MAT250-1 Calculus (3 credits)
Spring Semester 2009

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DESCRIPTION: The course is introducing students into fundamental methods in the differential and integral calculus of real-valued functions of single real variable. This limited framework allows for some necessary mathematical rigor in exposition, without decreasing accessibility of the course to students who have never studied calculus. The emphasis is on understanding basic concepts of the limit of a function, continuity and the operations of differentiation and integration. At the same time, students are introduced into methods of mathematical thinking. For the majority of students, it is the first opportunity to learn the rules of a mathematical proof and of developing of a mathematical theory through successive stages of proving new theorems based on those already proven. However, this aspect of the course is balanced by frequent illustrations of the application of theoretical results to solving problems of practical significance. The knowledge and intellectual skills acquired in this course give students a solid foundation for further study of the analysis of a wider class of functions, either in their continuing education or through individual work based on literature. At the same time, they acquire a useful tool applicable to solving limited, but still a quite extensive range, of problems in their education and professional activities.

OBJECTIVES: In this course students are acquainted with the conceptual framework of calculus at the fundamental level of the analysis of real-valued functions of a single real variable and with all basic methods used in the analysis. The design of the course includes introduction to theorem proving and exposition of the logical relationship of successively introduced concepts and theorems. The philosophy of such design is based on the assumption that the development of mathematical intuition in this domain, which because of its fundamental dependence on the concepts of infinity and infinitesimals, is totally inaccessible to our common sense, must be based on prior understanding of the basic formal elements of the theory. Only after acquiring the basic conceptual framework, in particular, after learning the definition of the limit of a function, students may try to build their own intuitive meaning of the concepts involved, and in the next steps they may avoid going into deep, strictly formal studies of the analysis of very general classes of functions, to acquire working knowledge of the methods used in applications. Also, students will have the ability to select proper mathematical tools in problem solving. In particular, they will be aware of the limitations imposed

by the conditions resulting from the assumptions made in theorems. This last ability is crucial, as its lack is the most typical deficiency of the courses, which sacrifice understanding of the fundamentals for the purpose of the expansion of the range of practical applications of mathematical methods. In addition to acquiring the knowledge of formal rudiments and developing some intuitive understanding of the concepts and methods of calculus developed within the limits of study of real valued functions of a single variable, students develop the basic level of proficiency in carrying on processes of differentiation and integration and in applying these processes to the study of functions in multiple applications. The range of these applications is equivalent to that of a standard introductory course in Calculus. Thus, students should be able to find limits of functions, including limits in infinity, local and absolute extrema of functions, intervals of their monotonicity, areas of regions defined by functions, etc.

STUDY MATERIALS:

<Textbook>

Saturnino Salas, Einar Hille, and Garrett Etgen. Calculus: One Variable, 10th ed. John Willey & Sons, 2007. ISBN-13: 978-0470-07333-0, ISBN-10: 0-470-07333-0

<Reference books, sources of readings and other information>

Following the famous dictum of Einstein, "Things should be made as simple as possible, but not simpler," several topics in this course will be presented in a way slightly different from that in the textbook. These modifications will require that some portions of the material in the textbook may be replaced by handouts prepared by the instructor. Students interested in expanding their perspectives on the subject of the course, or on mathematics in general, should ask the instructor for advice on additional, optional readings.

ASSESSMENT: Student achievement of the course objectives is being measured in terms of student performance in completing short homework assignments (25%,) in writing the Midterm Test (25%,) and in writing the Final Examination (50%). Frequently, students will get homework assignments consisting of a short selection of problems related to the material covered in class. **The solutions of ALL assigned problems should be turned in before or during next class meeting.** Each time, only one out of all assigned problems will be graded, but it does not limit students' responsibility to attempt solving all problems. In the grading of tests, the majority of credit is for the correctness of the method and for demonstrated understanding of the material. Calculation errors are mostly ignored.

ACADEMIC PREPARATION: Successful completion of this course requires good preparation. Only students who completed MAT 150: College Algebra with at least a "C" grade should consider taking this course. However, there is no expectation of the knowledge of material going beyond College Algebra course. The expectations regarding (English) language are not going beyond the requirements for the entry into Basic Education (TOEFL 500). It has to be stressed that even more important for the success in this course, than prior preparation, is the ability to maintain a high level of concentration through each class session and to work regularly on homework assignments. In this course, more than in other mathematics courses at AIU, every absence or disruption of your work puts your progress in jeopardy. If you do not understand the material from previous classes, it is nearly certain that you won't be able to understand the new material. This makes your study discipline a necessary condition for the successful completion of the course.

POLICIES: Acts of cheating or other forms academic dishonesty will be dealt with harshly. Attendance in all classes is mandatory, whether it is being checked by instructor, or not. It is student's responsibility to submit all assignments by the announced deadlines. Homework assignments are due on the next day of class meetings. **The AIU policies on mandatory attendance and on timely submission of homework will be strictly enforced. There is no time to make up lost classes or delayed work on the assignments. Late homework WILL NOT BE ACCEPTED, unless student has a documented reason for the delay. Students with several unexcused absences will be dismissed from the class with the failing grade.**

COURSE FORMAT AND ACTIVITIES: Generally, class sessions have format of lectures with frequent interactions between the instructor and students in the form of questions and answers. Students are working outside of the class on assigned problems. Each class session begins from the time for students' questions regarding difficulties in the homework or in the material from last session.

SCHEDULE: Homework assignments are due on the next day of classes! The only exception will be made when the cause of the delay is an officially approved absence, or when student receives prior approval from the instructor. The dates of classes are tentative. Slight changes are possible. If the date of a class is changed, so is the deadline for homework assignment. **Homework assignments should be written and submitted on separate pages (not in a notebook!) Each page should have on the top of the front page student's name and the number of the section from the textbook.**

(Below, numbers and titles of sections and the numbers of pages are referring to the part of the textbook material related to the subject of class session.)

1) Short review of the preliminary concepts from algebra, set theory, etc.
2) 2.1 The limit process p.53
   2.2 Definition of limit p.64
3) 2.3 Some limit theorems p.73
4) 2.4 Continuity p.83
5) 2.5 The Pinching Theorem: Trigonometric limits p.91
6) 2.6 Two basic theorems p.97
7) 3.1 The derivative p. 105
8) 3.2 Some differentiation formulas p.115
9) 3.3 Derivatives of higher order p. 124
   3.4 The derivative as a rate of change p.131
10) 3.5 The Chain Rule p. 133
   3.6 Differentiating the trigonometric functions p.142
11) 3.7 Implicit differentiation: Rational powers p. 147
12) 4.1 The Mean-Value Theorem p.154
13) 4.2 Increasing and decreasing functions p. 160
   4.3 Local extreme values p. 167
14) 4.4 Endpoint extreme values: Absolute extreme values p.174
   END OF MATERIAL FOR THE MIDTERM EXAM
15) 4.6 Concavity and points of inflection p. 191
16) 4.8 Some curve sketching p. 201
17) MIDTERM EXAMINATION
18) 5.1 An area problem and a speed problem p. 234
   5.2 The definite integral of a continuous function p.237
19) 5.3 Antiderivatives
20) 5.4 The Fundamental Theorem of Integral Calculus p.254
21) 5.5 Some area problems p.260
22) 5.6 Indefinite integrals p.268
23) 5.7 Working back from the Chain Rule p.274
24) 5.8 Additional properties of the definite integral p. 281
25) 5.9 The Mean-Value Theorems for Integrals p. 285
26) 7.2 The logarithm function I p.343
   7.3 The logarithm function II p.347
27) 7.4 The exponential function p. 357
28) 7.7 The inverse trigonometric functions p.379
29) 8.2 Integration by parts p.403

30) FINAL EXAMINATION