices, banking, and financial sector reforms.	Evaluate, Level 5	PLO1, PLO2, PLO4, PLO6, PLO7
CLO3	Assess trends in employment, wages, prices, and poverty in Bangladesh, along with the design and effectiveness of related government programs.	Evaluate, Level 5	PLO1, PLO2, PLO3, PLO4, PLO6, PLO7
CLO4	Critically appraise the political economy dimensions of Bangladesh's development policy, linking economic outcomes with governance, planning, and public administration.	Evaluate, Create, Level 5, 6	PLO1, PLO2, PLO3, PLO6, PLO7, PLO8, PLO10

Course Content

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLOs
1–4	**Chapter 1: Overview of the Bangladesh Economy:** growth performance, savings and investment trends, and the institutional and policy framework guiding macroeconomic management, including the medium-term macroeconomic framework and ongoing	Interactive lectures, discussion on recent Bangladesh Economic	Data interpretation exercise using the latest Bangladesh Economic	CLO1

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Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLOs
	reform programs.	Review data	Review	
5–9	**Chapter 2: National Income and Price Trends:** sector-wise growth of GDP, savings and investment; consumer price index and inflation; wage trends, labor force, employment, overseas employment, and remittances.	Interactive lectures, data reading exercises, class discussion	Data reading quiz / class test on GDP, prices, and employment trends	CLO1, CLO3
10–14	**Chapter 5: The External Sector:** world trade scenario, export and import policy, tariff structure, Bangladesh's position in the WTO and regional trade arrangements, balance of payments, exchange rate policy, and foreign exchange reserves.	Interactive lectures, group discussion, thematic assignments	Thematic assignment on trade policy and balance of payments	CLO2, CLO4
15–19	**Chapter 6: Agriculture, Industry and State-Owned Enterprises:** management of food grain production and agricultural credit; growth and performance of the manufacturing sector and SMEs; the production, financial performance, and reform of state-owned enterprises.	Interactive lectures, sector case studies, group presentations	Group presentation based on a sector case study	CLO2
20–23	**Chapter 7: Power, Energy, Transport, Communication and Human Development:** power generation and transmission, transport and communication infrastructure, and human development outlays covering education, health, women and children's affairs, and social welfare.	Interactive lectures, documentary screening, group discussion	Reflective assignment following documentary screening	CLO2, CLO3
24–26	**Chapter 8: Poverty Alleviation, Private Sector Development and Environment:** poverty trends and reduction strategies, employment generation programs, a private-investment-friendly environment, privatization and public-private partnership, and environmental and climate change challenges facing Bangladesh.	Interactive lectures, thematic assignments, policy debate	Policy debate evaluation on poverty alleviation and environment	CLO3, CLO4
27–28	Revision, Doubt-clearing Session, and Preparation for the Final Examination	Comprehensive review lecture and open discussion	Comprehensive review test covering all chapters	All CLOs

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Course Assessment Framework

Total Course Marks: 50 Examination Duration: 2.5 Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	4% (2 Marks)
	In-course Examination	10% (5 Marks)
	Quiz / Assignment Presentation	6% (3 Marks)
Summative Assessment (80%)	Final Examination • Students will have to answer 4 questions out of 6 • 10 marks per question (4×10) =40 marks • Each question may contain a maximum of 3 sub-sections (e.g., a, b, c)	80% (40 Marks)

List of Books

Bangladesh Bank. (n.d.). *Annual report*.

Islam, N. (2003). *Making of a nation, Bangladesh: An economist's tale*. University Press Limited.

Islam, S. M. M. (n.d.). *Bangladesh economy*. Bangladesh Publishers.

Khan, A. A. (1996). *Discovery of Bangladesh*. University Press Limited.

Mahmud, W. (Ed.). (n.d.). *Bangladesh's development experience: Some selected issues*. University Press Limited.

Ministry of Finance, Government of Bangladesh. (n.d.). *Bangladesh economic review*. Finance Division.

Sen, B., & Ali, Z. (Eds.). (n.d.). *Bangladesh development studies*. Bangladesh Institute of Development Studies (BIDS).

Sobhan, R. (2016). *Untranquil recollections: Nation building in post-liberation Bangladesh*. SAGE Publications.

অর্থ মন্ত্রণালয়, গণপ্রজাতন্ত্রী বাংলাদেশ সরকার। (২০২৫)। *বাংলাদেশ অর্থনৈতিক সমীক্ষা*। অর্থ বিভাগ।

ইসলাম, এস. এম. মুজাহিদুল। (প্রকা.কা.অ.)। *বাংলাদেশ ইকোনমি*। বাংলাদেশ পাবলিশার্স।

ইসলাম, ন. (২০০৩)। *মেকিং অফ এ নেশন, বাংলাদেশ: অ্যান ইকোনমিস্টস টেল*। ইউনিভার্সিটি প্রেস লিমিটেড।

ইসলাম, র. (২০১৫)। *উন্নয়ন ভাবনায় কর্মসংস্থান ও শ্রমবাজার*। ইউনিভার্সিটি প্রেস লিমিটেড (ইউপিএল)।

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ইসলাম, র. (২০২৩)। *উন্নয়নের অর্থনীতি*। ইউনিভার্সিটি প্রেস লিমিটেড (ইউপিএল)।

উল্লাহ, ম. (২০০৩)। *বাংলাদেশ অর্থনীতি*। বাংলাদেশ পাবলিশার্স।

খান, আ. আ. (১৯৯৬)। *ডিসকভারি অফ বাংলাদেশ*। ইউনিভার্সিটি প্রেস লিমিটেড।

খান, আ. আ. (২০২০)। *দারিদ্র্যের অর্থনীতি: অতীত, বর্তমান ও ভবিষ্যৎ*। প্রথমা প্রকাশন।

বাংলাদেশ ব্যাংক। (প্রকা.কা.অ.)। *অ্যানুয়াল রিপোর্ট*।

বায়েস, আ., এবং হোসেন, ম. (২০১৩)। *গল্পে গল্পে অর্থনীতি*। এ এইচ ডেভেলপমেন্ট পাবলিশিং হাউস।

মাহমুদ, ও. (সম্পা.)। (প্রকা.কা.অ.)। *বাংলাদেশস ডেভেলপমেন্ট এক্সপেরিয়েন্স: সাম সিলেক্টেড ইস্যুজ*। ইউনিভার্সিটি প্রেস লিমিটেড।

মুহাম্মদ, আ. (২০১০)। *অর্থশাস্ত্র পরিচয়*। সংহতি প্রকাশন।

রহমান, র. ই. (২০১২)। *বাংলাদেশের অর্থনীতি ও উন্নয়ন*। সাহিত্য প্রকাশ।

সেন, বি., এবং আলী, জ. (সম্পা.)। (প্রকা.কা.অ.)। *বাংলাদেশ ডেভেলপমেন্ট স্টাডিজ*। বাংলাদেশ ইনস্টিটিউট অফ ডেভেলপমেন্ট স্টাডিজ (বিআইডিএস)।

সোবহান, রে. (২০১৬)। *আনট্রাঙ্কুইল রিকলেকশনস: নেশন বিল্ডিং ইন পোস্ট-লিবারেশন বাংলাদেশ*। সেজ পাবলিকেশন্স।

Guidelines of Viva-voce

Course Code: 8223662	**Marks:** 50	**Credits**:2
Course Title: Viva-voce (Statistics)		

Course Description

The Viva-Voce is a comprehensive oral examination designed to evaluate students' overall academic achievement, professional competence, critical thinking, and communication skills acquired during the B.Sc. (Honours) in Statistics program. Conducted at the end of the program after the completion of written and practical examinations, the course provides students with an opportunity to demonstrate their understanding of fundamental and advanced statistical theories, probability models, data analysis techniques, and modern statistical software applications. The examination also assesses students' ability to integrate statistical reasoning, solve real-world problems in diverse fields (such as public health, economics, and data science), and communicate analytical findings effectively in academic and professional settings.

Course Objectives

The course's objectives are to:

- Evaluate students' core knowledge of statistical theory, probability distributions, inference, and applied data analysis techniques.
- Assess students' ability to design research, collect data, and apply appropriate statistical methods to solve real-world problems.
- Develop effective oral communication, technical presentation, and scientific reporting skills.
- Evaluate students' critical thinking, problem-solving, and data interpretation abilities using modern statistical software and tools.
- Assess students' professional ethics, teamwork, leadership qualities, and overall readiness for data-centric careers and higher studies.
- Prepare students for professional employment in research institutions, government and non-government organizations, and advanced academic pursuits.

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Course Learning Outcomes (CLOs)

After completing the viva-voce, the students will be able to demonstrate the following Course Learning Outcomes, mapped directly with the corresponding Program Learning Outcomes (PLOs) and Bloom's Taxonomy levels:

CLO	Course Learning Outcomes (CLOs)	Bloom's Level	PLO Mapping
CLO 1	Demonstrate comprehensive foundational and advanced knowledge of statistical theories, probability models, and data analysis methods.	Understand & Apply, Level 2 & 3	PLO1, PLO2
CLO 2	Apply statistical techniques and modern software tools to solve real-life problems in pure and applied statistics, public health, and social sectors.	Apply & Analyze, Level 3 & 4	PLO2, PLO5, PLO6
CLO 3	Design scientific research studies, collect and process relevant data, and interpret analytical results with logical conclusions.	Synthesize & Evaluate, Level 5 & 6	PLO3, PLO4
CLO 4	Communicate statistical ideas, findings, and complex reports clearly and confidently through oral presentations and professional writing.	Apply & Communicate, Level 3	PLO10
CLO 5	Exhibit professional ethics, integrity, teamwork, and effective time/project management in handling collaborative statistical tasks.	Value & Organize, Level 3	PLO8, PLO9, PLO11
CLO 6	Demonstrate career readiness, adaptability, and a commitment to lifelong learning in evolving data science and statistical landscapes.	Characterize, Level 3	PLO7, PLO12

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Teaching System

The course is conducted through an interactive and student-centered approach. Teaching and learning activities include orientation sessions, guided discussions, question-and-answer sessions, seminar presentations, mock viva examinations, data analysis project reviews, individual consultations, self-directed learning, and revision of core Statistics concepts. Students are encouraged to develop sound communication, critical thinking, analytical, and presentation skills in preparation for the final viva voce examination.

Assessment Strategy

Students will be assessed through a comprehensive viva voce examination conducted by the designated Examination Committee following the completion of written and practical examinations. The assessment will evaluate students' overall conceptual understanding of statistics, their ability to integrate theoretical knowledge with computational and data-analytic applications, critical thinking and problem-solving

capacities, oral communication skills, professional attitude, ethical responsibility, and responsiveness to technical questions. The final grade will be awarded based on the comprehensive performance demonstrated during the viva voce examination.

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