S311 - Honors Calculus III - Syllabus

Instructor: Elizabeth Ann Housworth

Text: Vector Calculus, Linear Algebra, and Differential Forms: A Unified Approach by Hubbard and Hubbard

Class: 9:05-9:55 am in SE 010

Office: Rawles Hall 371

Office Hours: Mondays 10:10-11 am, Wednesdays 8-8:50 am, Sundays 1-2 pm and by appointment

Important Dates: Last Date for Automatic Withdrawal is Wednesday, October 24.
Our Final Exam is 8-10 am on Wednesday, December 13.

Cheating Policy: No cheating will be tolerated on any exam. Any suspected cheating will be confronted, and, if I believe it has occurred, will result in your failing the course. You will have the opportunity to appeal through the Dean.
You may discuss the homework with each other but your write-ups of the assignments should be your own work. Thus, while I might expect to see similar proofs from you, I do not expect to see the same proof verbatim on several write-ups. Since there is a grey area between acceptable and unacceptable assistance, I will first provide warnings that you are stepping over the line, followed by refusing to accept a given homework assignment if the problem continues, followed by dropping your grade in the course by a letter, followed by failing you in the course. I do not want to discourage you from talking to each other about the assignments and proofs but I do want you to write up the results on your own.

Substitute: I expect to give birth sometime between October 11 and November 8. At that time, Nets Hawk Katz will substitute for me for up to six weeks. His office is Rawles Hall 232 and he will provide you information about his office hours when he starts subbing for me.

Mathematics Club: The department's mathematics club sponsors talks of interest to undergraduates, provides information about internships and undergraduate research experiences in mathematics, and encourages participation in mathematics competitions. More information, including contact information is available at: http://www.math.indiana.edu/programs/undergrad/mathclub/
This year's organizational meeting for the math club is on Wednesday, August 29 at 7 pm in the lounge of the mathematics department on the first floor of Rawles Hall.

Putnam Class: Math 491 is offered every Fall and you may enroll in it several times, I believe. It is a problem solving class designed to prepare students for the Putnam Exam, a prestigious college mathematics exam. Only about 50% of students who take the Putnam receive a positive score on the exam, but there are tricks and techniques that the Putnam seminar class teaches that can prepare you to do better than average on the exam.

Grading:

Homework	25%	generally due on the day after it is assigned
Exam 1	15%	
Exam 2	15%	
Exam 3	15%	
Final Exam	30%	

Week	Day	Sections	Topics	Homework
August 27 - 31	1	0.3-0.4	Introduction, set theory, 1-1 and onto functions	0.3.1, 0.4.4, 0.4.5
	2	0.1-0.2	Logic, negation, proofs, Greek	0.2.1, Find the contrapositive to the statement "If every subsequence of a given sequence has in turn a subsequence which converges to a number L, then the sequence itself converges to L."
	3		How to write proofs, strategies for constructing proofs, etc...	0.4.8, 0.4.10
	4	0.5	Least upper bound, emphasis on proofs, ideas, and writing	Re-write the proof of Theorem 0.5.3 for the case $-1 \leq x < 0$
September 3-7	1	0.5	Sequences, series, convergence, geometric series, intermediate value theorem	0.5.1, 0.5.3
	2	0.5	Work on 0.5.2 and 0.5.4 in class in groups	0.5.2, 0.5.4
	3	0.6	Cardinality - work 0.6.1 in class	0.6.2, 0.6.3
	4	1.1	Vectors and points	1.1.1, 1.1.4, 1.1.6(a, b, d, h)
September 10-14	1	1.2	Matrices omitting applications to probability and graph theory. Also, I will ignore Hubbard and Hubbard's strange way of formatting matrices for multiplication and simply write them side-by-side.	1.2.3, 1.2.6 (b, c, j, k, l), 1.2.8, 1.2.23
	2	1.3	Linear transformations = matrix multiplication	1.3.4, 1.3.7, 1.3.9, 1.3.10
	3	1.3	Linear transformations - geometry, composition, invertibility	1.3.11, 1.3.12, 1.3.14, 1.3.19
	4	1.4	Geometry of $\mathbb{R}^n$ - length, dot products, triangle inequality, Schwarz's inequality, length of a matrix	1.4.2, 1.4.4, 1.4.10
September 17-21	1	1.4	Geometry of $\mathbb{R}^n$ - determinants, cross products	1.4.9, 1.4.12, 1.4.14, 1.4.22
	2	1.5	Open sets, neighborhoods, closure, interior, boundary, convergence, limits	1.5.1, 1.5.3, 1.5.6
	3	Review/ Catch-up day		
	4	Exam 1 on Sections 0.1 - 1.4		

Week	Day	Sections	Topics	Homework
September 24-28	1	1.5	Convergence, limits, subsequences, functions, continuity	1.5.13, 1.5.16, 1.5.18
	2	1.5	Uniform continuity, matrices	1.5.10
	3	1.6	Every sequence in a compact set has a convergent subsequence	Suppose a sequence $x_1, x_2, ...$ in a compact set $C \subset \mathbb{R}^n$ does not converge. Show that there are two subsequences $x_{i(1)}, x_{i(2)}, ...$ and $x_{j(1)}, x_{j(2)}, ...$ that converge to distinct limits in C.
	4	1.6	Existence of maxima and minima	1.6.2, 1.6.6
October 1-5	1	1.6	Mean Value Theorem and the Fundamental Theorem of Algebra (without proof)	1.6.7, Let $f : \mathbb{R} \to \mathbb{R}$ be continuous on $[a, b]$ and differentiable on (a, b). Show that if the derivative is positive on (a, b) then the function is increasing on $[a, b]$.
	2	1.7	Derivatives, linear approximations, partial derivatives, alternative definition, Jacobian	1.7.5, 1.7.6
	3	1.7	Jacobian, alternative definition, Differentiability implies continuity, directional derivatives. Skip functions of matrices examples.	1.7.11, 1.7.13, 1.7.19
	4	1.8	Rules for derivatives, the chain rule	1.8.2, 1.8.6
October 8-12	1	1.9	Mean Value Theorem and pathological functions	The line from **a** to **b** in U is just one possible curve connecting to two points in U. Formulate and prove a mean value theorem along other kinds of curves from **a** to **b** in U.
	2	1.9	Pathological functions and criteria for differentiability	1.9.1, 1.9.2 (a)
	3	2.1-2.2	Row reduction and solving equations	2.2.2, 2.2.5, 2.2.10
	4	2.2-2.3	Solving equations, matrix inversion, and elementary matrices	2.3.3(b), 2.3.7, 2.3.13
October 15-19	1	2.4	Span and linear independence	2.4.2(b), 2.4.4, 2.4.8
	2	2.4	Linear independence, basis, dimension	2.4.2(a), 2.4.3, 2.4.10, 2.4.12
	3	Review/Catch-up day		
	4	Exam 2 on sections 1.5 - 2.3		

Week	Day	Sections	Topics	Homework
October 22-26	1	2.5	Kernels, images, rank, dimension formula, interpolation (skip partial fractions)	2.5.1, 2.5.3, 2.5.6, 2.5.9
	2	2.6	Abstract real vector spaces, linear transformations, independence, span, basis	2.6.2, 2.6.7
	3	2.6	Abstract real vector spaces, change of basis and dimension	2.6.4, 2.6.8
	4	2.10	Inverse Function Theorem - statement, examples	2.10.1, 2.10.2
October 29 - November 2	21	2.10	Inverse Function Theorem - proof following Spivak	2.10.3
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	3	2.10	Implicit Function Theorem - statement and examples	2.10.5, 2.10.7
	4	2.10	Implicit Function Theorem - proof following Spivak	2.10.8, 2.10.9
November 5-9	1	3.1	Manifolds - definition, examples, pictures	3.1.2, 3.1.5
	2	3.1	Manifolds - implicit function theorem and independence from coordinates	3.1.7, 3.1.10
	3	3.1	Manifolds - parameterizations	3.1.11, 3.1.12
	4	3.2	Tangent spaces	3.2.1, 3.2.3, 3.2.9
November 12-16	1	3.3	Taylor polynomials	3.3.3, 3.3.9, 3.3.13
	2	3.4	Rules for computing Taylor polynomials	3.4.2, 3.4.3, 3.4.4
	3	Review/Catch-up day		
	4	Exam 3 on sections 2.4-3.2		
November 19-23	1	3.5	Quadratic forms, sums of squares, signature	3.5.3, 3.5.5, 3.5.6
	2	3.5	Quadratic forms, positive definite, rank, symmetric matrices	3.5.4, 3.5.7
	Thanksgiving Break			
November 26-30	1	3.6	Classifying critical points	3.6.2, 3.6.5, 3.6.7
	2	3.7	Constrained optima, parameterizations, substitution	3.7.1, 3.7.8
	3	3.7	Lagrange Multipliers - omitting the spectral theorem	3.7.5, 3.7.6
	4	3.8	Planar curves and curvature	3.8.1, 3.8.2, 3.8.8
December 3-7	1	3.8	Curves in $\mathbb{R}^3$, curvature, torsion, normal and tangential components to acceleration, Stewart 13.4 on e-reserves	Stewart 13.4.34, 13.4.40
	2	3.8	Supplementary material on Kepler's Laws, see course e-reserves	no homework
	3	3.8	Supplementary material on Kepler's Laws, see course e-reserves	no homework
	4	Review		
Final Exam 8-10 am Wednesday, December 13				