COURSE NAME AND CODE:

Calculus I (MATH 1142)

LEVEL:

I

SEMESTER:

I

NUMBER OF CREDITS:

3

PREREQUISITES:

CAPE or GCE A-Level Mathematics, or M08B/MATH0100 and M08C/MATH0110, or equivalent

RATIONALE:

MATH 1142 is an introductory three credit course in calculus. Students in this course will develop the mathematical skills associated with the core topics of limits, derivatives and integration, and learn the wider context for these skills within the mathematical sciences. In a unified fashion, the course makes the case for using functions to model physical phenomena and simultaneously teaches methods to analyze these functions in a meaningful way. Applications of calculus abound in the physical and life sciences and, increasingly, in social sciences like economics as well. It is the theoretical engine that is used in these client disciplines when it comes time to reason in a quantitative way.

COURSE DESCRIPTION:

This is a Level I compulsory course for majors and minors in Mathematics, which is suitable for all science students. This course will give students the basic knowledge of calculus which in turn will develop the student's ability to understand and work with continuous functions, limits, derivatives and integrals and will prepare the students to the next first year course in calculus, i.e. Calculus II, as well as to the second year courses, which will give more rigorous study of limits, integration, series, and differential equations. Furthermore, students will be exposed to modern mathematical software (Math Lab, Maple or Mathematica) to explore the concepts encountered in the course.

CONTENT:

Limits and Continuity – Differentiability -- Application of derivatives – Integration and applications of integrals

OBJECTIVES:

At the end of the course, students will be able to:

- Compute limits using several standard techniques, without using the "delta-epsilon" definition;
- Compute derivative using laws of calculus. Produce equations of tangent lines and use them to make first-order estimations for values of functions;
- Produce Taylor polynomials for given functions at given point and use them to make *n*th-order estimates for values of functions;
- Produce maxima and minima both for functions defined on **R** and those defined on a closed interval. Find points of inflexion, asymptotes and construct the graph;
- Compute upper and lower sums of *f*, given a continuous function *f* on a closed interval [*a, b*] and a partition *P* of the interval [*a, b*];
- Apply different integration techniques such as *u-du* substitutions, partial fraction decomposition and integration by parts;
- Use the Fundamental Theorem of Calculus for computing definite integrals;
- Compute areas under a curve and volumes, obtained by rotation of a curve.

SYLLABUS

Limits and Continuity: [8 hours]

Limit of function, continuity and properties of continuous functions.

Differentiability and Application of Derivatives: [8 hours]

Derivatives of functions, product, quotient and chain rule, application of derivatives, L'Hospital's rule, Taylor's formula and Taylor polynomials; maxima, minima and inflection points; detailed investigation of a function and construction of its graph.

Integration: [10 hours]

The definite integral as a Riemann sum and properties of the definite integral; fundamental theorem of calculus, the indefinite integral; methods of integration; applications of integration: areas and volumes.

Tutorials: 15 hours

TEACHING METHODOLOGY

This course will be delivered by a combination of interactive lectures and participative tutorials. The total estimated 41 contact hours are broken down as follows: 26 hours of lectures and 15 hours of tutorials. The course material will be posted on the webpage

http://ourvle.mona.uwi.edu/

Practice problems and assignments will also be available to students via this webpage, as well as the solutions to the assignment questions after the due date.

ASSESSMENT

The course assessment will be divided into two components: a coursework component worth a 30% and a final exam worth a 70%.

- Two course work exams will take place during weeks 5 and 9. Each will be worth a 15% of the student's final grade.
- The final exam will be two hours in length and consist of compulsory questions.

REFERENCE MATERIAL:

Books:

1. S. Lang: A first course in Calculus, Springer Undergraduate Texts in Mathematics, 5th Edition, 2005

   - Serge Lang's text teaches the skills needed to solve challenging calculus problems, while teaching to think mathematically. The text is principally concerned with how to solve calculus problems. Key concepts are explained clearly. Methods of solution are effectively demonstrated through examples. The challenging exercises reinforce the concepts, while enabling to develop the skills required for solving hard problems. Answers to the majority of exercises (not just the odd-numbered ones) are provided in a hundred page appendix.

2. M. Spivak: Calculus, Cambridge University Press, 3rd Edition, 2008.

   - This book combines leisurely explanations, a profusion of examples, a wide range of exercises and plenty of illustrations in an easy-going approach that enlightens difficult concepts and rewards effort.

3. M. Comenetz: Calculus: the elements, World Scientific Publishing, 2002

   - This is by far the best book grasping and retaining the fundamentals of calculus. It starts a topic by building from the most basic and expands it to a conclusion. The text uses numerous technical applications to help in conveying the concepts. The student reading this book must of course dedicate the time and effort to fully understand the concepts. Proofs are used throughout and provide added value to those so inclined to have a rigorous presentation.

Online Resources:

http://www.math.temple.edu/~cow - A collection of auto-scoring calculus modules organized into books, chapters, and sections, with help and hints for the problems. Modules with asterisks (including chain rule, Taylor polynomials, Riemann sums, and arc length) allow you to change values and see the effect. Book I: functions and geometry; limits and continuity; the derivative; techniques and theory of differentiation; applications of the derivative; and integration. Book II: integration; applications of integration; transcendental functions; methods of integration; geometry, curves, and polar coordinates; and sequences and series. Book III: sequences and series; vectors and analytic geometry; curves; functions; and integration. Registered students can log in for a session in which their work will be recorded and graded.

http://www.sosmath.com/calculus/calculus.html - An online course: learning units presented in worksheet format review the most important results, techniques and formulas in college and pre-college calculus. Logarithms and Exponential; Sequences; Series; Techniques of Integration; Local behaviour of Functions; Power Series and much more; and an Appendix of Mathematical Tables.