MATH 251 SECTION 01
– MULTIVARIATE & VECTOR CALCULUS –
FALL 2017

Meeting: MWF 11:25–12:40
Classroom: Robert A. Pritzker Science Center, Room 240
Instructor: Dr. Benjamin ("Ben") Reiniger
Office: 110 Rettaliata Engineering Building
Email: breiniger@iit.edu (please include "Math251" in your subject lines)
Website: Blackboard, WebAssign, Piazza;
materials from Blackboard will be archived to www.math.iit.edu/∼breiniger/teaching/17Fall
Office Hours: TBD
I can often accommodate additional office hours by appointment.

General Information: This class extends the ideas in Calculus 1 to higher dimensions. We start by learning about higher-dimensional (analytic) geometry and higher-dimensional functions (which come in two flavors: multivariate and vector-valued). Then we consider derivatives and integrals involving these creatures, and their applications.

Text: James Stewart, *Multivariable Calculus Hybrid Edition*. WebAssign access is bundled with this Hybrid editions; if you have a non-hybrid version, a used textbook, or you had access that has now expired, then you will need to purchase WebAssign access separately. You may also purchase just the WebAssign access and use the eBook it provides.

Course Objectives:
- Geometry of vectors and space (Chapter 12)
  - Operations: compute and interpret sums, scalar multiples, dot products, cross products, and projections of vectors in the plane or in space
  - Objects: describe points, lines, planes, spheres, and other surfaces using equations, vectors, set notation, or geometric objects of a different kind
- Parametric curves (Chapter 13)
  - Parametrization: find parametrizations of lines, circles, and other curves
  - Calculus: compute and interpret the limit and derivatives of a vector-valued function; understand and compute Frenet frames and curvature; apply these in a physics context
- Multivariate functions (Chapters 14, 15)
  - Visualization: sketch or predict appearance of the graph of a function or curve based on a formula or other description; sketch or describe level sets of a function
  - Limits: understand and compute limits of functions of more than one variable; determine continuity
  - Derivatives: compute and interpret partial derivatives and gradient of a function of 2 or 3 variables; apply and explain equality of mixed partial derivatives, including sufficient conditions for such equality to hold
  - Linearization: find tangent vectors, tangent lines, and tangent planes; understand the definition of differentiability; approximate curves and surfaces near a point
  - Optimization: use higher derivatives to collect data about shape of the graph of a function; classify critical points; use Lagrange multipliers; understand and use the Extreme Value Theorem for multivariate functions

  - Integral Calculus: accurately describe regions over which double or triple integrals are computed; perform calculations of double or triple integrals; apply and justify change-of-coordinate formulas, including spherical coordinates
- Vector fields (Chapter 16)
  - Visualization: sketch or predict appearance of a vector field
  - Derivatives: compute and interpret divergence and curl of a vector field
- Line and surface integrals (Chapter 16)
  - Parametrization: find parametrizations of planes, spheres, and other surfaces
  - Integration: compute line or surface integrals of scalar and vector fields; understand the components of such integrals; use these methods to find length, area, work, and flux
- Classical theorems (Chapter 16)
  - Integrability conditions: check conditions for a vector field to be irrotational or divergence-free, and explain the meaning of these conditions; find potential functions
  - Generalizations of FTC: explain the meaning and significance of Green's Theorem, Divergence Theorem, and Stokes's Theorem; use these to convert integrals between various forms, especially to make computation easier

Grading: Your course grade will be obtained roughly as follows:

- WebAssign: 18%
- PaperAssign: 10%
- Exam 1: 12%
- Exam 2: 15%
- Exam 3: 15%
- Final Exam: 30%

"PaperAssign" may consist of written homework, quizzes, or other projects.
The assignment of letter grades will be no more strict than the standard 10 point scale.
Grading of all written work is based on the following criteria:

- Content: correctness of the mathematical ideas.
- Style: the explanations of your work, where applicable.

Written work will be returned graded and commented. If you have any questions or concerns about the grade or comments, contact me within a week for clarification/regrade.

Late & missed work: Late WebAssign submissions are dealt with automatically in WebAssign: you may request an extension within one week of the deadline, after which you will have two days to submit new work for up to 70% of the missed score. Other late assignments will not be accepted, and quizzes will not be excused. Your two lowest WebAssign grades (and likely some lowest PaperAssign grades) will be dropped to accomodate for illness or other unexpected disruptions. If you need to miss an exam, advance notice is vastly superior; if official documentation is provided, a conflict exam will be provided.

Homework: Homework will primarily be assigned in WebAssign (which will most often be due two class meetings after we have finished discussing a section), but some written assignments will also be given.
You are encouraged to work on homework in whatever groups you like. (I suggest meeting in groups of 3 or 4.) However, it is your responsibility to ensure that you understand the concepts and methods presented or reinforced by the homework. To this end, **all written homework must be composed individually**. (You may discuss the problems as much as you wish before, but when writing your solutions it must be done on your own.) Quizzes and exams will not allow calculators, so I recommend not using one on the homeworks either except to check your work.

Quizzes & Exams: We will have three exams during the semester as well as a comprehensive final exam, and there may be several quizzes throughout the semester. Quizzes and exams will be taken without the aid of calculators and other electronic devices, notes, or classmates.
Exam dates may change, but expect them around Sept. 18, Oct. 11, and Nov. 1.

For help:

- Me! In-class, office hours, Piazza, email, ...
- Applied Math TAs in RE129
- Academic Resource Office, arc.iit.edu

Attendance Policy: You are expected to attend every class meeting. If you miss a meeting, you are responsible for catching up on the material.
For University-excused absences, contact me to determine appropriate accommodations. Remember that you are responsible for all information that you miss; find a friend who has the notes.
(See also §"Late & missed work.")

Disabilities: Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources. Please also make an appointment with me to discuss implementation of accommodations. If you will be taking an exam outside of normal class hours, I need at least 5 business days' notice to accommodate you.

Academic Integrity: Academic Integrity may be summed up by the phrase, "your work must be your own." Violations will be processed according to the established guidelines. Please note that it is a violation "to engage...in a course of action that would cause a reasonable student to conclude a violation...would be the likely result". A range of academic sanctions may be taken against a student who engages in academic dishonesty. Please see Article I of the Handbook for additional information and procedures.

Decorum: During our meetings you should be respectful of everyone's time. Please silence cell phones. I don't mind if you bring food, but do so in a way that is not distracting to others. Late arrivals and early departures are also disruptive.

Feedback: You will have several opportunities during the semester to provide feedback on this class. Please make use of these opportunities, and have thoughtful comments ready. You don't need to wait for these opportunities: if you have suggestions/questions/comments, please let me know.

I look forward to working with all of you this semester. Good luck!