COURSE OUTLINE

Spring 2009

COURSE MAT141 - Calculus with Analytic Geometry I

COURSE NUMBER 22747

PREREQUISITE C or better in MAT125 or MAT126

INSTRUCTOR Dr. Jean Nicolas Pestieau
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WEBSITE
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OFFICE HOURS
Monday 4:00 p.m. - 5:00 p.m. (online),
Tuesday 12:00 p.m. - 4:00 p.m., or by appointment.

COURSE CATALOGUE DESCRIPTION
Study of limits, continuity, theory and application of the derivative; related rate problems; maxima and minima; definite and indefinite integrals; areas under curves.

COURSE GOALS

A. Introduce the basic concepts of one variable calculus.

B. Prepare students for advanced mathematics, physics and engineering courses.
C. This course satisfies the SUNY general education requirement for mathematics.

COURSE OBJECTIVES

Upon successful completion of this course, students will be able to:

A. Use the definition of limits to calculate the value of limits; use technology to calculate the value of limits.
B. Apply the relationship between infinite limits and asymptotes to the sketching of graphs of functions; use technology to simulate asymptotic behavior numerically.

C. Apply the concept of continuity to polynomial, rational, composite, trigonometric, exponential, and logarithm functions.

D. Show and apply the relationship among the tangent to a graph of a function, the difference quotient, the two forms of the definition of the derivative, continuity, and differentiability.
E. Compute the derivative of polynomial, rational, trigonometric, exponential, and logarithmic functions. Compute derivatives using the product rule, the quotient rule, and the chain rule.

F. Apply the concept of derivatives to related rates, optimization problems, curve sketching, higher order derivatives, implicit differentiation.

G. Calculate the Taylor polynomial (degree 1, 2 & 3) approximation to a function.

H. Use summation formulae to evaluate Riemann sums. Use Riemann sums to approximate the definite integral.
I. Find antiderivatives of polynomial functions and those functions whose derivatives are known.

J. State and apply the results of the Mean Value Theorem, the Fundamental Theorem of the Calculus, and the average value of a function.

K. Use definite integrals to calculate the area between curves.

REQUIREMENTS
The student is responsible for all material taught or assigned by the instructor, as well as for any announcements made by the instructor in class. Should he/she miss a class, it is his/her responsibility to obtain any missed assignments from a classmate or from the instructor.

Students are required to behave in accordance with the student code of conduct as outlined in the student handbook. An atmosphere of mutual respect will be maintained at all times in the classroom. Any student who is disruptive or violates proper classroom decorum will be simply asked to leave.
Four in-class exams and a cumulative final exam will be given. In addition, homework problems will be assigned after each lecture, but not collected. Each week two students will be asked to show a chosen homework problem on the board.

The instructor may choose to make any of the four exams a take-home graded assignment.

In order to pass this course, the student must demonstrate a reasonable understanding of the subject topics. He/she should then be capable of performing
the course objectives cited above. An overall assessment of the student will be made based on his/her class participation and, more importantly, on his/her performance on the written exams. Final student grades will be decided based on the median class performance (roughly corresponding to a C+ grade) and a reasonable class grade distribution.

The student is responsible to follow registrar procedure for withdrawal. Students who neglect to do so and stop attending the course will receive a grade of F.
Exceptions will be made only for extenuating circumstances and at the discretion of the instructor.

ATTENDANCE POLICY

All students are expected to attend every class. Students are responsible for all that transpires in class whether or not they are in attendance.

In order to keep an updated class roster, an attendance sheet may be passed around during lecture, for all students to sign. It is important and, frankly, in your best interest that you come to class regularly and sign this sheet. I expect students to be
present for each class, or to notice me of their absence should they have a valid
reason to skip class.

CALCULATOR

The use of a scientific calculator such as the TI-83/84 is required for this course. The
student will need to use this graphing utility throughout the course, in class and
during exams. Use of any other type of electronic device is prohibited. All cell
phones, beepers, etc. will be turned off at all times during class.
GRADING PROCEDURES

The lowest exam grade, not including the final exam, will be dropped.

Students are strongly encouraged to view all the corrected exams posted on the course website.
Homework problems will be assigned throughout the semester. While these will not be collected, all students should try doing these problems at home and, subsequently, ask questions about them at the start of each class. One of the weekly lectures will be devoted to homework problems. Students should always be prepared to present problems on the board.

It is the student’s responsibility to come to each of the exams, or notify me of their absence in due time should they have a valid reason to miss one. If an exam absence can be justified, arrangements with the student will be made.
The final grade will be determined according to the following formula:

65% ..................................... exams

25% ......................................... final exam

10% ......................................... homework
Free tutoring and use of computer software is available at the Academic Skills Center, in Orient 213.
A. Limits and Continuity

1. definition of the limit of a function
   a. definition
   b. calculation of limits

2. limit theorems
a. calculation of limits

b. proofs of some basic limit theorems (such as sum, product & quotient)

3. "one-sided" limits

   a. definitions

   b. calculations

4. infinite limits
a. definitions

b. calculations

c. asymptotes, sketching

5. limits at infinity

a. definitions

b. calculations

c. asymptotes, sketching
6. continuity

   a. definitions

   b. essential (non-removable) and removable discontinuities

   c. theorems on continuity (with applications)

7. continuity on an interval

   a. arithmetic of continuous functions

   b. polynomial functions
c. rational functions

d. radical functions

e. composite functions

8. continuity of trigonometric functions

a. the "squeeze" theorem

b. limit and continuity theorems applied to sine and cosine

justified using a numerical approach.
i. \[ \lim_{x \to 0} \frac{\sin x}{x} = 1 \]

ii. sine and cosine functions are continuous at 0

iii. \[ \lim_{x \to 0} \frac{1 - \cos x}{x} = 0 \]

9. continuity of log and exponential functions

B. The Derivative
1. the tangent and normal lines to a curve
   a. definitions
   b. calculations

2. the derivative
   a. definition and relationship to a tangent line
   b. alternative forms of the definition of a derivative
   c. definition of differentiability
3. relationship between differentiability and continuity

   a. differentiability implies continuity

   b. "one-sided" derivatives

4. derivation of the rules for differentiation of algebraic functions

5. derivatives as rates of change

6. derivatives of all trigonometric functions
7. derivatives of exponential and log functions

8. derivatives of composite functions (the chain rule)

9. derivatives of power functions

10. implicit differentiation
11. higher order derivatives

C. Applications of the Derivative

1. differentiation applied to related rates
2. differentiation applied to finding maximum and/or minimum values of

   a function

   a. over the domain of real numbers

   b. on a closed interval

   c. absolute and relative extrema

3. Mean Value Theorem

4. increasing and decreasing functions
a. definitions: increasing, decreasing, monotonic

b. first derivative test for extrema

c. second derivative test for extrema

5. concavity and inflection

a. definitions

b. use of second derivatives

c. points of inflection
6. curve sketching

7. Taylor polynomial approximations

D. The Differential and Antiderivative

1. the differential

   a. definitions (dx, dy)

   b. approximation of values of functions
2. antidifferentiation

   a. definition of antiderivative

   b. "rules" of antidifferentiation

   c. "Chain Rule" for antidifferentiation

3. applications

   a. differential equations
b. antidifferentiation applied to rectilinear motion

E. The Definite Integral

1. summation techniques

2. finding area under a curve by summation and limits
3. the definite integral
   
   a. definitions (Riemann sum, integrable, definite integral, limits of integration, area)
   
   b. properties

4. Riemann sum approximations

5. the average value of a function
6. the Fundamental Theorem of Calculus

F. Applications of the Definite Integral

1. area between curves

   a. horizontal increments of area

   b. vertical increments of area