

Course Code: CAL-212

Title: Calculus-II

Credit Hours: 03

Prerequisite: Calculus-I

Course Objectives:

To prepare the students with the essential tools of calculus to apply the concepts and the techniques in Economics.

Course Contents

Partial & Total Differentiation

Partial Differentiation. Marginal Physical Product of Labor and Capital. Marginal Utility Functions. Money Market Analysis, Demand for Money Function Analysis using Partial Derivatives. Income Elasticity of Demand and Cross Price Elasticity of Demand using Partial Derivatives.

Second and Higher Order Derivatives. Profit Maximization Condition using Second Derivative. Young's Theorem. Partial Derivatives Application on Three Input Production Function

Differentials versus Derivatives. Point Elasticity using Differentials, Income and Price Elasticity of Demand using Differentials. Concept of Total Differentials. Savings Function and Total Differentials. Specific Utility Function and Total Differentials.

Concept of Total Derivatives. Specific Production Function with time-dependent Labor and Capital. Exponential Functions and Growth. Rules of Differentiation of Exponential and Logarithmic Functions. Optimal Timing: A Problem of Wine Storage, A Problem of Timber Cutting, A Problem of Land Purchase for Speculation.

Finding the Rate of Growth using Exponential and Logarithmic Functions. Point Elasticity. Rate of Growth of Per Capita Employment. Rate of Growth of Profit.

Optimization

Concept of Optimization: Calculus Approach to Optimization, 1st Order and 2nd Order Conditions. Average Cost Minimization Analysis. Matrix Approach to Optimization (2nd Order) Test: Hessian. Profit Maximization Analysis, Profit Maximization of Technically Related Goods, Monopolistic Firm Producing Related Goods, Firm Producing Substitute Goods. Short Run Production Function Analysis.

Optimization of More than one Choice Variable, Economic Application on Multi-product Firm, Multi-plant Firm, Price Discrimination by Monopoly, Price Discrimination by Monopsony, Input Decision of a Firm, Profit Maximization of Two-Product Firm.

Comparative-Static Aspects of Optimization, Rationale for Constrained Optimization. Finding Stationary Values using Substitution-Elimination Method. Finding Stationary Values Method of Lagrange Multiplier. Interpretation of the Lagrange Multiplier. Second Order Condition: The Bordered Hessian. Convexity and Concavity using Second Order Derivative. Economic Applications: Utility Maximization, Law of Equi-marginal Utility using Lagrangian Multiplier, Production Function Maximization, Logarithmically Transformed Production Function.

Integral Calculus

Dynamics and Integration. The Nature of Indefinite Integrals. Basic Rules of Integration. The Substitution Rule and the Rule of Integration by Parts. Economic Applications of Integrals: Finding Total Functions from Marginal Functions, Investment & Capital Formation, Utility Function. Definite Integrals. Major Properties of Definite Integral. A Definite Integral as an Area Under a Curve. Improper Integrals.

Consumer Analysis using Integrals

Applications of Definite Integrals: Consumer's Reservation Price using Differential Equations, Consumer Willingness to Pay using Integrals, Consumer Surplus using Integrals, Differential of Consumer Surplus using Integrals, Producer & Social Surplus using Integrals, Producer Surplus with Tax using Integrals.

Firm Related Microeconomic Applications of Integrals

Wine Storage Problem with Storage Costs. Breakeven Analysis of a Firm. Scale of Production Analysis. Mobile Production Analysis. Firm's Average Profit Analysis. Firm's Average Cost Analysis. Average Production Analysis. Average Inventory Analysis. Advertisement Analysis. Profit over Useful Life of Machine. Oil Extraction Analysis, Dynamics of Labour Cost.

Miscellaneous Microeconomic Applications of Integrals

Efficiency Analysis using Integrals. Cost Effectiveness Decision using Differential Equations. Depreciation Analysis using Integrals. Retirement Annuity Analysis using Integrals. Wage Differential using Integrals. Present Value of Cash Flow. Present Value of a Perpetual Flow.

Macroeconomic Applications of Integrals

Gini Index using Integrals. Depletion of Energy Resources Analysis using Integrals. Present Value of Gold Mine using Integrals. Balance of Trade Analysis using Integrals. Demand Analysis of Oil using Integrals. Demand Analysis of Oil using Integrals. Domar Growth Model: Framework, Solution and Numerical.

Recommended Books:

- Chiang A.C. Fundamental Methods of Mathematical Economics McGraw Hill –Latest Edition.
- Weber E. Jean, Mathematical Analysis, Business and Economic Application (latest edition).
- Bradley, T. Essential mathematics for economics and business. Latest edition. John Wiley & Sons.
- Dowling, E. T. Theory and Problems of Introduction to Mathematical Economics. Latest Edition, McGraw-Hill, New York.
- Hoffman, L. D., & Bradley, G. L. Calculus for business, economics, and the social and life sciences. McGraw-Hill. Latest edition.
- Kolman, B., & Beck, R. E. (1995). Elementary linear programming with applications. Academic Press.
- Sydsæter, K. and Hammond, P. Essential Mathematics for Economic Analysis. Latest edition., Pearson Education Limited, England.