Subject Title: **Basic Mathematics (212205)**

Course Teacher: **Md. Abdus Salam (T-08) & Md. Alhaj Uddin (T-09)**

Chapter No & Chapter Title	**Number of Classes with Class Title**	**Learning Outcomes** At the end of the class the students would be able to
1. Review of Some Core Concepts (T-08)	1. Foundations of Mathematical Economics.	1. Define and explain the nature of mathematical economics and its role in economic analysis. 2. Differentiate between variables, constants, and parameters in the context of economic modeling. 3. Apply the concept of model building to formulate simple mathematical representations of economic problems.
	2. Real Number System and Its Properties.	1. Classify numbers into different sets within the real number system (natural, whole, integers, rational, irrational). 2. Identify and differentiate even, odd, prime, and composite numbers with examples. 3. Apply the laws of exponents in simplifying algebraic and numeric expressions.
	3. Working with Numbers in Mathematical Contexts.	1. Perform operations involving fractions (addition, subtraction, multiplication, division) accurately. 2. Convert between improper fractions, mixed numbers, and decimals. Use fractions and other number types to represent and solve basic economic relationships.
2. Concepts of Sets (T-09)	4. Some Basic Definitions- Set	1. Define and explain basic set concepts such as set, element, finite set, infinite set, null set, and unique set, and identify real-world examples of each**.** 2. Distinguish between different types of sets (e.g., equal sets, equivalence relations, subsets) and apply these definitions to solve problems involving set relationships and comparisons.
	5. Set operations and comparisons.	1. Define and compute the power set of a given set, and understand the concept of a family of sets and how they relate to the universal set. 2. Evaluate the relationships between sets such as disjoint sets, subsets, and the universal set, and apply these concepts to solve problems involving set operations and comparisons.
	6. Venn Diagrams	1. Construct and interpret Venn diagrams to represent relationships among two or more sets, including intersections, unions, and complements. 2. Solve problems involving set operations by using Venn diagrams to visualize and calculate the number of elements in combined or distinct sets.

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	7. Representation of Set-Basic Operation	1. Represent sets using roster form, set-builder form, and through Venn diagrams effectively. 2. Perform and explain basic set operations such as union, intersection, and difference using both symbolic notation and graphical methods.
	8. Representation of Set-Basic Operation	1. Apply De Morgan's Laws to simplify set expressions and verify these laws using examples and Venn diagrams 2. Solve real-world problems by modeling situations with sets and applying operations and De Morgan's Laws accurately.
	9. Idempotent Law, Identity Law;	1. Explain and apply the Idempotent Law and Identity Law to simplify set expressions and demonstrate their properties through examples. 2. Identify and prove the Idempotent Law and Identity Law using Venn diagrams and symbolic notation.
	10. Partition of Set.	1. Illustrate the concept of a partition of a set, including how to divide a set into disjoint subsets, and prove whether a given collection of subsets forms a partition. 2. Apply the principles of Idempotent and Identity Laws in combination with set partitions to solve problems related to set theory and real-world scenarios.
3. Elementary Static Analysis (T-08)	11. Understanding Economic Equilibrium	1. **Define** the concept of equilibrium in the context of economics. 2. **Distinguish** between static and dynamic equilibrium. 3. **Illustrate** how equilibrium reflects a balance between economic forces such as supply and demand.
	12. Introduction to Partial Equilibrium Analysis	1. Explain the concept of partial equilibrium and its underlying assumptions. 2. Analyze how individual markets reach equilibrium through the interaction of supply and demand. 3. Identify real-world examples where partial equilibrium can be applied.
	13. Partial Equilibrium Diagrams and applications.	1. Draw and interpret partial equilibrium diagrams showing demand and supply intersections. 2. Predict how shifts in demand or supply affect market equilibrium price and quantity. 3. Assess the effects of price controls, subsidies, or taxes on market equilibrium.
	14. National Income Analysis – Concepts and Components	1. **Define** national income and describe its significance in macroeconomic analysis. 2. **Compare** the three main methods of measuring national income: income, expenditure, and output. 3. **Break down** national income into its major components and explain their economic roles.

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	15. Solving National Income Equilibrium	1. **Set up** a simple national income model using the income-expenditure approach. 2. **Calculate** equilibrium income given specific values of consumption, investment, government spending, etc. 3. **Evaluate** how changes in components (like investment or government spending) affect national income equilibrium.
4 Function, Limit and Continuity (T-09)	16. Concept of a function	1. Define the concept of a function, classify various types of functions (e.g., linear, quadratic, cubic, inverse), and represent these functions diagrammatically, including identifying key features such as slope, intercepts, and the shape of the graph. 2. Interpret and analyze the graphs of linear, quadratic, cubic, and inverse functions, understanding their characteristics, such as slope, intercepts, and turning points, and solve related problems involving two-variable functions.
	17. Limit of a function	1. Define the limit of a function at a point, explain its significance in mathematical analysis, and determine the limit of a function from both graphical and numerical perspectives. 2. Apply appropriate limit laws and techniques (including one-sided and two-sided limits) to evaluate limits of algebraic and piecewise functions and identify situations involving discontinuities.
	18. Continuity of a function	1. Define continuity at a point and over an interval and explain the conditions under which a function is considered continuous using formal mathematical language. 2. Analyze functions to determine points of continuity and discontinuity and apply these concepts to evaluate limits and sketch graphs that reflect the continuity behavior of functions.
	19. Exponential functions and Logarithmic functions	1. Define and explain exponential functions and logarithmic functions (including common and natural logarithms) and understand their interrelationship and properties. 2. Apply rules of logarithms to simplify expressions, compute the logarithm of a number using common and natural logarithms, and solve exponential and logarithmic equations in real-world and mathematical contexts.
5. Equation System (T-08)	20. Solving Basic Equations	1. **Identify** and classify different types of algebraic equations used in economics. 2. **Solve** basic linear and quadratic equations using appropriate algebraic methods. 3. **Interpret** the solutions of equations in the context of economic relationships.

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	21. Simultaneous Equations and Their Applications	1. **Solve** systems of two or more simultaneous linear equations using substitution and elimination. 2. **Analyze** the meaning of solutions (unique, no solution, infinite solutions) in an economic context. 3. **Apply** simultaneous equations to solve basic demand and supply models.
	22. Advanced Applications for Simultaneous Equations in Economics	1. **Construct** simultaneous equation models for real-world economic problems. 2. **Solve and interpret** systems of equations that represent multiple interconnected markets. 3. **Evaluate** how changes in parameters affect equilibrium outcomes in economic models.
	23. Inequalities and Their Applications	1. **Solve** and graph linear inequalities in one and two variables. 2. **Apply** inequalities to model economic constraints like income and production limits. 3. **Interpret** the feasible region in economic optimization problems using inequality systems.
	24. Geometry in Economics – Linear Models and Coordinates.	1. **Plot** points and lines on the Cartesian plane and interpret their significance in economics. 2. **Calculate** the distance between two points and the slope of a line, linking it to the rate of change. 3. **Formulate and apply** linear equations to represent economic relationships, such as cost and revenue functions.
6. Geometry (T-09)	25. Cartesian Co-ordinate System	1. Describe the Cartesian coordinate system, plot points on a plane, and accurately calculate the distance between two points using the distance formula. 2. Derive and interpret the equation of a straight line in various forms (e.g., slope-intercept, point-slope), determine slope and intercepts, and graph linear equations on the Cartesian plane.
	26. Distance between Two Points, Straight Line	1. Translate real-life situations and word problems into linear equations and interpret the meaning of variables and constants in context. 2. Solve linear equations and apply the solutions to make informed decisions or predictions in various fields such as business, economics, and science.
	27. Application of Linear Equations	1. Apply linear equations to determine the equations of lines (e.g., parallel, perpendicular, or intersecting) given geometric conditions or coordinate points. 2. Solve geometric problems involving angles, distances, and areas by translating geometric relationships into linear equations and interpreting the solutions.

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7. Elementary Differential Calculus (T-08)	28. Introduction to Derivatives and the Slope of Functions	1. **Define** the derivative as a measure of the instantaneous rate of change and explain its economic interpretations (e.g., marginal cost/revenue). 2. **Differentiate** simple functions using standard rules (power, sum, product, and quotient). 3. **Interpret** the slope of a non-linear (curvilinear) function at a point using the first derivative.
	29. Higher Order Derivatives, Concavity, and Curve Sketching	1. **Compute** second and higher-order derivatives of functions and explain their significance in economics (e.g., acceleration, marginal change). 2. **Determine** the concavity or convexity of a function using the second derivative. 3. **Sketch** the shape of a curve by analyzing critical points, intervals of increase/decrease, and inflection points.
	30. Advanced Derivatives and Special Rules	1. **Apply** implicit differentiation to functions that are not easily solved for one variable. 2. **Use** the inverse function rule in differentiating inverse relationships (e.g., price vs. quantity). 3. **Differentiate** exponential and logarithmic functions and explain their applications in growth models
	31. Total and Partial Derivatives	1. Functions of Several Variables 2. Total and Partial Derivatives 3. Applications in Economics (e.g., Production, Utility Functions)
	32. Total Differential and Partial Differential in Economic Modeling	1. **Compute** the total differential and use it to approximate changes in multivariable functions. 2. **Interpret** partial differential equations in economic contexts (e.g., utility maximization, cost minimization). 3. **Analyze** how small changes in multiple independent variables simultaneously affect an economic outcome using differentials.
8. Optimization (T-09)	33. First-order derivative tests & Second-order derivative test	1. Identify and classify critical points of a function using first-order derivative tests to determine local maxima, minima, and points of inflection. 2. Apply the second-order derivative test to confirm the nature of critical points in single-variable functions.
	34. Optimization of a multivariable function	1. Formulate and solve optimization problems involving one or more variables, subject to given constraints, using calculus-based methods. 2. Analyze multivariable functions to find and classify relative extrema using partial derivatives and the second derivative (Hessian) test.