MATH 215 Honors Vector Calculus SYLLABUS

Prof. Sachs Fall 2021

TEXT: Notes from me along with access to a regular calculus text (there are several free online or use our regular calculus text –Thomas) 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, 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.

WARNING: We will be experimenting with some alternate sequencing of topics. Given the traditional textbook order of topics, this will be uncomfortable in a few spots.

MEETING: Mon. and Weds. 10:30–11:45 am, Horizon 3012

OFFICE HOURS: Will pick time once I survey you – my office is Exploratory 4211, and I will make appointments at times other than office hours.

CONTACT INFO: OFFICE PHONE: 703-993-1464 E-MAIL: rsachs@gmu.edu
Use headers to avoid spam filtering!

GTA: Mr. Heath Camphire, hcamphir@gmu.edu

COURSE WEB PAGE: Blackboard page at mymasonportal

GRADING: Grading will be fair and impartial. Points used as the basis of the grade will be: Hmwk. (200 pts.); Class Participation (50 pts.); Recitation Participation (50 pts.); Exams (300 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.

EXAMS: Exam 1 **Tentative** Wednesday, Sept. 22
Exam 2 **Tentative** Wednesday, Oct. 20
Exam 3 **Tentative** Wednesday, Nov. 17
Final Exam **Definitely** Mon. 12/13 10:30 am – 1:15 pm

MATERIAL COVERED AND TENTATIVE WEEKLY SCHEDULE (probably 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: Functions of two and three variables: graphs, level sets, limits, continuity.
- Week 4: Curves in space; Curvature and torsion; planetary motion; line integrals.
- Week 5: Exam 1; Functions of several variables: partial derivatives, linear approximation.
- Week 6: Gradient vector, differentials, drawing gradient field; solving for gradient – curl and divergence introduced.
- Week 7: (short) Chain rule; Max-min problems; constraints and Lagrange multiplier rule.
- 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
- 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.

Some themes along the way: dimensionality, parametrization, approximation, and visualization (will use computer software - Mathematica- and on-line applets to aid us).

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.