MATH 217 101 2023W1 Multivariable and Vector Calculus

MATH 217 Multivariable and Vector Calculus

Contact info:

- Instructor: Prof. Jim Bryan, jbryan@math.ubc.ca
- Teaching Assistant: Tina Torabi,   torabit@math.ubc.ca

Course Structure:

Lectures will be live (whether we have a simultaneous zoom session is TBD):

- Tuesday and Thursdays, 9:30 am to 11:00 am. Blackboard lecture live from BUCH A202.
- Wednesdays, 11:00 am to 12:00 pm. Blackboard lecture live from BUCH A202.
- Office hours: Mondays 2:00-3:00pm in Math 226.
- TA Office hours: TBD

Learning Materials:

- Main Text: CLP-3 Multivariable Calculus Textbook and CLP-4 Vector Calculus Textbook by Joel Feldman, Andrew Rechnitzer, and Elyse Yeager. These locally developed texts are available here. The companion Problem Books (draft versions) to these texts, available at the same site, will also be useful.
- Lectures are being recorded with the Panopto system. A link to the livestream is hereLinks to an external site..
- I will post my lecture notes under "pages"-->"notes"
- I will post practice midterms and finals before each midterm and final.
- Piazza: Access our course Piazza page from Canvas. Tina and I will answer questions there.

Webwork

Weekly webwork assignments will appear on the Assignments tab in Canvas. Assignments are due on Tuesdays at midnight. **Always access the webwork assignment through the link in Canvas** (otherwise the grades don't sync correctly).

Assessment of Learning:

There will be weekly webwork assigned as well as at least two midterms (I am currently planning on two midterms, but this may change). The course grade will normally be given by the *better* of the following two schemes:

- 50% Final Exam + 35% Midterm grades + 15% WebWork Grade, or

- Scaled Final Exam grade - 10

Please note that grades may be scaled.

Course Policies:

- There will be (at least) two midterms during the term. There are no make-up midterms. Missing a midterm for a valid reason normally results in the weight of that midterm being re-distributed to the remaining midterm and final exam. Any student who misses a midterm is to present the Department of Mathematics self-declaration form for reporting a missed assessment to their instructor within 72 hours of the midterm date. This policy conforms with the UBC Vancouver Senate's Academic Concession Policy V-135 and students are advised to read this policy carefully.

Learning outcomes:

Here is a list of learning outcomes: skills.pdfDownload skills.pdf

Schedule of Topics:

Here is our expected progress through the course laid out in weeks. A week is roughly 4 lecture hours. Corresponding sections of the texts are listed.

Weeks 0 and 1 (Sept 7th-14th): Intro, coordinates, vectors, dot and cross products, lines and planes (CLP3: 1.1-1.5)

Week 2 (Sept 19th-21st): curves, tangents, arc length, sketching surfaces, (CLP3: 1.6-1.9)

Week 3 (Sept 26th-Sept 28th): functions of several variables, partial derivatives, higher-order derivatives, equality of mixed partials (CLP3: 2.1-2.3), tangent planes and linear approximation (CLP 2.5, 2.6), chain rule (CLP3: 2.4);

Week 4 (Oct 3rd-5th): directional derivatives and the gradient (CLP3: 2.5-2.7), classification of critical points (CLP 2.9)

Week 5 (Oct 10th-12th): maxima and minima, Lagrange multipliers (CLP3: 2.9-2.10);

Week 6 (Oct 17th-19th): double integrals, volumes, double integrals in polar coordinates (CLP3: 3.1-3.2); **First midterm in class on October 17th.**

Week 7 (Oct 24th-26th): applications of double integrals, triple integrals, triple integrals in cylindrical and spherical coordinates (CLP3: 3.3-3.7)

Week 8 (Oct 31st-2nd): vector fields, line integrals, path independence (CLP4: 2.1-2.4, 1.6);

Week 9 (Nov 7th - 9th): parameterized surfaces, surface integrals (CLP4: 3.1-3.5)

Week 10 (Nov 16th): **(Reading week)** surface integrals continued.

Week 11 (Nov 21st - 23rd): gradient, divergence, curl (CLP4: 4.1); **Second midterm in class Nov 23rd.**

Week 12 (Nov 28th -Nov 30th): the divergence theorem, Green's theorem, Stokes' theorem (CLP4: 4.2,4.3, 4.4)

Week 13 (Dec 5th -Dec7th): Differential Forms (CLP4: 4.7); review

Final exam: TBD

Math 217: Learning Goals

A student successfully completing Math 217 (Fall 2023) should:

• understand vector functions of one variable, their use in describing space curves (their tangent vectors, lengths), and in describing motion in space (position, velocity/speed, acceleration)

• be able to recognize the equations of and roughly sketch simple surfaces such as planes, spheres, ellipsoids, paraboloids and hyperboloids

• understand functions of several variables, their domains, ranges, graphs, level curves/surfaces, limits, and continuity

• understand the de_nition, computation, and interpretation of partial derivatives; their relation to the tangent plane and their role in linear approximation; higher partials and equality of mixed partials

• know and be able to use the various forms of the chain rule for functions of several variables

• know the gradient vector and its meaning, and its relation to level curves/surfaces and to directional derivatives

• be able to _nd local and global maximum and minimum values of functions of several variables, and use Lagrange multipliers for constrained problems

• understand the de_nition and simple applications (volumes, centres of mass) of double and triple integrals, and be able to compute them as iterated integrals using rectangular, polar, cylindrical or spherical coordinates

• know what vector _elds are and how to represent them graphically

• know how to to compute line integrals of functions (with respect to arc length or one of the coordinates) and vector _elds, by parameterizing the curve

• know what conservative vector _elds are, how to detect them using curl (or its 2D version), the path-independence property of their line integrals, and the fundamental theorem for line integrals

• understand parametric surfaces, their normals and surface areas, and how to compute surface integrals of (scalar) functions and vector _elds by parameterizing the surface

• know how to compute the curl and divergence of a vector _eld, the basic calculus of div, grad, and curl (eg. product rules with dot or cross products, etc.), and that curl grad = 0 and div curl = 0

• understand the statements of the theorems of Green, Stokes, and Gauss (divergence) and be able to use them to compute/relate line, surface, and double/triple integrals

• understand the basics of di_erential forms in R^3. Namely, wedge product, exterior di_erentiation, and the dictionary between these concepts and the usual notions from vector calculus (functions, vector _elds, dot product, cross product, gradient, curl, and divergence). Understand the statement of the generalized Stoke's theorem in this context.