Multivariate Calculus

MATH2210 403

READ:

Welcome to Multivariate Calculus! This syllabus has a lot of information. Please take time to read through it and re-read relevant parts when questions about the course arise later. This will help you be familiar with the course. Ask your instructor questions you have that are not directly addressed in the syllabus; frequent communication with your instructor is highly recommended. Ignorance regarding information in the syllabus, the course's due dates, assignments, exams, etc., is not accepted nor excused. Be aware and be prepared. Work well and work hard. If you do, then you will learn a lot in this course, and consequently, you will develop mathematically and intellectually, which is part of its many purposes. Have a great semester!

Course Description

This is the third semester of the calculus series. Topics include partial derivatives, multiple integrals, curves and surfaces; vector calculus including Green's and Stoke's theorems.

Pre-Requisite: Within the last year, MATH 1220 w/C grade or better.
Semester: All

Text: Textbook is required. Calculus: Early Transcendentals, 8th edition

Author: James Stewart, Brooks/Cole, Cengage Learning (publisher)

INTRODUCTION: SLCC is committed to fostering and assessing the following student learning outcomes in its programs and courses:

1. Acquiring substantive knowledge in the field of their choice

2. Developing quantitative literacies
3. Developing the knowledge and skills to be civically engaged
4. Thinking critically

Communicating effectively

OBJECTIVE: Calculus III continues the study of vector-valued functions and motion in space; functions of two or more variables and their derivatives, multiple integrals, vector fields, line integrals, Green's and Stokes Theorems, curl and divergence. This course will also emphasize a greater understanding of the applications of these topics.

MATERIALS: Besides the mentioned text, you will need to obtain the following for this class:

1. A basic scientific calculator (TI series recommended)
2. Computer access for software related to homework and projects (all software available online or in the Math Dept. Lab

Required Text

The Disability Resource Center

SLCC values inclusive learning environments and strives to make all aspects of the College accessible to our students. If you have a disability and believe you need accommodations to improve access to learning materials or the learning environment, please contact the Disability Resource Center: (phone) 801-957-4659; (email) drc@slcc.edu; (website) www.slcc.edu/drc.

The Student Code of Conduct

All students are expected to follow the SLCC Student Code of Conduct.

Title IX Statement

Title IX of the Educational Amendments of 1972 prohibits discrimination based on sex in any educational institution that receives federal funding. Salt Lake Community College does not tolerate sex discrimination of any kind including: sexual misconduct; sexual harassment; relationship/sexual violence and stalking. These incidents may interfere with or limit an individual's ability to benefit from or participate in the College's educational programs or activities. If you have questions or concerns regarding your rights or responsibilities, or if you would like to file a Title IX complaint please contact:

Kenneth Stonebrook, J.D. Title IX Coordinator Salt Lake Community College Taylorsville Redwood Campus – STC 276A (801) 957-5027 ken.stonebrook@slcc.edu

Online Reporting Form: http://www.slcc.edu/title-ix/complaint.aspx

For more information on text accessibility, contact Accessibility & Disability Services at ads@slcc.edu.

Course Prerequisites

This course is for students who, within the past year, have successfully completed a Calculus II course, such as MATH 1220, with a grade of C or better (preferably, a B or better).

Brief Description of Assignments/Exams

Homework: Each chapter has a homework assignment. Homework will come in a variety of forms including exercises from the book, projects, and analysis. Paper

homework is due before each midterm test (late homework not accepted after the unit midterm test.) Submit your papers in a neat and orderly fashion—they will be evaluated. Sloppy or irritating papers will be returned unread with no credit. There are two aspects to a good paper: content and presentation. This course emphasizes both since they are equally important. I may return an assignment to be “polished” if I feel it needs help with presentation or accuracy. To do well in this course you must complete the homework. Learn the why’s of your homework, not just the how’s !!

Specifics on how homework is to be presented:

- All homework is to be done in pen/pencil.
- Not Accepted after unit midterm test
- Sloppy work will not be accepted.
- Organized and well presented
- Appropriate Theorems Referenced

Turn in your homework paper in the format indicated in the diagram below. Clearly separate problems and identify your answer, sometimes a box is appropriate. Present papers with pride—content and presentation are equally important.

Exam Opportunities: We will have three mid-term exam opportunities and a Comprehensive final exam to show off all that we have learned. Testing protocol will be provided by your instructor. Full credit will be awarded on test problems only if your work can be readily followed and solutions are precisely and clearly indicated. None of the midterm exams will be dropped. No makeup exams unless a valid documentation is approved (Example: Medical documentation). It is a SLCC department policy that a student attaining a score of less than 60% on the final shall receive a grade no higher than “D” for the course. Exam dates will be announced under “Announcements” in canvas or can be found in the calendar.

Final Exam: There is a mandatory, departmental, comprehensive, proctored final exam. Its format will be paper, and pen-or-pencil, with 20 to 30 mandatory, show-your-work problems, no multiple choices. Students will show/write their work for each problem and all final exams will be graded according to the work shown. Partial credit is possible for relevant, partially correct work. Final exams are not given early or late (plan now). All

students must take the final exam to pass the class. Final exams can only be taken once a semester. Final exams are not returned to students, not even upon request. The Math Department keeps final exams on record for up to a few years for data collection, samples of student work, and to help prevent cheating in following semesters.

Exam Rules: *Every* exam is proctored. No note cards, notes, texts, collaboration, internet devices, programming/graphing calculators, or external aid of any kind are allowed on any exam, including the final exam. Scratch paper and a standard scientific, non-graphing, non-programmable calculator are allowed, e.g., TI30 but not TI36 or higher; see the Calculator Rule below. All exam-work to be graded must be (re)written on the exam's pages itself. There are no final exam retakes and no final exam corrections of any kind can be submitted for points.

60% Final Exam Rule: The Math Department's 60% Final Exam Rule is that if a student scores less than 60% on their final exam then their total course grade will be the lower of a D or their grade as calculated according to the weights of the grading categories on the syllabus. In other words, if a student fails their final exam (scores less than 60%), then the highest total course grade that they can earn for the course is a D.

This is an important departmental rule, which must be enforced to help ensure the success of students taking courses that have Math 2210 as a prerequisite. Moreover, it enforces a reasonable standard. Rules such as this also help make, "seamless," transfers to other USHE institutions possible. Without such rules, your SLCC math credit might not transfer to other higher ed institutions!

The Dates and Times of

Regular Exams and the Final Exam

Exam 1: XX, XX INSTRUCTORS: FILL-IN YOUR DATES AND RELEVANT INFO

Exam 2: XX, XX

Exam 3: XX, XX

....

Final Exam: XX, XX

SLCC's Final Exam Schedule This link is typically for in-person classes, whose final exams are conducted according to this schedule. We include for mere convenience in case it applies.

Math Department's Testing Rule: *All* SLCC math exams, regular exams and final exams, must be taken in person in a live proctored/monitored environment for *all* modalities (in-person, hybrid, broadcast, or online). Online and broadcast students are required to take their exams at an SLCC testing center facility or, if outside a 50-mile radius, coordinate with the Testing Center for a proctoring site nearer to their home. Any accommodations to this rule must be approved by the SLCC Math Department Associate Dean. Students are encouraged to make arrangements early in a semester with employers and families to ensure they are free during the scheduled exam periods; see the disclaimer below.

In-Person Testing Disclaimer: It is a student's responsibility to make arrangements early with employers, family, etc. to be free during all scheduled exams. **Missing an exam for work, for example, is not excused** as students are aware of exam dates the first day of classes. Any student not willing or not able to comply with in-person testing in their classroom, or at an SLCC Testing Center, during scheduled times should not register, or remain registered, for this class.

Communication Plan

I will respond to Canvas Inbox email within 24-48 hours except on weekends and holidays.

I will update feedback/exam grades within 7 working days.

The best way to contact me is via the Canvas Inbox, as I will prioritize this email over other modes of communication.

Grading Scale

Grade Weights: The breakdown percentages are as follows.

Homework: 10%

Projects: 10%

Quizzes /In class Participation): 10%

Exams (3 exams): 45%

Final Exam: 25%

Total numeric course grades are mapped to letter grades according to the following partition, using interval notation:

A [93%, 100%]	C [73%, 77%)
A- [90%, 93%)	C- [70, 73%)
B+ [87%, 90%)	D+ [67, 70%)
B [83%, 87%)	D [63, 67%)
B- [80%, 83%)	D- [60, 63%)
C+ [77%, 80%)	E [0%, 60%)

Take note that grades are not, “rounded up“ or curved.

Incompletes: Typically, incompletes are only considered when a student has completed at least 70% of total course work and is passing the class at the time the incomplete is requested. In this class, this amounts to all course work being completed minus the final exam. Thus, if a student has completed all work except the final and is passing, then their instructor may consider, but does not have to grant, an incomplete

grade to a requesting student; it is the instructor's prerogative. Incompletes are not given for more time to learn material or to avoid an undesirable grade. They are given primarily in the case of an emergency that prevented a student from being able to submit final papers/exams/etc.

Calculator Rule

Programmable calculators, graphing calculators, and any calculators capable of algebraic manipulations, are not allowed on in-class quizzes, regular exams, or the final exam.

Prohibited calculators include all the various makes of the following base models: TI36, TI83, TI84, TI86, TI89, TI92, TI-Nspire, HP48, as well as other similar models and brands. **An example of an acceptable standard, scientific, non-graphing calculator is the TI30**, which is relatively inexpensive. Your instructor can verify if a calculator is acceptable for use during quizzes or exams. How to use graphing software or how to program will not be taught in Math 1050, but it will also not be assessed.

Occasionally, a standard scientific calculator, say, a TI30, is required for basic approximation of radicals, logarithmic expressions, and the like, even on exams, like the final exam. It is advised that students always have a basic calculator with them for quizzes and exams just in case that one is allowed or needed. Note that it is the instructor's prerogative to give quizzes, tests, or portions of tests that do not allow any calculator. Not having a calculator does not excuse a student from being responsible for taking a quiz or exam at the assigned time or completing problems.

Students are expected to be able to perform basic calculations such as fractional arithmetic, finding exact simplified root values, manipulating algebraic expressions at the course level, etc., without a calculator. While a few homework problems and applications may require the use of a graphing calculator or online app, e.g., Desmos, questions on in-person quizzes or exams will only test basic facts that must be demonstrated by students without aid beyond blank scratch paper and a standard, scientific, non-graphing calculator. A student’s performance will be measured primarily on their understanding of the concepts and their competency in performing symbolic operations rather than a mere ability to use technology (pushing buttons) to get answers. Full credit will only be awarded on exam questions when answers are justified by a legible and valid argument.

Student Conduct

Students are expected to follow the SLCC Student Code of Conduct at Student Code of Conduct.

Classroom Deportment: Each student is responsible for their own behavior. Any student who shows a pattern of disrespect for others, or who at any time displays egregious disrespect for others, will be subject to penalties as per the student code of conduct.

Attendance: Class attendance and/or participation, whether in-person, broadcast, or online, are expected. They are typically essential to achieve satisfactory results. It is the student's responsibility to be aware of all material covered, in-class announcements, tests dates, assignment due dates, etc.

Electronic Devices in the Classroom: Absolutely no video or audio recording in the classroom is allowed without prior written authorization from the instructor. Cell phones and other electronic devices should be in silence mode during classes, tests, and final exams. Moreover, such devices should not be on desks during lectures, tests, and the final exam unless they are part of the class' participation activities.

Cell phones and tech in-class: In case of emergency, or otherwise, students should exit the classroom before they e-mail, text, or use their cell phones. If students choose to use a computer or electronic device in class to take notes, they may do so without distracting their classmates. Computer activities that are not directly related to the class should not be done in-class, e.g., watching YouTube or the like. Students who text, scroll on their phones, talk on their cell phone, or use their computers to do activities not directly related to the class will be asked to leave the classroom.

Cheating Rule: Cheating on any assignment or exam will minimally result in a failing grade of 0% for that assignment without any possibility for that work to be made up, resubmitted, or for the failing grade to be substituted by any other work's grade. Moreover, cheating on a single assignment or exam can result in a failing grade for the entire class; this is typically the prerogative of the individual instructor. Cheating is not

tolerated, so, take heed and do honest work to learn and develop intellectually. For more details about academic dishonesty, consult the Student Code of Conduct, where this topic is addressed in section C (see below too):

Policies and Student Affairs.

Sanctions for Academic Misconduct (taken from the Student Code of Conduct): Faculty, program directors, associate deans, deans, and the provost for Academic Affairs are authorized to impose any one or a combination of the following sanctions after finding a student responsible for acts of academic misconduct. The possible sanctions include, but are not limited to

- verbal warning and reprimand,
- restriction of privileges, such as access to lab facilities, library facilities, or testing centers,
- failure of the exam, quiz, project, or other assessment,
- failure for the course,
- withdrawal from the course, or
- withdrawal from the academic program.

Upon the circumstance of catching a student cheating, even if the infraction seems minor or the student is remorseful, instructors are expected to fill out the following form (the Dean of Students uses these forms to establish patterns of behavior):

Academic Misconduct Violation Reporting Form.

Student Academic Calendar

As students you should be aware of all important dates in the semester, such as the day that courses begin and end, as well as the drop date and the last day to withdraw. To learn more about those dates, navigate to the Student Academic Calendar below:

SLCC Student Academic Calendar

Contingency Remote Workday/Learning Plan

Under Utah legislation, the governor can now call a "Remote Workday" given certain circumstances. These remote workdays can be due to inclement weather, pollution, or natural disasters.

1. Each math instructor (full or part-time) will **check-in/communicate** with the Math AD, say, with an email that acknowledges the remote workday and their relative plan for it.
2. The Math AD will verify whether a class will still meet on a campus if something happens at the campus, etc.
3. Each instructor will make a **Canvas class announcement and communicate with students**, informing them of the remote learning day and what their relative plan is for the day's class. Announcements will include pertinent info for the remote day and/or any adjustments to the next class:

- What are the assigned readings, video lectures to watch, practice problems to work?
- Is the instructor holding a Zoom meeting in lieu of the in-person class? The Zoom meeting must be optional and should be conducted at the same time as the regularly scheduled class, if possible. Moving to livestream modality is only an option, not required of the instructor or students. The Zoom meeting could simply be to answer student questions.
- Any test that was scheduled on a remote learning day will be postponed, either to the next class or possibly later scheduled through the Testing Center. Instructors will let students know that the exam has been postponed in their Canvas announcement.

How to Navigate to Canvas

Institutional Policies

As members of our academic community, we would like to invite you to review the Institutional Syllabus which covers important policies and procedures. This document

contains important links for students on the code of student rights and responsibilities, academic integrity, and grading policies, Title IX and other important acknowledgements. By familiarizing yourself with this information, you can help us create a safe and respectful environment for everyone.

You can access the document by clicking on the following link: https://slcc.instructure.com/courses/530981/pages/institutional-syllabus

Learning Support and Tutoring Services

We are pleased to offer a range of tutoring and learning support services to help you achieve your academic goals. Whether you need assistance with a specific subject or want to improve your study skills, you have many options for tutoring or other support.

To learn more about the services we offer and how to access them, please visit the Institutional Syllabus under the Tutoring and Learning Support tab: https://slcc.instructure.com/courses/530981/pages/institutional-syllabus. We encourage you to take advantage of these resources to help you succeed in your studies. If you have any questions or would like to schedule a tutoring session, please don't hesitate to reach out to us. We are here to support you in any way we can.

General Learning Support & Tutoring Services

General Learning Support & Tutoring Services provide support for SLCC students enrolled in any class at the College. You may also ask your instructor about discipline-specific learning support and tutoring services. The following resources are provided free-of-charge.

- In your Canvas course, there is a (blue) tab, “Online Tutoring,” in the left column of tabs. This literally provides free online tutoring during hours of operation.
- For in-person Redwood campus help in math, the next resource is highly recommended: **STEM Center** in SI building, which offers free STEM tutoring.

STEM Center Hours (may vary by semester): Monday-Thursday, 10:00 a.m.-9:00 p.m. Friday and Saturday, 10:00 a.m.-5:00 p.m.

Tutoring: This is an index of tutoring resources.

STEM Learning Centers: Provides free assistance in Math, Science, Accounting, CSIS and Allied Health Classes at 6 campus locations.

Student Writing Center: Provides in-person and online feedback on all writing assignments.

Library Services: Provides research help, print and online resources, computers and study space.

ePortfolio Lab: Provides drop-in assistance for all ePortfolio questions.

eLearning Support: Provides support for navigating online and hybrid classes.

Accessibility and Disability Services: If you have a disability and want an accommodation, please contact:

- Phone: 801-957-4659
- Email: ADS@slcc.edu
- Website: ADS

Advising and Counseling Support Services

At our institution, we are committed to supporting your academic and personal growth. That's why we offer a range of advising and counseling services to help you navigate the challenges of college life. To learn more about the resources available to you and how to access them, please visit the Institutional Syllabus under the Advising and Counseling Support Services tab: https://slcc.instructure.com/courses/530981/pages/institutional-syllabus. Our advising team and the support centers across campus are here to support you in achieving your goals and overcoming any obstacles you may face.

Course Student Learning Outcomes

- Graph standard quadric surfaces, including paraboloids, spheres, ellipsoids, hyperboloids of one and two sheets, and hyperbolic paraboloids.
- Work with plane/space curves to find parametric representations of plane/space curves and surfaces, and reparametrize in terms of arc length.
- Work with plane/space curves to identify curves and surfaces from parametric representations.
- Work with plane/space curves to determine limits, continuity, differentiability/derivatives, and integrability/integrals of vector-valued functions.
- Work with plane/space curves to find the unit tangent, normal, and binormal vectors at a given point.
- Work with plane/space curves to find the curvature and torsion at a given point.
- Work with plane/space curves to find the length of a curve between two points.
- Work with particle motion, given a position vector find the velocity, speed, and acceleration.
- Work with particle motion, given the acceleration find the velocity, position, use initial conditions.
- Find level curves and level surfaces.
- Work with limits of multivariate functions and understand the definition of continuity and recognize continuous functions.
- Work with and understand partial derivatives find first and higher order partial derivatives.
- Work with and understand partial derivatives use Clairaut's theorem.
- Understand the multivariate definition of differentiability and find the tangent plane to surface at a given point. Find the gradient, find the tangent plane to a surface at a given point in all the following cases.

Assignment Schedule

Due Date	Assignment Name	Assignment Type	Points
	Exam 1	Assignment	100

Due Date	Assignment Name	Assignment Type	Points
	Exam 2	Assignment	100
	Exam 3	Assignment	100
	Final Exam	Assignment	100
	HWK set 1	Assignment	200
	HWK set 2	Assignment	150
	HWK set 3	Assignment	100
	HWK set 4	Assignment	100
	In class participation Sept	Assignment	400
	Introduce Yourself	Discussion	0
	Introduce Yourself	Discussion	0
	Project 15	Assignment	150
	Project 16	Assignment	150
	Project C 14	Assignment	150
	Project C12	Assignment	150
	Project C13	Assignment	150
	Quizzes & Participation August	Assignment	150

Sections to be covered from the text book

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Vectors and the Geometry of Space
12.5 Equations of Lines and Planes

12.6 Cylinders and quadratic Surfaces

Vector Functions

13.1 Vector Functions and Space Curves

13.2 Derivatives and Integrals of Vector Functions

13.3 Arc Length and Curvature 13.4 Motion in Space (velocity and accelerations)

Partial Derivatives

14.1 Functions of Several Variables 14.2 Limits and Continuity 14.3 Partial Derivatives 14.4 Tangent Planes and Linear Approximations 14.5 The Chain Rule 14.6 Directional Derivatives and Gradient Vector 14.7 Maximum and Minimum Values 14.8 Lagrange Multipliers

Multiple Integrals

15.1 Double Integrals over Rectangles

15.2 Double Integral over General regions

15.3 Double Integrals in Polar Coordinates

15.4 Applications of Double Integrals (Optional- depending on time)

15.5 Surface Area

15.6 Triple Integrals

15.7 Triple Integrals in Cylindrical Coordinates

15.8 Triple Integrals in Spherical Coordinates

15.9 Change of Variables in Multiple Integrals

Vector Calculus

16.1 Vector Fields

16.2 Line Integrals

16.3 The Fundamental Theorem of Line Integrals

16.4 Green’s Theorem

16.5 Curl and Divergence

16.6 Parametric Surfaces and Their Areas

16.7 Surface Integrals

16.8 Stokes’ Theorem

16.9 The Divergence Theorem