| *Course Code*: ECON 303 | *Course Title*: Mathematical Economics |
|---|---|

**Course Type (GED/Core/Elective)**: Core
**Year/Level/Semester/Term**: 3rd Year
**Academic Session**: 2021-22 & 2022-23
**Course Teacher/ Instructor**:
**Pre-requisite (if any):** ECON 103
**Credit Value**: 04
**Contract Hours:** 60

**Course Rationale**: Tools learned in mathematical economics help present economic theories in elegant ways. Optimizing behavior of households and firms, both from static and dynamic viewpoints, cannot be understood well without proper knowledge of mathematical economics.

**Course Objectives**: The purpose of this course is to introduce a variety of mathematical concepts used in economic analysis including integration, difference and differential equations, linear and non-linear programming, calculus of variations and set theory.

**Course Learning Outcomes:** After successful completion of the course, students will be able to:

1. solve constrained optimization problems faced by both households and firms;
2. apply rules of integration to recover the parent function from a given function;
3. solve dynamic economic problems involving difference and differential equations;
4. find equilibrium time path of variables from difference and differential equations; and
5. present arguments in terms of set theory.

**CLOs Mapped to PLOs**

| CLO/PLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CLO1** | 3 | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 1 |
| **CLO2** | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 1 | 2 |
| **CLO3** | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 2 |
| **CLO4** | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 2 | 1 |
| **CLO5** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 1 | 1 |

**Course Contents**

| Topic | Content Summary | Teaching Strategies/Tools | In-Class Assessment | #Class Hours | CLOs |
|---|---|---|---|---|---|
| 1 | **Constrained Optimization:** Free vs. Constrained Optimization, Lagrangian Method; Constrained Utility Maximization; Constrained Output Maximization and Constrained Cost Minimization. | **Strategies**: Verbal and mathematical exposition. **Tools**: Books; Handouts; Multimedia; Online resources | Q&As Quizzes Homework Assignments Presentations Tutorials | 6 | 1 |
| 2 | **Review of Matrix Algebra**: Applications; Leontief's Input-Output Model - Input Coefficient, Output Matrix, Final Demand Vector, Specific Input-Output Matrix Equation, Correct Levels of Output. | As above | As above | 6 | 1 |
| 3 | **Homogeneous Functions**: Properties of homogeneous and homothetic functions; Linear vs. linearly homogeneous production functions; Euler's theorem; Elasticity | As above | As above | 6 | 2 |

| | | | | | |
|---|---|---|---|---|---|
| | of Substitution. | | | | |
| **4** | **Integration:** Definite vs. indefinite integral; Geometric interpretation Use of definite integrals; Computing consumer and producer surplus. | As above | As above | 6 | 2, 3 |
| **5** | **Differential Equation**: Definition of Differential Equation, First Order Linear Differential Equation With Constant Coefficient and Constant Term, With Variable Coefficient and Variable Term, General Solution, Definite Solution, Applications. | As above | As above | 6 | 4 |
| **6** | **Difference Equation**: Differential and Difference Equations; First Order Difference Equation; Solutions of a Difference Equation, Time Path; Cobweb Model; Inventory Model. | As above | As above | 8 | 4 |
| **7** | **Linear and Non-Linear Programming:** Classical vs. Non-classical Technique of Solving Optimization Problem; Elements of a Linear Programming Problem - Objective Function, Inequality Constraints, Basic Feasible Solutions, Graphical Solutions, Simplex Method; Duality; Nonlinear Programming: Kuhn-Tucker Conditions. | As above | As above | 8 | 5 |
| **8** | **Elementary Notions of Calculus of Variations:** Functional necessary conditions for optimal values; Boundary conditions; Economic applications: Inter-temporal consumption decision, Efficient paths of capital accumulation, Optimum growth and Turnpike Theorem. | As above | As above | 6 | 6 |
| **9** | **Sets:** Elements of a set; Set operations; Set union & intersection Complementation; Venn diagrams; Properties of relations; Domain and converse domain; Equivalence relations; Pre-ordering; Weak and strong ordering; Applications; Theory of consumer behavior, Preference and indifference relations, Complete and partial ordering. | As above | As above | 4 | 6 |

**Class Schedule**:

**Lesson Plan**

| Week(s) | Topic(s) | #Classes | CLO(s) | Remarks |
|---|---|---|---|---|
| **1 – 3** | 1 | 1 – 6 | 1 | |
| **4 – 6** | 2 | 7 – 12 | 1 | |
| **7 – 9** | 3 | 13 – 18 | 2 | ***Class Test 1***: (**Topics 1 & 2**) 13th Class |
| **10 – 12** | 4 | 19 – 24 | 2, 3 | |
| **13 – 15** | 5 | 25 – 30 | 4 | ***Class Test 2***: (**Topics 3 & 4)** 25th Class) |
| **16 – 19** | 6 | 31 – 38 | 4 | |

| | | | | |
|---|---|---|---|---|
| **20 – 23** | 7 | 39 – 46 | 5 | ***Class Test 3***: (**Topics 5 & 6**) 39th Class |
| **24 – 26** | 8 | 47 – 52 | 5 | |
| **27 – 28** | 9 | 53 – 56 | 6 | |
| **29 – 30** | **1 - 9** | 57 – 60 | 6 | ***Review*** |

**Overall Evaluation Policy:**

a. **Continuous Internal Evaluation (CIE): Marks - 00**

b. **Year-End Examination (YEE): Marks - 100**

| Bloom's Category | Marks (100) |
|---|---|
| **Remember** | **20** |
| **Understand** | **20** |
| **Apply** | **30** |
| **Analyze** | **10** |
| **Evaluate** | **10** |
| **Create** | **10** |

c. **Grading Scheme:** ***As in Section 19***

**Policy for Make-Up Classes:**

- Utilize the open slots in consultation with students
- Swap classes with colleagues

***Basic Text***

1. Chiang, A. C., & Wainwright, K. (2013). *Fundamental Methods of Mathematical Economics*. Boston: McGraw Hill.

***Recommended References***

1. Allen, R. G. D. (2009). *Mathematical Analysis for Economists*. Macmillan.
2. Arrow, K. J., & Intriligator, M. D. (eds.) (2010). *Handbook of Mathematical Economics*. North-Holland.
3. Dowling, E. T. (2012). *Introduction to Mathematical Economics*. McGraw Hill.
4. Hoy, M., Livernois, J., McKenna, C., Rees, R., & Stengos, T. (2011). *Mathematics for Economics*. The MIT Press.
5. Intriligator, M. D. (2013). *Mathematical Optimization and Economic Theory*. PHI Learning Ltd.

***Other Resources***

- Online video lectures
- Course-packs
- Handouts