MATH 215 Fall 2020 Honors Vector Calculus SYLLABUS Prof. Sachs

TEXT: Use one that works for you. Use our regular calculus text (Thomas) or free online ones.
Strang (MIT): https://ocw.mit.edu/resources/res-18-001-calculus-online-textbook-spring-2005/textbook/
the book Active Multivariable Calculus here: https://activecalculus.org/multi/frontmatter.html
My notes are available here: math.gmu.edu/˜rsachs/math215/textbook

COURSE OVERVIEW: This course introduces the ideas and techniques of multivariable/ vector calculus and explores their uses. Extending calculus takes several forms: vector-valued functions of one variable; scalar and vector functions of several variables. Throughout we will emphasize conceptual understanding using the unifying idea of linear approximation, and at times quadratic approximation, which leads to a better view of how these ideas and techniques were developed. Vector and matrix algebra organize calculations and clarify reasoning. Computer calculation and visualization will be used often.

The key concepts of derivative and integral will be extended and at the end of the semester we will examine the fundamental theorems (note the plural) of multivariable calculus. We will restrict ourselves to two and three dimensional spaces but moving to larger finite dimensions is not that difficult if needed in your later studies.

A BIT ABOUT ME: I love calculus. I tried to learn this material myself while in high school, but I had a poor teacher. In college, I was a Teaching Assistant for this course my last two years. My teaching will challenge you to think deeply and flexibly about the material. This will not always be fun or comfortable.

WARNINGS: (1) We will be changing the sequencing of topics in places, making the traditional textbooks mildly uncomfortable. (2) Events may force changes at any time. Let me know if your situation changes and we will find ways to make it work.

ONLINE MEETING: Tues. and Thurs. 1:30–2:45 pm in our Blackboard collaborate room

OPEN STUDENT HOURS: M 3:00-4:30pm, R 3:30-5:00pm **CONTACT INFO:** OFFICE PHONE:

703-993-1464 (not good for start of classes) E-MAIL: rsachs@gmu.edu
Use headers to avoid spam filtering!

GTA: Ms. Savannah Crawford, scrawfo9@gmu.edu

COURSE WEB PAGE: Blackboard page at mymasonportal

GRADING: Grading will be fair and impartial. It is unlikely to result in bell curve. Points used as the basis of the grade will be: Hmwk. (200 pts.); Class Participation (50 pts.); Computer Exercises (100); Recitation Participation (50 pts.); Exams (200 pts.); Final exam (150 pts.). If the class decides to add quiz grades we will incorporate them also.

POLICIES: The GMU Honor code is in effect at all times and students are expected to be fully aware of its requirements. Group work may be part of the course, in which case group members will truthfully report on non-contributing members. Absence from quizzes and exams must be for a valid reason and requires PRIOR NOTIFICATION except in extreme circumstances. DO NOT ARRANGE TO LEAVE BEFORE THE FINAL EXAM. If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Resources at 703/993-2474. All academic accommodations must be arranged through that office. CIVILITY IS CRITICAL IN THIS DIFFICULT TIME.

EXAMS: Exam 1 **Tentative** Thursday, Sept. 24
Exam 2 **Tentative** Thursday, Nov. 12
Final Exam **Definitely** Tues. 12/15 1:30 pm – 4:15 pm

MATERIAL COVERED TENTATIVELY (will go slower in early weeks in reality)

- Week 1: Overview of course; 2-D and 3-D coordinates; vectors (dot product, cross product); orientation; rotation; matrices
- Week 2: Equations of lines, planes; functions of one and several variables; graphing issues.
- Week 3: Curves in space; Curvature and arclength.
- Week 4: planetary motion; line integrals; functions of several inputs.
- Week 5: Functions of two and three variables: graphs, level sets, limits, continuity. Exam 1 review and exam.
- Week 6: Functions of several variables: partial derivatives, linear approximation.Gradient vector, differentials, drawing gradient field; solving for gradient – curl and divergence introduced.
- Week 7: Chain rule; Max-min problems; constraints and Lagrange multiplier rule (may drop as topic).
- Week 8: Integral in 2-D: rectangles; 2-D general domains, polar coordinates. Integral in 3-D: boxes, general domains, cylindrical and spherical coordinates.
- Week 9: Substitution in integration; Start applications of integration.
- Week 10: More applications of integration: surface area, average values, center of mass, moments. Exam 2 review and exam.
- Week 11: Integration over lower dimensional objects: surface integral; vector form.
- Week 12: Independence of path in line integrals and Fundamental Theorem for line integrals; Green's theorem. Divergence form for flux.
- Week 13: (short) Flux and circulation.

- Week 14 Reviewing flux and circulation; additive properties. Exam 3
- Week 15: Extending Green's theorem into 3-D: Stokes' theorem and Gauss' theorem. Review and summary.

Along the way, we will talk about some themes: dimensionality, parametrization, approximation, and use computer software (Mathematica/geogebra) and on-line applets to aid in visualization and calculation. I am planning on using Gradescope to help in grading written work. Submit through there in pdf format to help me grade in reasonable time and effort.

Students as Scholars: This course is a Discovery level course in the Mason Students as Scholars program. You will be developing an understanding of scholarship in STEM and Economics via calculus. Information on Students as Scholars is at http://oscar.gmu.edu/ or ask me.

MIDCOURSE CORRECTIONS: This semester it is quite likely there will be changes to the plan beyond those we already made. I will communicate these clearly to you. Exams may change format.