Syllabus for
MAT 421—Advanced Calculus I
3 Credit Hours
Spring 2005

I. COURSE DESCRIPTION

A development of a metric topology for the real number line. Includes connectedness and compactness of sets and continuity and differentiablility of functions.
Prerequisite: MAT 202 and 321.
Academic technology fee: $45.

II. COURSE GOALS

This course will enable the student to develop a rigorous foundation for the basic topics of analysis, and the less tangible acquisition of an accurate intuitive feeling for analysis. The written projects are one vehicle through which these goals will be realized, allowing the student to increase skill in critical analysis and in communication of results.

III. STUDENT LEARNING OUTCOMES FOR THIS COURSE

A. Unit 1: Sets and Sequences.
The student will be able to do the following:
1. Use the well-ordering principle and its variant principles of mathematical induction to complete inductive arguments.
2. Discuss the countability of sets.
3. Use the Cauchy criterion to test for convergence of a real sequence.

B. Unit 2: Limits of Functions and Continuity
The student will be able to do the following:
1. Prove equivalent various formulations of continuity.
2. Identify compact subsets via the Heine-Borel theorem.
3. Apply various properties of continuous functions, including the Bolzano intermediate value theorem.

C. Unit 3: Differentiation and Integration.
The student will be able to do the following:
1. Prove the basic differentiation rules.
2. Derive the mean-value theorem and some of its many important consequences.
3. Define the integral as a limit of Riemann sums and derive its fundamental properties.

D. Unit 4: Infinite Series, Sequences, and Series of Functions.
The student will be able to do the following:
1. Use appropriate tests, such as the limit comparison test or the ratio test to determine convergence or divergence of infinite series.
2. Find the Taylor series for a given function and compute its radius of convergence.
3. Use the Weierstrass M-test to determine uniform convergence of a series of functions and use the uniform convergence of power series to differentiate and integrate these series.

IV. TEXTBOOK

Advanced Calculus by Patrick M. Fitzpatrick. PWS Publishing Company ISBN 0-534-92612-6

V. POLICIES AND PROCEDURES

A. University Policies and Procedures

1. Attendance at each class or laboratory is mandatory at Oral Roberts University.
2. Double cuts will be assessed for absences immediately preceding or following holidays.
3. Excessive absences can reduce a student's grade or deny credit for the course.
4. Students taking a late exam because of an unauthorized absence will be charged a late exam fee.
5. Students and faculty at Oral Roberts University adhere to all laws addressing the ethical use of others' materials, whether it is in the form of print, video, multimedia, or computer software.
6. Final exams cannot be given before their scheduled times. Students need to check the final exam schedule before planning return flights or other events at the end of the semester.

B. Computer Science and Mathematics Department Policies and Procedures

1. Each Student who uses the computer is given access to the appropriate computer resources. These limited resources and privileges are given to allow students to perform course assignments. Abuse of these privileges will result in their curtailment. Students should note that the contents of computer directories are subject to review by instructors and the computer administrative staff.
2. A fee of $10.00 will be assessed for all late exams. This policy applies to all exams taken without notifying the professor prior to the regularly scheduled exam time, and to all exams taken late without an administrative excuse.

C. Course Policies and Procedures

Other information

1. Projects
   Each student submits three written projects during the semester. The projects are longer, multi-part problems that either extend the concepts in the chapter or introduce related topics that did not merit inclusion in the text but which, nevertheless, are interesting. Students may work on an assigned project in small groups of size, at most 3 (individual work is permitted if preferred), but each student must write his or her own report of the entire project. These reports are like business reports in that neatness, appearance, and content are all important. Of course they must be submitted at the appointed time (see the assignment schedule in this syllabus). More details will follow in a few weeks.
2. Evaluation Procedures
   Grading: The standard grading scale will be used: A (90% - 100%), B (80% - 89%), C (70% - 79%), D (60% - 69%), F (0% - 59%). The composite score is determined by the following distribution:

three fifty-minute exams @ 100 points	300 points
daily exercises and problems	100 points

written project @ 100 points 100 points
one final exam @ 200 points 200 points

3 ePortfolio Requirements
There may be an ePortfolio artifact associated with this course. Check your ePortfolio handbook for the requirements.

4. Chapters 1 through 8 of the textbook will be covered in this course. A generally accepted measure of time required outside of class on assignments and projects is two hours per each hour of class. Occasionally, more time may be needed. Groups of 1, 2, or 3 will be permitted to work on the projects, as well as the daily assigned problems. Makeup examinations or projects must be arranged in advance. Late homework is not acceptable for credit, and no project is acceptable after its due date.

5. "Consistent with Section 504 of The Rehabilitation Act of 1973, and the Americans With Disabilities Act, ORU ensures that no **"qualified individual"** will be denied reasonable accommodation in the form of modification of policies, practices and/or procedures." Students with disabilities who wish to access services should contact their professor(s) and the Office of Disability Services at Ext. 7355 to initiate the process.

6. You are encouraged to work together on daily assignments. But working together means working together, not getting together and letting someone else show you how to do everything. Try not to get behind! In mathematics courses especially, every new concept builds upon everything that precedes it, and once lost, you will not be able to "cram" and pass an examination. You are evaluated on your use of techniques, so looking at your neighbor's paper to get the right numerical solution to a problem, or copying his or her homework without figuring how the problems were solved, will do you no good in this course. No credit will be given for late homework assignments.

7. Makeup examinations will be given by prior arrangement only. These arrangements must be made prior to the day on which the test is given, and the makeup test must be taken before the first class period following the regularly scheduled test date. There is a fee of $10 which must be paid before any test may be taken late.

8. Students and faculty in the Department of Mathematics and Computer Science adhere to all laws addressing the ethical use of others' material, whether it be in the form of print, video, multimedia, or computer software.

VI. COURSE CALENDAR

LESSON	SECTION	TOPIC	EXERCISES
1	0-0	Preliminaries	
2	1-1	Completeness Axiom	1, 2, 3, 4, 5, 7
3	1-2	Archimedean Property	1, 2, 3, 5, 8
4	1-3	Three Inequalities	1, 3, 5, 7, 8, 11, 13
5	2-1	Convergence of Sequences	1, 3, 4, 6
6	2-2	Bolzano-Weierstrass Theorem	1, 3, 5, 7, 8, 9
7	3-1	Continuity	2, 3, 5, 7, 8
8	3-2	Extreme Value Theorem	1, 3, 5, 7
9	3-3	Intermediate Value Theorem	1, 3, 4, 6, 7
10	3-4	Images and Inverses	1, 3, 5, 7
11	3-5	Uniform Continuity	1, 3, 5, 7, 8, 10, 12
12	3-6	Limits	2, 3, 6, 7, 8, 10
13		Review for Exam I	
14		Exam I - Chapters 1, 2, 3	
15	4-1	Algebra of Derivatives	1, 2, 3, 4, 5, 7, 10
16	4-2	Differentiating Inverses	1, 2, 4, 5, 7, 8, 9
17	4-3	Lagrange Mean Value Theorem	1, 2, 5, 6, 8, 9
18	4-4	Cauchy Mean Value Theorem	1, 2, 3, 5, 6
19	4-5	A Fundamental ODE	1, 2, 3, 4, 5
20	4-6	Leibnitz Notation	2, 3, 4
21	5-1	Logs and Exponentials	2, 4, 6, 9, 10, 11
22	5-2	Trig Functions	2, 3, 4, 5, 7, 9, 11
23	5-3	Inverse Trig Functions	1, 2, 3, 5
24		Review for Exam II	
25		Exam II - Chapters 4, 5	
26	6-1	Integration	
27	6-2	Riemann Integral Definition	1, 4, 5, 6, 7, 8
28	6-3	1^{st} Fundamental Theorem of Calculus	1, 2, 3
29	6-4	Darboux and Riemann Sums	2, 3, 4, 5, 7, 9
30	6-5	Algebraic Properties	2, 3, 5, 6, 7, 8, 9
31	7-1	2^{nd} Fundamental Theorem of Calculus	1, 2, 3, 7, 8, 9
32	7-2	Existence of Solutions to ODES	1, 2, 3, 4, 7
33	7-3	Two Classical Methods	1, 2, 3, 6, 7
34	7-4	Numerical Integration	1, 3, 5, 7, 8
35		Review for Exam III	
36		Exam III - Chapters 6, 7	
37	8-1	Taylor Polynomials	1, 2, 5
38	8-2	Lagrange Remainder Theorem	1, 4, 5, 6, 7, 8
39	8-3	Convergence	1, 2, 4, 5
40	8-4	Logarithms	1, 2, 3, 4
41	8-5	Cauchy Integral Remainder Formula	1, 2, 4, 6, 7, 9
42	8-6	Infinitely Differentiable but not Analytic?	1, 2, 3
43	8-7	Weierstrass Approximation	1, 2, 3, 4, 5
44 & 45		Review for Final Exam	

Course Inventory for ORU's Student Learning Outcomes

MAT 421 – Advanced Calculus I
Spring 2005

This course contributes to the ORU student learning outcomes as indicated below:
Significant Contribution – Addresses the outcome directly and includes targeted assessment.
Moderate Contribution – Addresses the outcome directly or indirectly and includes some assessment.
Minimal Contribution – Addresses the outcome indirectly and includes little or no assessment.
No Contribution – Does not address the outcome.

The Student Learning Glossary at http://ir.oru.edu/doc/glossary.pdf defines each outcome and each of the proficiencies/capacities.

OUTCOMES & Proficiencies/Capacities		Significant Contribution	Moderate Contribution	Minimal Contribution	No Contribution
1	**Outcome #1 – Spiritually Alive** Proficiencies/Capacities				
1A	Biblical knowledge			X	
1B	Sensitivity to the Holy Spirit			X	
1C	Evangelistic capability			X	
1D	Ethical behavior			X	
2	**Outcome #2 – Intellectually Alert** Proficiencies/Capacities				
2A	Critical thinking	X			
2B	Information literacy	X			
2C	Global & historical perspectives			X	
2D	Aesthetic appreciation			X	
2E	Intellectual creativity	X			
3	**Outcome #3 – Physically Disciplined** Proficiencies/Capacities				
3A	Healthy lifestyle			X	
3B	Physically disciplined lifestyle			X	
4	**Outcome #4 – Socially Adept** Proficiencies/Capacities				
4A	Communication skills			X	
4B	Interpersonal skills			X	
4C	Appreciation of cultural & linguistic differences				X
4D	Responsible citizenship				X
4E	Leadership capacity				X