2210-90 Calculus III, Summer 2021

Course Information: Math 2210 Calculus III is a 3 credit course.

Prerequisite Information: "C" or better in (MATH 1220 OR MATH 1250 OR MATH 1320) OR AP Calculus BC score of at least 4.

Course Description: Vectors in the plane and in 3-space, differential calculus in several variables, integration and its applications in several variables, vector fields and line, surface, and volume integrals. Green's and Stokes' theorems.

Instructor: Dr. Matt Cecil

Email: mcecil@math.utah.edu

Office Hours: To be determined at the beginning of the semester.

Text: *Calculus with Differential Equations*, by Varberg, Purcell, and Rigdon (9th edition). Additional information regarding purchasing the textbook can be found at http://www.math.utah.edu/schedule/bookInfo/. Chapter 11 of the textbook is available electronically through the library reserves.

Overview: This is an exclusively online class, run primarily through the Canvas interface. You can access the Canvas page through CIS or by logging in at utah.instructure.com. Students should check the Canvas page regularly for course information and resources. Email notifications and correspondence will be sent to the student's UMail address ([u-number]@utah.edu); this email account must be checked regularly.

There will be short lectures posted each week on Canvas discussing the main points of the chapter; however, students will need to supplement these lectures with careful reading of the book sections. Students have many resources available to use in learning the course material in addition to the text, posted videos, and the assigned problem sets. These include

- **Interaction with the Instructor**- The instructor will be available to meet in person or online for office hours, will respond to emails, and participate in discussion boards.

- **Interaction with Other Students**- The Canvas interface makes connecting with other students easy. Though it is required that every student do his or her own work, you are encouraged to form study groups and/or ask questions of your peers. Students are encouraged to answer discussion posts too.

- **Math-Department Tutoring Lab**- Room 155 of the T. Benny Rushing Mathematics Center (in the basement connector between the LCB and JWB math buildings). For more information, see http://www.math.utah.edu/undergrad/mathcenter.php

- **Supplementary Notes & Past Exams**- There is a departmental webpage for the class that has some additional resources, including exams from past semesters. See http://www.math.utah.edu/online/2210/.

- **Anything Else...**- There are many free resources available on the web that may be helpful. Beware, however, that the quality and accuracy of these resources vary. If you find a helpful website or video, feel free to share it with the other students.

This course is not a learn-at-your-own-pace course. It follows the University's semester-based academic calendar and has hard due dates for homework and exams. Because course learning is guided through an online interface, it does provide greater time flexibility than a traditional lecture course. However, with this time flexibility comes the responsibility to use your time wisely and effectively.

The instructor will try his/her best to be helpful, responsive, and available. However, it is the student's responsibility to ask questions well in advance of homework due dates. You can expect instructor replies within one day of sending during normal daytime hours, although the instructor will often respond much sooner. It is imperative that you get started on the WebWork assignments early so that you allow time for responses to any questions you might have. In general, you should not expect an answer to homework question posed past 7:00pm until the next day.

Technical Requirements:

- Students are expected to be computer literate and Canvas and Zoom navigation skills are expected. Knowledge and navigation of Canvas and Zoom is critical to access all features and resources of this course

- Exams will be proctored in Zoom and all students will be expected to have a working webcam and microphone.

- Students MUST use their U-mail email account ([u-number]@utah.edu) for all student-instructor email correspondence, and must send email to the instructor using the email address listed above. Check your U-mail regularly because all official class announcements will be sent through this email.

- The university suggest that you use Firefox, Chrome, or Safari to login to Canvas, but not Internet Explorer. For any technical help with Canvas, you should contact the UOnline Helpdesk at (801) 581-6112.

For information on borrowing a laptop from the university or about off-campus wifi access, see
https://lib.utah.edu/coronavirus/checkout-equipment.php

Keys to Success: To be successful in this online course format, a student must be an active participant in their own learning. This requires motivation, time management, and discipline. Here are some strategies that will be effective:

- **Get Started Early-** Get started learning the material early in the week. You will retain and understand the material better if you do a small amount of work each day for a few days than if you try to cram the week's material into one day. Plus, starting early gives you plenty of time to get questions answered from discussion or email. Set aside specific times each week that you will devote to the course work. If you work a job during the day or are more of a night owl, pretend that the homework is due the night before it actually is; that way, you will be sure to get it done in time, and you will have the next day to get any remaining questions answered. Do not wait until the last minute!

- **Work Examples-** A math textbook is not good bedtime reading. You should be actively working while you are reading. Get out paper and pencil and read through the text and examples, working through each step on your paper. If you do not understand a step, go back and work through it again. Progress may be quite slow, but your time will be rewarded by a better understanding of the material.

- **Print Out Homework-** Print out the WebWork problems and do them first carefully with paper and pencil. Remember that, although WebWork only requires an answer, exams will be taken with paper and pencil. On exams, it will be important that you show your work and that your work is clear and legible. Your method is as important as your final answer! Practice this on your WebWork assignments.

- **Ignore your Calculator-** Do your WebWork assignments without a calculator. There are a few WebWork problems that do expect numerical answers, but most problems do not require a calculator. For example, suppose you find that an answer to a problem is $\frac{\sqrt{5}}{3} + \sin\left(\frac{\pi}{4}\right)$. You could get out your calculator and find that this equals 1.45246..., then input 1.4525 into the WebWork blank. However, it is better to input the whole expression and let WebWork handle the calculation. In this example, you would input 'sqrt(5)/3+sin(pi/4)'. This is better for a few reasons. If you need to use this answer in another part of the problem, you can simply cut and paste and/or modify your entry appropriately in the new blank. This eliminates any rounding errors that might cause your second answer to be counted as incorrect if the rounded decimal form is used. Secondly, if you enter decimal answers, it is virtually impossible for the instructor to understand what you are doing to arrive at that answer. This makes it difficult for the instructor to diagnose the problem by looking at your previous answers. Kick the calculator habit!

- **Use Homework as a Tool-** You should view the WebWork homework as a tool for accessing and evaluating your understanding of the course material. Getting a high homework score is desirable, of course. However, that should not be your only goal. WebWork questions vary in difficulty and relevance, but they will often follow an example in the book quite closely. All you are required to input is the answer, and it may be possible to get that answer by shortcut methods (following computations in the book, finding a pattern in previous answers, etc). It is not in your best interest to take shortcuts; any additional points you get by these methods will be negated by points you miss on an exam where

the problems will be different and you will be expected to show all of your work. There is nobody looking over your shoulder to make sure you are doing the WebWork problems honestly, so you need to police yourself. If you get a correct answer but are not totally confident of the method, go back and work it again.

- **Seek Help if Needed-** If you are having difficulty with a concept or question, it is up to you to seek help from the instructor, other students, or a tutor. You should attempt to be an honest evaluator of your own understanding. Constantly ask yourself, 'How well do I understand this concept?' One way to evaluate this is to pick a problem from the end of the section in the book. If you can't get started or keep getting stuck, then you clearly are lacking some necessary component of understanding. So seek out help. There is no shame in getting assistance. Learning mathematics alone is difficult for everyone and often you just need a nudge back in the right direction. Make sure the help you are getting is directed at your conceptual understanding and not just how to get the final answer. Whether or not you get a particular answer correct or not on your homework will have a negligible effect on your course grade, but whether or not you understand the underlying concept will ultimately have an effect on your course grade through higher exam scores.

Grading: The following are the grade components and the percentage each contributes to a student's final grade:

WebWork Assignments (20%) - assignments will be due weekly (except for exam weeks) and will utilize the Webwork environment. You can access the Webwork assignments by clicking on the Assignment listing in Canvas. For specific due dates and times, please consult the course calendar. There will be 11 homeworks in total, plus an introductory assignment. The number of questions per assignment and hence the total points each assignment is worth will vary. The introductory assignment is graded. The lowest score will be dropped.

Written Supplementary Assignments (10%) - these will be along with the webwork assignments and cover the same material. The purpose of this course component is to practice and get feedback on writing clear and complete solutions (as opposed to focusing on a correct final answer, as is done in Webwork). The lowest score will be dropped.

Midterm Exams (70%) - Every assignment will have a mini-exam associated to it. These are 22-minute exams split evenly between a computer-graded portion and a written answer portion. These exams will be administered at four times throughout the semester (see course calendar). Exams will be given at a common time to be determined by availability. The lowest two-computer graded exam scores will be dropped. So there are 11 computer-graded exam scores (only 9 of which are graded) and 11 written exam scores total. This makes each graded portion worth 3.5% of the final course grade.

Exams will be proctored, through Zoom, so a webcam will be required. The use of the textbook, notes, and a basic non-graphing calculator will be allowed during the exam. Online resources and communication with others (either in person or electronically) will not be allowed during the exams. Violations of these rules will be considered academic misconduct; a zero will be given on the exam and a report will be sent to the College of Science.

Final Exam - There is no cumulative final exam for this course.

Final course letter grades will be tentatively determined as follows: If X is your course percentage weighted according to the above, then $\{X \geq 88\% \Rightarrow A, X \geq 85\% \Rightarrow A-, X \geq 82\% \Rightarrow B+, X \geq 73\% \Rightarrow B, X \geq 70\% \Rightarrow B-, X \geq 67\% \Rightarrow C+, X \geq 58\% \Rightarrow C, X \geq 55\% \Rightarrow C-, X \geq 52\% \Rightarrow D+, X \geq 43\% \Rightarrow D, X \geq 40\% \Rightarrow D-, X < 40\% \Rightarrow E\}$.
The instructor retains the right to modify this grading scheme during the course of the semester; students will, of course, be well notified of any adjustments. Note that, given the percentages outlined above, missing a midterm exam will result in a student's grade falling at least one and a half letter grades, while missing the final exam will result in a student's grade falling at least two letter grades. It is therefore unlikely a student will pass the class if any exam is missed.

Extra Credit- Participating in the Canvas Discussions allows you to earn a small amount of extra credit. Everyone who posts a discussion question or reply with mathematical content will receive one additional

point on that week's homework assignment (maximum of one point per week). This does not seem like very much, but a student who participates every week will add about 2% to their final course score. You will also find that the benefits you receive by participating in the discussions go well beyond the extra credit. Keep in mind, though, that to receive the maximum benefit you need to start participating early in the semester. Everyone benefits when there is more class participation in the Discussions. There may be additional extra credit opportunities.

Other Important Information

- Students must self-report if they test positive for COVID-19 via coronavirus.utah.edu.

- If you are having difficulty with a Webwork problem and would like help from the instructor, please use the 'email instructor' button which is located on the problem page. This will send the instructor an email containing your question and a link which allows the instructor to view your specific problem and the previous answers you have input. This added information makes diagnosing your problem much easier.

- When asking about a problem, either via the Webwork "email instructor" button or discussion posts, please make sure to include the following information: (1) state the problem in your own words, (2) state your general strategy to solve the problem and any relevant intermediate computations, and (3), your answer. Often, you will find that if you take the time to write out the above information clearly, your mistake will become apparent. Also, the above information is important because the homework problems are randomized. No two students will get the same homework problems. So references to answers without the problem context will not be meaningful.

  When all three elements are included, the instructor can very often diagnose any problems in the student's computations and/or strategy and suggest a correction. The instructor will most likely not supply a complete answer in reply. The goal of instructor interaction is to facilitate learning. It is the student's responsibility to complete their own calculations to earn credit.

- Practice tests will be posted about a week prior to each exam. Practice exams will be similar in structure and format to the real exam. There are also exams and solutions from previous semesters which can be accessed through a link on the departmental webpage http://www.math.utah.edu/online/2210/.

- The Canvas interface (discussion posts, chat, etc.) should be used for Calculus III coursework only. The instructor moderates student activity and has the right to initiate disciplinary action in the event of inappropriate activity.

Expected Learning Outcomes: Upon successful completion of this course, a student should be able to:

1. Perform basic vector computations, as well as dot and cross products of two vectors and projection of one vector onto another vector.

2. Convert between cylindrical, rectangular and spherical coordinates. Understand when it's prudent to switch to one coordinate system over another in computing an integral.

3. Determine the equation of a plane in 3-d, including a tangent plane to a surface in 3-d.

4. Find the parametric equations of a line in 3-d.

5. Perform calculus operations on functions of several variables, including limits, partial derivatives, directional derivatives, and gradients; understand what the gradient means geometrically.

6. Find maxima and minima of a function of two variables; use Lagrange Multipliers for constrained optimization problems.

7. Understand divergence and curl of a vector field.

8. Compute double and triple integrals in rectangular, spherical and cylindrical coordinates; proper use of double or triple integrals for finding surface area or volume of a 3-d region.

9. Compute line and surface integrals.

10. Determine if a vector field is conservative and if so, find the corresponding potential function.

11. Use and understand when to apply Green's Theorem, Gauss' Divergence Theorem and Stokes Theorem.

Student Responsibilities: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, and I will do so, beginning with verbal warnings and progressing to dismissal from and class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee. http://regulations.utah.edu/academics/6-400.php

ADA Statement: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which Includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veterans status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Student Names and Personal Pronouns: Class rosters are provided to the instructor with the students legal name as well as Preferred first name (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class, on papers, exams, group projects, etc. Please advise me of any name or pronoun changes (and update CIS) so I can help create a learning environment in which you, your name, and your pronoun will be respected. If you need assistance getting your preferred name on your UIDcard, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email bpeacock@sa.utah.edu to schedule a time to drop by. The LGBT Resource Center hours are M-F 8am-5pm, and 8am-6pm on Tuesdays.

Wellness Statement:. Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a students ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

Safety Statement: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

University Counseling Center The University Counseling Center (UCC) provides developmental, preventive, and therapeutic services and programs that promote the intellectual, emotional, cultural, and social development of University of Utah students. They advocate a philosophy of acceptance, compassion, and support for those they serve, as well as for each other. They aspire to respect cultural, individual and role differences as they continually work toward creating a safe and affirming climate for individuals of all ages, cultures, ethnicities, genders, gender identities, languages, mental and physical abilities, national origins, races, religions, sexual orientations, sizes and socioeconomic statuses.

Office of the Dean of Students The Office of the Dean of Students is dedicated to being a resource to students through support, advocacy, involvement, and accountability. It serves as a support for students

facing challenges to their success as students, and assists with the interpretation of University policy and regulations. Please consider reaching out to the Office of Dean of Students for any questions, issues and concerns. 200 South Central Campus Dr., Suite 270. Monday-Friday 8 am-5 pm.

Student Success Advocates: The mission of Student Success Advocates is to support students in making the most of their University of Utah experience (ssa.utah.edu). They can assist with mentoring, resources, etc. Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact a Student Success Advocate for support (https://asuu.utah.edu/displaced-students).

Course Roadmap Week-by-Week: Except for the first introductory assignment, all WebWork due dates are Tuesday 11:59pm and all Written Assignment due dates are Thursday 11:59pm. Webwork answers will be available and the next assignment will be posted when the previous one closes.

Week 1 WebWork demo assignment due—learn to log in, navigate environment

Week 2 Assignment #1 due, Chapter 11.1-4: Vectors Geometry, Dot and Cross Products. **Note, Wednesday May 26 is the last day to drop course**

Week 3 Assignment #2 due, Chapter 11.5-7: Lines, Curves, Velocity, Acceleration, Curvature, Tangents and Normals.

Week 4 Assignment #3 due, Chapter 11.8-9: Surfaces, Cylindrical and Spherical Coordinates. Exam 1 (TBD between Jun. 10 - Jun. 12).

Week 5 Assignment #4 due, Chapter 12.1-4: Functions of Two or More Variables, Partial Derivatives, Limits, Continuity, Differentiability.

Week 6 Assignment #5 due, Chapter 12.5-7:Directional Derivatives, the Gradient, Tangent Planes, the Chain Rule, Implicit Differentiation, Approximation with Differentials. **Note, Friday Jun. 25 is the last day to withdraw from course**

Week 7 Assignment #6 due, Chapter 12.8-9: Maxima and Minima, Lagrange's Method. Exam 2 (TBD between Jul. 1 - Jul. 3).

Week 8 Assignment #7 due, Chapter 13.1-5: Double Integrals and Applications.

Week 9 Assignment #8 due, Chapter 13.6-9: Surface Area, Triple Integrals, Change of Variables.

Week 10 Assignment #9 due, Chapter 14.1-2: Vector Fields and Line Integrals. Exam 3 (TBD between Jul. 22 - Jul. 24).

Week 11 Assignment #10 due, Chapter 14.3-4:Independence of Path, Green's Theorem.

Week 12 Assignment #11 due, Chapter 14.5-7: Surface Integrals, Divergence and Stokes's Theorems. Final Exam (TBD between Aug. 5 - Aug. 7).