MATH 102 course outline - hardcopy summary

From UBCMATH WIKI

Course overview

As with any course on differential calculus, the central character in this course is the derivative. The course starts by building up to the limit definition of the derivative and proceeds through analytical, graphical and numerical approaches to build students' understanding of several types of functions and their derivatives. Next, we cover optimization, with applications to biological systems as well as principles of data fitting. A section on growth, decay and periodic phenomena precedes an introduction to differential equations and their use in modeling of biological systems.

One big difference between this course and a more traditional calculus course is the inclusion of examples and applications from the life sciences in place of the more traditional emphasis on physics. These examples and applications come from a wide range of fields including biochemistry, cell biology, ecology, genetics, population biology and evolution.

Course policies

Prerequisites

See the UBC Calendar entry for Math 102 (http://www.calendar.ubc.ca/vancouver/courses.cfm?code=MATH#102) for course prerequisites. If you do not satisfy the course prerequisites, you may find yourself automatically de-registered from the course once the term begins. The fact that you were able to register does not mean you satisfy the prerequisites!

Marking scheme

- Assignments 20%
- Midterms 30% (two midterms worth 15% each)
- Final exam 50%

The assignment grade consists of two components: solutions to problems submitted through the WeBWorK system (15%), and solutions to problems that are submitted on paper (5%). Each problem submitted to WeBWorK is given equal weight and your total WebWork score will be counted out of 95% of the total number of WeBWork problems. Thus, if there are a total of 300 WeBWork problems this term, you can get 15 of them wrong and still get the full 15% allocated to WeBWork problems. This is not intended as a point give-away. It is intended to account for the fact that, early in the semester, you will take some time to master using WeBWorK and we do not have the resources to evaluate every request for accommodation for every technical glitch you run into.

A minimum mark of 44% on the final exam is required to pass the course, independent of all others marks in the course.

Independent work

You are encouraged to work in groups on homework assignments although independent effort is also crucial to learning. However, any misrepresentation of another person's work as your own is considered to be academic dishonesty. In particular, directly copying someone else's homework will be treated as a violation of UBC's Academic Integrity Code. See the UBC regulations of plagiarism (http://vpacademic.ubc.ca/integrity/ubc-regulation-on-plagiarism/) for details.

Midterm absences, late or non-existent homework

If you are unable to attend one of the midterms, you must notify your instructor by Sept. 23 with a legitimate reason or provide professional documentation of any medical emergency etc. within two days of the exam date. In either of these two cases (and only in these two cases), suitable accommodations will be made. (Generally, your final exam grade will be used in place of the missing midterm grade.) Undocumented absence from the midterm will be given a score of zero.

No midterm rewrites will be granted.

No late homework will be accepted.

Final exam regulations

For a full description of the final exam regulations, see the UBC Calendar page on Student Conduct during Examinations (http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,41,90,0) . In particular, note, calculators, cell phones and other electronic devices are strictly prohibited from use during the exam. This includes use of cell phones for checking the time. The same regulations apply for the midterms.

Registration

Add/drop forms must be brought to the math department office. The instructor's signature is neither sufficient nor necessary on an add/drop form. See the Mathematics Department registration information page (http://www.math.ubc.ca/Ugrad/ugradRegistration.shtml) for more information.

Re-marking requests

If you feel that a returned homework assignment or midterm is incorrectly marked, you can appeal that mark by writing a note that details your concern, attaching it to the assignment, and resubmitting it to the instructor within one week of the return of the marked assignment. The note should include a summary of what you feel was incorrectly evaluated with some justification of the claim.

Course calendar

	Date	Topic	Notes	Videos
Week 1	Sep 3	Cell size: volume, area. Power functions.	Sec 1.1-1.2	link
	Sep 5	Power functions (cont). Sketching simple polynomials (y=x^3-ax). Example of graphing with spreadsheet.	Sec 1.1, 1.4,1.6	link
Week 2	Sep 8	Sketching simple polynomials (cont). Rational functions, Michaelis-Menten and Hill functions, "limits" at infinity. **OSH 1 due!** (Section 105, due Tuesday.)	Sec 1.4, 1.5	link

	Sep 10	Average rate of change and secant lines. Definition of the derivative. Instantaneous rate of change.	Sec 2.2-2.5	link
	Sep 12	Limits and continuity, examples. One example of computing derivative of $y = ct^2$ from the definition.	Sec 2.5, Sec 3.2, Appendix D.	link
Week 3	Sep 15	Derivatives: analytic, and geometric (zoom in on a point). Sketching $f'(x)$ given $f(x)$ (intro). **OSH 2 due!** (Section 105, due Tuesday.)	Sec 3.1-3.2	link
	Sep 17	Derivatives (cont): computational (spreadsheet example in class). More examples of sketching $f'(x)$ given $f(x)$ (intro).	Sec 3.2-3.3	link
	Sep 19	Rules of differentiation: Product and quotient rules. Antiderivatives of power functions. Application to falling ball, motion of Listeria. Sketching $f(x)$ given $f'(x)$ (intro).	Chap 4	link
Week 4	Sep 22	Tangent lines and linear approximation.	Chap 5	link
	Sep 24	Introduction to Newton's method. Sketching the graph of a function using calculus tools: increasing, decreasing, critical points.	End of Chap 5, Sec 6.1	link
	Sep 26	Sketching the graph of a function using calculus tools (cont): concavity and inflection points.	Sec 6.2-6.3	link
Week 5	Sep 29	Putting it all together - sketching. **OSH 3 due!** (Section 105, due Tuesday.)		link
	Sep 30	**MIDTERM 1: 6-7 pm**		
	Oct 1	Finish sketching functions. Introduce simple optimization problem(s).	Sec 6.3-6.4, 7.1	link
	Oct 3	More optimization examples including those with a constraint and those on bounded intervals. Distinction between absolute (global) and local minima and maxima.	7.1-7.3	link
Week 6	Oct 6	Kepler's Wedding - A wine optimization problem.	Sec 7.2	link
	Oct 8	Optimal Foraging.	Sec 7.4	link
	Oct 10	Least Squares - finding the mean of a data set.	Wiki	link
Week 7	Oct 13	THANKSGIVING - no classes.		link
	Oct 15	Least Squares - finding the best fitting line y=ax through a set of data points. **OSH 4 due!** (Section 105, due Tuesday.)	Wiki	link
	Oct 17	Chain Rule: examples, applications to optimization problems.	Chap 8	link
Week 8	Oct 20	More Chain Rule: Related Rates and Implicit differentiation.	Chap 9	link
	Oct 22	Exponential functions: intro and motivation, derivative of exponential functions.	Sec 10.1-10.2	link
	Oct 24	Inverse functions and logarithm, applications of logs.	Sec 10.3-10.4	link
Week 9	Oct 27	Exponential growth and decay, intro to differential equations, population growth and/or other examples. **OSH 5 due!** (Section 105, due Tuesday.)	Sec 11.1-11.2 or 11.3	link
	Oct 29	Solving differential equations of the type $dy/dt = a - by$.	Sec 12.1-12.3	link
	Oct 31	Newton's Law of Cooling (Murder Mystery example).	Sec 12.4	link
Week 10	Nov 3	Complete and/or review above topics.	Chaps 11-12	link

	Nov 4	**MIDTERM 2: 6-7 pm**		
	Nov 5	Solving differential equations approximately using Euler's Method.	Sec 12.4	link
	Nov 7	Go over midterm. Introduction to nonlinear ODEs, qualitative analysis.	Sec 13.1	link
Week 11	Nov 10	Slope fields with logistic equation as example. **OSH 6 due!** (Section 105, due Thursday.)	Sec 13.2	link
	Nov 11	Remembrance Day. University closed.	Sec 13.2	link
	Nov 12	State-space diagrams and examples (logistic).	Sec 13.2	link
	Nov 14	Disease dynamics	Sec 13.3	link
Week 12	Nov 17	Review of differential equations and/or complete above topics.	Chaps 11-13	link
	Nov 19	Introduction to Trigonometric Functions.	Sec 14.1-14.2	link
	Nov 21	Trigonometric Functions and cyclic processes, phase, amplitude, etc. (fitting a sin or cos to a cyclic process), Inverse trig functions.	Sec 14.2-14.3	link
Week 13	Nov 24	Derivatives of trig functions, related rates examples. **OSH 7 due!** (Section 105, due Tuesday.)	Sec 15.1-15.2	link
	Nov 26	The Escape Response and inverse trig functions.	Sec 15.3	link
	Nov 28	Second order ODEs. Complete and/or review trig.	Sec 15.4	link

Course notes

These course notes were written by Prof. Leah Keshet (UBC Math) and are based on material taught in Math 102 over several years. They are being updated over time. These notes are provided for all interested in learning. Copyrights are reserved by Keshet. Last update: August, 2013.

An updated version of the course notes will appear here soon!

Hard copies

You can buy a printed paper copy of this material from Copiesmart (http://copiesmart.com/) on University Boulevard.

Address: Copiesmart, #103 5728 University Blvd. Tel: 604-222-3189, 604-222-3194.

Additional references

- Stewart's *Calculus: Early Transcendentals* is available at the UBC bookstore and can be found secondhand as it is used for a number of other first year calculus courses on campus. It does not cover all the topics we cover in this course and covers some topics we do not cover but there is a significant overlap and, for some topics, especially the basic ones, you might find useful worked examples.
- Paul's online notes (http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx) , written by Prof. Paul Dawkins (http://www.math.lamar.edu/faculty/dawkins/dawkins.aspx) at Lamar University (http://www.lamar.edu/) provides a good, free and online resource for a standard calculus course.

Supplements

- Fitting data - least squares
- Optimal foraging