Syllabus for
MAT 321—Calculus III
4 Credit Hours
Fall 2015

I. COURSE DESCRIPTION

A course studying the calculus of several variables including graphs of functions in three dimensions, partial derivatives, directional derivatives, optimization, multiple integrals, and calculus of vectors.
Prerequisite: MAT 202.

II. COURSE GOALS

The purpose of this course is to enable the student to be able to do the following:

A. Understanding of the differential and integral calculus of functions of several variables.

B. Use the computer to explore the concepts of calculus and to find solutions to the more difficult problems.

C. Gain a thorough understanding of the foundations of calculus by studying the introductory concepts of several-variable calculus. It is designed for students in engineering, economics, life science, mathematics, and physical science seeking basic skills and knowledge in those disciplines. First, the students are given a graphical introduction to functions of two variables. Vector geometry follows as the door to calculus of vector-valued functions. Partial differentiation and optimization of functions of several variables is also treated. Problems concerning (or solvable by) double and triple integrals are considered. Finally, vector calculus is studied.

III. STUDENT LEARNING OUTCOMES FOR THIS COURSE

A. Unit Objectives

1. Functions of Several Variables

As a result of successfully completing this unit, the student will be able to do the following:

a. Apply several variable functions to real world situations.
b. Find the distance between two points in three-dimensional space and determine the equation of a sphere in the Cartesian coordinate system.
c. Sketch the level curves or surfaces for functions of several variables.
d. Describe surfaces parametrically in three-dimensional space and find the equation of a plane.
e. Describe and recognize graphs of functions of several variables in rectangular, cylindrical, and spherical coordinates.
f. Describe and recognize graphs of vector functions and space curves.
g. Consider limits of functions of several variables and determine the direction and concavity of a surface at a point *P* in the direction of a second point *Q*.
h. Compute the partial derivatives of functions of several variables.
i. Convert among spherical, cylindrical, and Cartesian coordinate systems.
j. Find the gradient and the directional derivative of a function.

2. Differentiable Functions of Several Variables

As a result of successfully completing this unit, the student will be able to do the following:

a. Determine the differentiability of a function of several variables
b. Find equations of tangent planes for various surfaces and use tangent plane approximation.
c. Use and apply the chain rule for derivatives of functions of several variables.
d. Differentiate implicitly defined functions of several variables.
e. Find and classify critical points for functions of several variables.
f. Use the method of LaGrange Multipliers to optimize functions with constraints.
g. Find the velocity and acceleration of particles in three dimensions.
h. Find the arc length and curvature of a space curve.
i. Perform basic vector operations in two and three dimensions.

3. Multiple Integration

As a result of successfully completing this unit, the student will be able to do the following:

a. Find volumes of solids bounded by surfaces by evaluating double integrals.
b. Change the order of integration and compute double and triple integrals.
c. Compute the surface area of the graph of a function of several variables.
d. Compute double and triple integrals in cylindrical and spherical coordinates.
e. Use a change of variables and the Jacobian to evaluate double integrals over nonrectangular regions.

4. Vector Calculus

As a result of successfully completing this unit, the student will be able to do the following:

a. Make some elementary analyses of certain vector fields.
b. Find potential functions for conservative vector fields.
c. Use a variety of methods to evaluate line integrals.
d. Use the Fundamental Theorem of Line Integrals and Green's theorem to compute line integrals.
e. Compute the divergence and curl of a vector function.
f. Use a variety of methods to evaluate surface integrals.
g. Use the Divergence Theorem and Stokes' Theorem to compute surface integrals.

5. Project

As a result of successfully completing this unit, the student will be able to do the following:

a. Submit one project during the semester.
b. Choose from related projects contained in each chapter or from the some related projects that the instructor has.
c. Use the Computer Algebra System Maxima © to make computations and generate graphs for the project.
d. Work on their assigned project in small groups of no more than three (individual work is permitted if preferred).
e. Write project report in the format of a term paper and hand it in at the appointed time (see the assignment schedule in this syllabus).

B. Objectives for Students in Teacher Preparation Programs.
The Teacher Preparation Program meets the competency-based requirements established by the Oklahoma Commission on Teacher Preparation. This course meets the following competencies: Subject Competencies (SC) 5, 6, 7, 8, and 9.

SC5. Has a broad and deep knowledge of the concepts, principles, techniques, and reasoning methods of mathematics that is used to set curricular goals and shape teaching.
SC6. Understands significant connections among mathematical ideas and the applications of these ideas to problem solving in mathematics, in other disciplines, and in the world outside of school.
SC7. Has experiences with practical applications of mathematical ideas and is able to incorporate these in curricular and instructional decisions.
SC8. Is proficient in, at least, the mathematics content needed to teach the mathematics skills described in Oklahoma's core curriculum from multiple perspectives. This includes, but is not limited to, a concrete and abstract understanding of number systems and number theory, geometry and measurement, statistics and probability, functions, algebra, discrete mathematics, and calculus necessary to effectively teach the mathematics skills addressed in the sixth through twelfth grade in the Oklahoma core curriculum. (The depth and breadth of knowledge should be much greater than for the Intermediate Mathematics certification.)
SC9. Is proficient in the use of a variety of instructional strategies to include, but is not limited to cooperative learning, use of concrete materials, use of technology (i.e., calculators and computers), and writing strategies to stimulate and facilitate student learning.

IV. TEXTBOOKS AND OTHER LEARNING RESOURCES

A. Required Materials
1. Textbooks
Briggs, William, and Lyle Cochran. *Calculus: Early Transcendentals*. Boston: Pearson Education, 2011. ISBN-13: 9780321570567.
2. Homework
Mymathlab access. ISBN-13: 9780321199911. Course ID: valderrama55055
3. Other
Maxima © Computer Algebra System

B. Optional Materials
1. Textbooks
Greenberg, Michael D. *Advanced Engineering Mathematics*. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1998. ISBN-10: 0133214311
2. Other
A graphing calculator is required. The instructor uses the TI-83 Plus throughout the course; however, any graphing calculator is acceptable.

V. POLICIES AND PROCEDURES

A. University Policies and Procedures
1. Attendance at each class or laboratory is mandatory at Oral Roberts University. Excessive absences can reduce a student's grade or deny credit for the course.
2. Students taking a late exam because of an unauthorized absence are charged a ($15) late exam fee.

3. Students and faculty at Oral Roberts University must adhere to all laws addressing the ethical use of others' materials, whether it is in the form of print, electronic, video, multimedia, or computer software. Plagiarism and other forms of cheating involve both lying and stealing and are violations of ORU's Honor Code: "I will not cheat or plagiarize; I will do my own academic work and will not inappropriately collaborate with other students on assignments." Plagiarism is usually defined as copying someone else's ideas, words, or sentence structure and submitting them as one's own. Other forms of academic dishonesty include (but are not limited to) the following:
    a. Submitting another's work as one's own or colluding with someone else and submitting that work as though it were his or hers;
    b. Failing to meet group assignment or project requirements while claiming to have done so;
    c. Failing to cite sources used in a paper;
    d. Creating results for experiments, observations, interviews, or projects that were not done;
    e. Receiving or giving unauthorized help on assignments.

    By submitting an assignment in any form, the student gives permission for the assignment to be checked for plagiarism, either by submitting the work for electronic verification or by other means. Penalties for any of the above infractions may result in disciplinary action including failing the assignment or failing the course or expulsion from the University, as determined by department and University guidelines.
4. 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.
5. Students are to be in compliance with University, school, and departmental policies regarding Whole Person Assessment (WPA) requirements. Students should consult the WPA handbooks for requirements regarding general education and the students' majors.
    a. The penalty for not submitting electronically or for incorrectly submitting an artifact is a zero for that assignment.
    b. By submitting an assignment, the student gives permission for the assignment to be assessed electronically.

B. Department Policies and Procedures
1. Computer Resources - 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. Late Exams - Each instructor has his or her own late-exam policy, so an instructor may decide that an exam missed because of an unexcused absence cannot be made up
3. Unexcused Absences - Any student whose unexcused absences total 33% or more of the total number of class sessions will receive an F for the course grade
4. Incompletes – As stated in the University catalog, incompletes are granted only for "good cause," such as extended hospitalization, long-term illness, or a death in the family. Students must petition for an incomplete using the form available

in the Computing and Mathematics Department. Very few incompletes are granted

C. Course Policies and Procedures

1. Evaluation Procedures

a. The composite score is determined by the following distribution:

Three fifty-minute exams at 160 points: 480 points	(48%)
Homework and quizzes: 170 points	(17%)
Computer labs: 100 points	(10%)
Written project: 100 points	(10%)
One final exam: 150 points	(15%)

b. Grading scale:
A=90%
B=80%
C=70%
D=60%
F=59% and below

2. Whole Person Assessment Requirements

a. A WPA artifact is required for this course. For specific requirements, check the WPA handbook at http:// wpahandbook.oru.edu. Artifacts not submitted electronically or incorrectly submitted receive a zero for that assignment.

b. The WPA artifact is your Vector Calculus Exam 4 that counts as 5% of the homework score and is therefore 1% of your course grade.

3. Other Policies and/or Procedures

a. Points may be deducted for unexcused absences.

b. This course is part of the Participation Development Points Program that applies to some Computer Science and Mathematics courses. For attendance at a qualified event, the student will receive 10 points added to their homework total. The maximum number of points to be added will be 30 points, which is about 10% of your homework grade.

c. Class discussion is required for optimal learning. The student may be asked to put some problems or exercises on the board in class.

d. There are three types of activities—reading, text exercises, and computer laboratory. A daily assignment schedule is included in this syllabus. Each section of the text is to be read prior to the class discussion of that section. Exercises and problems must be turned in by the end of the day in order to receive credit.

e. Reading mathematics is very different from reading a novel. Every word and equation is important. A pencil and paper should be kept handy when reading in order to fill in details that may not be written down explicitly. The answers to exercises are in the back of the text. The student should ask questions in class about the problems. The student should not be afraid to ask, since there are others with the same questions.

f. Some exercises are routine and mechanical, much like traditional homework in mathematics courses. Other exercises require more thought.

g. The computer laboratories are designed so the student can explore the concepts that are covered in the text. The first few minutes of the lab period are used to introduce the laboratory exercise. Then the student will spend the rest of the time investigating calculus with Maxima ©.

h. There are four exams as scheduled (see the daily assignment schedule) as well as a final exam. Each exam is similar to the exercises; the majority are similar to the problems that were assigned for homework. From time to time throughout the semester, there may be a quiz on the material covered recently in class. These quizzes may or may not be announced in advance.

i. The student should ask for help whenever he or she does not understand something or cannot solve a problem. The instructor tries to be available as much as possible. If the instructor's office hours are inconvenient, the student may call for help or make an appointment.

j. Any extra-credit or extension on the homework is available to students who have impeccable attendance records.

k. Any student who scores below 65% on initial assessment test, should need to do 1-2 hours weekly tutoring with professor at his office, during Tuesday or Thursday mornings until substantial improvement is shown on the next exam.

VI. COURSE CALENDAR

Lesson	Topic	Date
AT	**Calculus II, initial assessment test**	**08/14**
11	**Vectors and Vector-Valued Functions**	
11.1-11.2	Vectors in the Plane. Vectors in 3-D	**08/17**
11.3-11.4	Dot Products. Cross Products	**08/19**
11.5	Lines and Curves in Space	**08/21**
11.6	Calculus of Vector-Valued Functions	**08/24**
11.7	Motion in Space	**08/26**
11.8	Length of Curves	**08/28**
11.9	Curvature and Normal Vectors	**08/31**
	Review Exercises	**09/02**
Ex1	**Exam 1, Chapter 11**	**09/04**
12	**Functions of Several Variables**	
12.1	Planes and Surfaces	**09/09**
12.2	Graphs and Level Curves	**09/11**
12.3	Limits and Continuity	**09/14**
12.4	Partial Derivatives	**09/16**
12.5	The Chain Rule	**09/18**
12.6	Directional Derivatives and the Gradient	**09/21**
12.7	Tan. Planes and Linear Approximation	**09/23**
12.8	Max./Min. Values	**09/25**
12.8	Max./Min. Values	**09/28**
12.8	Lagrange Multipliers	**09/30**
12.8	Lagrange Multipliers	**10/02**
	Review Exercises	**10/05**
Ex2	**Exam 2, Chapter 12**	**10/07**
13	**Multiple Integration**	
13.1	Double Integrals over Rectangular Regions	**10/09**
13.2	Double Integrals over General Regions	**10/19**
13.3	Double Integrals in Polar Coordinates	**10/21**
13.4	Triple Integrals	**10/23**
13.5	Triple Integrals Cylindrical and Spherical Coordinates	**10/26**
13.6	Integrals for Mass Calculations	**10/28**
13.7	Change of Variables in Multiple Integrals	**10/30**
13.7	Change of Vars. in Multiple. Integrals	**11/02**

	Review Exercises	**11/04**
Ex3	**Exam 3, Chapter 13**	**11/06**
14	**Vector Calculus**	
14.1	Vector Fields	**11/09**
14.2	Line Integrals	**11/11**
14.3	Conservative Vector Fields	**11/13**
14.5	Green's Theorem	**11/16**
14.5	Divergence and Curl	**11/18**
14.6	Surface Integrals	**11/20**
14.6	Surface Integrals	**11/23**
14.7	Stokes' Theorem	**11/30**
14.8	The Divergence Theorem	**12/02**
	Review Exercises	**12/04**
Ex4	**Written Project Deadline + WPA essay. Chapter 14**	**12/05**

Course Inventory for ORU's Student Learning Outcomes
MAT 321—Calculus III
Fall 2015

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	