COURSE TITLE: MATHEMATICAL METHODS IN ECONOMICS III

COURSE CODE: ECON 2016

LEVEL: II

SEMESTER: II

CREDITS: 3

PREREQUISITES: ECON1004 **or** PASS in Advanced Level Mathematics or Pass in CAPE Pure Mathematics

DEPARTMENT: ECONOMICS

INSTRUCTOR INFORMATION:

Lecturer and Tutor: Mr. Richard Quarless
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REQUIRED TEXT

Tamara Todorova: Problems to Accompany Mathematics for Economists, First Edition, John Wiley and Sons, 2011

HIGHLY RECOMMENDED READING

K. Sydsaeter and P.J.Hammond: Mathematics for Economic Analysis, Prentice Hall, New Jersey. Third Edition.2008

COURSE DESCRIPTION:

This course builds on the foundation provided in the first two level courses in Mathematics and Economics. It will provide Level II Economics students with a wider and deeper exposure to the Calculus of Functions of One Variable as well as Functions of Several Variables and the application of these concepts to the discipline of Economics.

This course is also the last formal Mathematics course for students pursuing a Major or Special in Economics. The concepts in this course are intended to provide you with a solid foundation for the mathematical analysis to be encountered in Microeconomics and Methods of Economic Investigation at the graduate level.

Emphasis will be placed on the understanding and applying mathematical concepts as well as honing problem solving skills rather than mere computational skills, the use of algorithms and the manipulation of formula.

This course is organized into ten (10) units.

PRE-REQUISITE(S):

ECON 1004 – Mathematics for Economics III
ECON 1001 – Introduction to Economics I
ECON 1002 – Introduction to Economics II

A Pass in Additional Mathematics, AS Mathematics, or Mathematics at GCE Advanced Level or CAPE will be considered as an alternative prerequisite to ECON 1003.

Students interested in reading this course should refresh their knowledge of

a. Sets
b. Matrices
c. Differential and Integral Calculus

As set out in the Course Outline for ECON1003 and ECON1004.

PURPOSE OF THE COURSE:

This course is designed to build on students' understanding of Calculus (as gained at Level I), expose them to mathematical concepts that underpin the mathematical models that will be encountered in the Level II/III and graduate courses in Economics and enhance their problem-solving skills.

Goals/Aims

This course aims to develop the knowledge and problem-solving skills of students reading the Economics Major and Economics Special Programs so that they can:

a. Interpret and use intermediate mathematical data, symbols, terminology and functions

b. Demonstrate understanding and proficiency in elementary skills in Mathematical Methods for Economics building on the knowledge and skills acquired at Level I

c. Select the appropriate mix of concept, logic and method of solution required for solving problems in Applied Economics

d. Apply these mathematical methods to problems in the area of Applied Economics with confidence and accuracy.

Advice to Students:

Courses such as Mathematics require a mix of learning approaches. Students are required to read the lecture materials from one of the course texts prior to the lecture, engage the in-class discussion of that material and supplement these with a second reading of the course text. Such reading and discussion must be followed by work on the tutorial sheets.

Tutorial Sheets are designed to help students flesh out concepts and practice the application of the logic and concepts to a range of problem situations. These are important in this course since they provide the basis for formal practice and assist in reinforcing the concepts introduced in lectures. It is expected that students will also use the texts and recommended references. Every effort should be made to complete each tutorial sheet within the time period indicated on the sheet.

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Students are advised to read through the tutorial sheet to identify the concepts required for its solution prior to revising the concepts so identified; it is only after such revision that you should proceed to attempt the solutions. Some questions in an assignment sheet will be solved in one attempt; others will require more than one attempt. Students are encouraged to adopt co-operative learning approaches (i.e. working with another student or students) to solve the more challenging questions in the tutorial sheet. Always remember that perseverance is a necessary attitude in reading a Mathematics course.

If after the individual effort and the co-operative learning effort, the student feels challenged by a question(s), he/she owes it to himself/herself to seek out the Course Lecturer or Tutor for guidance and assistance.

Under no condition should a student come to a tutorial class unprepared to contribute to the class proceedings. The student's contribution must be the result of his/her efforts invested in the reading of the text/course notes and in solving the tutorial sheet.

Overall students must invest a minimum of **seven (7) hours per week** apart from lectures, tutorial classes and online quizzes to this course.

Remember to apply yourself consistently from the first week.

CONTENT

The content of the ten units of this course is defined below.

Unit 1:

Readings: Course Notes

Revisit of Set Theory, Basic Set Operations, Equality of Sets, De Morgan's Laws.
Introduction to the concepts of Boundary Points, Limit Points, Open Sets, Closed Sets, Convex Sets, Concave Sets, Bounded Sets, Compact Sets.

Unit 2:

Readings: Course Notes as well as **Chaing & Wainwright, Sydsaeter and Hammond, Dowling, Hoffman, Ayres, Parry, or Haussler, Paul and Wood**

Revisit of Functions, Inverse Functions, Step Functions, Limit of a Function.
Introduction to Monotonic Functions and L'Hopital's Rule.
Applications.

Unit 3:

Readings: Course Notes as well as **Chaing & Wainwright, Sydsaeter and Hammond, Dowling, Hoffman, Ayres, Parry, or Haussler, Paul and Wood**

Revisit of Differentiation for functions of one variable.
Introduction to Implicit Differentiation, Logarithmic Differentiation and Elasticity.
Applications.

Unit 4:

Readings: Todorova Chapters 4 and 5 as well as **Course Notes**

Review of Second Order Derivatives for functions of one variable and Global Extreme Points of a function of one variable.
Introduction to Convex and Concave Functions.
Characterization of Points of Inflexion and Maxima and Minima for functions of one variable defined over the entire Real Line or over a closed interval of the Real Line.
The nth Derivative Test.
Introduction to Taylor's Theorem.
Applications.

Unit 5:

Readings: Todorova Chapter 8 as well as **Course Notes**

Revisit of Integration for functions of one variable – Indefinite Integrals and Definite Integrals. Double Integrals.
Gini Index and Consumer & Producer Surplus.
Applications.

Unit 6:
Readings: Todorova Chapter 9 as well as **Course Notes**
Introduction to First and Second Order Differential Equations.
Solution to first and second order differential equations.
Solution of Systems of first or second order differential equations.
Applications.

Unit 7:
Readings: Todorova Chapter 10 as well as **Course Notes**
Introduction to First and Second Order Difference Equations.
Solution to first and second order difference equations.
Solution of Systems of first or second order difference equations.
Concept of Stability of a Solution to a difference equation.
Applications.

Unit 8:
Readings: Todorova Chapters 2 and 3 as well as **Course Notes**
Introduction to Functions of Several Variables, Partial Derivatives, The Differential, Marginal Analysis, The Chain Rule and Euler's Theorem.
Applications.

Unit 9:
Readings: Todorova Chapter 6 as well as **Course Notes**
Unconstrained Optimisation of functions of several variables utilizing positive definiteness, negative definiteness and indefiniteness.
Applications

Unit 10:
Readings: Todorova Chapter 7 as well as **Course Notes**
Constrained Optimisation with the objective function and the constraints being functions of several variables. Introduction to Lagrange Multipliers and Kuhn Tucker Conditions.
Applications.

UNIT OBJECTIVES:

Unit 1: At the end of this Unit I students must be able to:

- Appropriately and correctly apply De Morgan's Laws
- Identify Boundary Points of Sets
- Manipulate Set Notation
- Classify sets as Open or Closed, Convex or Concave
- Sketch graphs of sets formed from inequalities involving linear, quadratic, exponential and logarithmic functions.

Unit 2: After studying Unit 2 each student must be able to:

- Manipulate function notation
- Create Inverse Functions
- Use L'Hopital's Rule to find limits of functions at a point
- Manipulate Monotonic functions;

Unit 3: By the end of Unit 3, each student must be able to:

- Apply all Rules of Differentiation correctly;
- Apply Implicit differentiation to equations from which the dependent variable cannot be written exclusively as a function of the independent variable;
- Apply Logarithmic Differentiation correctly;
- Perform Marginal Analysis
- Compute Elasticity for a demand function;
- Differentiate between Elastic, Inelastic; and Unit Elastic situations
- Find Extreme Points of a function
- Apply Differentiation the Theory of the Firm

Unit 4: By the end of Unit 4, each student must be able to:

- Use Second Order Derivatives to classify functions as Convex or Concave
- Use Second Order Derivatives to classify extreme points of a function
- Compute Higher Order Derivatives
- Use Higher Order Derivatives to create series expansion of a function using Taylor's Theorem;

Unit 5: By the end of Unit 5, each student must be able to:

- Compute Indefinite Integrals for a range of functions;
- Compute Definite and Double Integrals for a range of functions;
- Compute Gini Index
- Compute Producer & Consumer Surplus;

Unit 6: By the end of Unit 6, each student must be able to:

- Classify First Order and Second Order Ordinary Differential Equations;
- Solve First Order and Second Order Ordinary Differential Equations
- Construct Systems of First Order and Second Order Ordinary Differential Equations
- Solve systems of First Order and Second Order Ordinary Differential Equations

Unit 7: By the end of Unit 7, each student must be able to:

- Classify First Order and Second Order Difference Equations;
- Solve First Order and Second Order Difference Equations
- Check for stability in the solution of a Difference Equation
- Construct Systems of First Order and Second Order Difference Equations
- Solve systems of First Order and Second Order Ordinary Difference Equations

Unit 8: By the end of Unit 8, each student must be able to:

- Manipulate functions of several variables;
- Find partial derivatives of multivariate functions
- Perform Marginal Analysis on multivariate functions
- Apply all rules of differentiation of multivariate functions correctly
- Confirm that Euler's Theorem has been satisfied

Unit 9: By the end of Unit 9, each student must be able to:

- Find stationary points of a multivariate function
- Classify the stationary points of a multivariate function

Unit 10: By the end of Unit 10, each student must be able to:

- Model a constrained optimization problem involving multivariate functions
- Solve a constrained optimization problem involving multivariate functions using Lagrange Multipliers
- Interpret the Lagrange Multipliers
- Solve a constrained optimization problem involving multivariate functions using Kuhn Tucker Conditions

General Objectives

On successful completion of this course, students will be able to demonstrate that they have acquired the knowledge and skills of Mathematical Methods for Economics at the introductory level and thereby be in a position to logically approach situations at Level III in their undergraduate program that require the application of mathematical methods.

In addition, students will acquire a solid foundation for the mathematical analysis to be encountered in Microeconomics and Methods of Economic Investigation at the graduate level.

ASSESSMENT

Assessment Objectives are linked to the Course Objectives. The approach to be adopted for assessment in this course has three (3) objectives:

a. to effectively measure the students' proficiency in interpreting and using the mathematical concepts, symbols and terminology

b. to effectively measure the students' proficiency in recognising the appropriate mix of mathematical concepts and methods that are required for addressing problems in the areas of economics, accounting and management

c. to effectively measure the students' ability to apply the appropriate mix of mathematical methods in a logical manner.

Assessment will take the form of Coursework and a Final Examination.

The Coursework Component is comprised of a Diagnostic Exercise, Graded In-Class Tests, and Pre-Lecture Online Quizzes.

Each student is required to complete a **Diagnostic Activity**: this activity will provide students with an opportunity to revisit key concepts and methods captured in CXC CAPE Pure Mathematics or G.C.E. 'A' Level Mathematics or in ECON1004. There are **two (2) deliverables** for this diagnostic activity:

1. The submission of the solutions to the ECON1004 Semester I 2017-2018 *(econ1004_1_18)* Final Examination Paper. **Deadline for submission of the solutions to the Economics Department Office is the Monday of the second week of the semester.**

2. Students will be provided with a soft copy of the Solutions to the Examination Paper via the course website on the **Tuesday of the second week of the semester**. On receipt of the solutions, students must retrieve their submissions at 1. above from the Economics Department Office, undertake their own evaluation of their solutions, identify areas of weakness, develop their own strategies for addressing those weaknesses, and write a concise summary of the weaknesses identified and the corrective strategy. **Deadline for submission of the summary to the Economics Department Office is Friday of the third week of semester.**

Marks will be awarded only on submission of the two deliverables.

Students will be continuously assessed by way of four (4) **In-Class Tests** which will be administered at approximately **fortnightly** intervals beginning with **Week #4**. The questions that comprise each test will be based on the topics covered in the lectures over

the previous two weeks and the tutorial assignment(s). Solutions to each in-class test will be posted on the course website.

Students must be prepared for four (4) **online quizzes** to be posted on Myelearning during Week #3, 5, 8 & 10 of the semester.

Students will be required to engage Lecturers and Tutors by way of Office Hours Consultation consistently over the semester in discussion on concepts and approaches to problem solving. Experience has shown that students, who are so engaged, perform well.

Students are strongly advised to familiarize themselves during Week 1 of the Semester with the University Regulations on Examination Irregularities particularly in so far as these regulations relate to Cheating during coursework assessment activities and/or the final examination. The Lecturers will apply these regulations to students determined to have cheated during any of the coursework activities.

The **Final Examination** at the end of the Semester will be based on the entire course. Students are strongly advised to use the Learning Outcomes of the course as a meter for measuring their preparation for the final examination. The examination will be of two-hour duration. All questions will be compulsory.

The **Overall Mark** in the course will therefore be a composite of the marks obtained in the coursework and final examination components; the relative weights being:

The **coursework marks** will be allocated as follows:

Diagnostic Activity	3%
Pre-Lecture Online Quizzes	12%
In-Class Tests	25%.

The **final examination** at the end of the semester will consist of a two (2) hour paper, comprising four (4) questions drawn from all units of the course. Students will be required to answer all four (4) questions.

The **overall mark** for each student will be a weighted score of the coursework and final examination marks; the weights being

Coursework	40%
Final Examination	60%.

TEACHING STRATEGIES

The course will be delivered by way of an individual diagnostic activity, lectures, class discussion, tutorials, in-tutorial presentations, pre-lecture online quizzes, in-class tests, in-class group presentation, and consultation during office hours or by appointment.

Seven (7) **Assignments** will be issued during the course. These assignments must be completed at a pace that fits into the schedule of In-Class Tests.

Tutorial Assignment	Related Units
1	Part A – Unit 1; Part B – Unit 2
2	Part A – Unit 3; Part B – Unit 4
3	Unit 5
4	Unit 6
5	Unit 7
6	Unit 8
7	Unit 9

Self-assessment/diagnosis at the start of the course will be encouraged and should not be underestimated. In this regard, students reading the course for the first time must (a) complete all questions in the December 2017 Examination Paper for ECON1004 (b) compare their solutions with the Mark Scheme for the examination paper (c) identify and report on their knowledge/skill gaps and their own plan to close these gaps.

Participation in class discussion is a critical input to the feedback process within a lecture. The rules of engagement for these discussions will be defined by the Course Lecturer at the first lecture.

Pre-Lecture Online Quizzes and In-Class Tests will be administered by the Course Lecturer. These are aimed at assisting the student to (a) become familiar with the key concepts to be discussed in a new unit of the course and (b) measure the extent to which the learning outcomes for a previous unit has been derived.

Students will be provided with three (3) contact hours weekly; two (2) for lectures and one (1) for tutorials.

Registration for tutorial classes will be **online at the end of Week #1.**

In addition, the Course Lecturers will be available for consultations during specified **Office Hours** and at other times by appointment.

Attendance at all Lectures and Tutorial Classes will be treated as **compulsory**. **University Regulation #19** allows for the Course Lecturer to debar from the Final Examination students who do not attend at least 75% of tutorials. The Course Lecturers **will be enforcing this regulation**.

Course Schedule

Week	Activity
1 21st Jan.	Diagnostic Activity Group; Orientation Lecture; Unit 1 Lecture
2 28th Jan	Unit 1 Lecture; Tutorial; Consultation during Office Hours
3 4th Feb	Unit 2 Lecture;; Tutorial; Consultation during Office Hours; Pre Lecture Online Quiz I
4 11th Feb	Unit 3 Lecture; Tutorial; Consultation during Office Hours; In-Class Test I
5 18th Feb	Unit 4 Lecture; Tutorial; Consultation during Office Hours; Pre Lecture Online Quiz II
6 25th Feb	Unit 5 Lecture; Tutorial; Consultation during Office Hours; In-Class Test II
7 4th Mar	No Lecture (*Carnival 4th & 5th March*)
8 11th Mar	Unit 6 Lecture; Tutorial; Consultation during Office Hours; Pre Lecture Online Quiz III
9 18th Mar	Unit 7 Lecture; Tutorial; Consultation during Office Hours; In-Class Test III
10 25th Mar	Unit 8 Lecture; Tutorial; Consultation during Office Hours; (*Spiritual Baptist Liberation Day Wednesday 30th Mar*); Pre Lecture Online Quiz IV
11 1st Apr	Unit 9 Lecture; Tutorial; Consultation during Office Hours; In-Class Test IV
12 8th Apr	Unit 10 Lecture; Tutorial; Consultation during Office Hours;
13 15th Apr	Course Review; Tutorial; Consultation during Office Hours

REFERENCE TEXTS

1. **A.C. Chaing & K. Wainwright**: Fundamental Methods of Mathematical Economics, Fourth Edition, Mc Graw-Hill/Irwin, New York. 2005

2. **Dowling, Edward T**., Calculus for Business, Economics, and the Social Sciences, Schaum's Outline Series, McGraw-Hill.

3. Hoffman, L. D. Calculus for Business, Economics, and the Social Sciences, McGraw-Hill.

4. **Ayres, Frank** Calculus, 2nd Edition, New York, McGraw-Hill, 1964

5. **Lewis J Parry** An Introduction to Mathematics for Students of Economics. Macmillan 1970

6. **Haeussler, E., Paul, R. and Wood, R**., Introductory Mathematical Analysis for Business, Economics and the Life and Social Sciences**,** Eleventh Edition Prentice Hall. 2005

7. **Tan, S. T.**, College Mathematics for the Managerial, Life and Social Sciences**,** Sixth Edition, Thomson Brooks/Cole. 2005

Grading System

2016/2017 Grading Policy		
Grade	**Quality Points**	**Mark%**
A+	**4.3**	**90-100**
A	**4.0**	**80-89**
A-	**3.7**	**75-79**
B+	**3.3**	**70-74**
B	**3.0**	**65-69**
B-	**2.7**	**60-64**
C+	**2.3**	**55-59**
C	**2.0**	**50-54**
F1	**1.7**	**45-49**
F2	**1.3**	**40-44**
F3	**0.0**	**0-39**