INSTRUCTOR: Prof. Dr. rer. nat. Henri Schurz
Office: Neckers 265, Telephone: (618) 453-6580, E-mail: hschurz@math.siu.edu

OFFICE HOURS: MWF 9:00am-11am or by appointment

PREREQUISITES: 4 years high school math including trig, and C+ in Calculus I+II (Math 150 + 250)
or replacement exam as permission of the department.

It is crucial that you have a good working knowledge of high school math including facility with basic algebraic,
manipulations, knowledge of analytic geometry of straight lines, similar triangles, trig functions, and exponential functions.

Do you know how to simplify \((3^{\frac{1}{2}})^{3}\) and \(3^{\frac{3}{2}}\)? How about \(\sin^2(\theta) + \cos^2(\theta)\) and \(\tan^2(\theta) - \sec^2(\theta)\)?

Do you know how to find solutions of \(x^2 - x - 2 = 0\) or, in general, the roots of \(Ax^2 + Bx + C\)?

How about the table of standard derivatives and antiderivatives?

TEXT: Essential Calculus: Early Transcendentals (Chapters 10, 11, 12, 13, up to 13.6)

LECTURES: Mon-Wed-Fri 8:00am-8:50am in Neckers 156

GRADER and TEACHING ASSISTANT: Mr. Luke Yang (hzyang2@siu.edu)

HOMEWORK and QUIZZES: Homework sets and quizzes will be arranged and announced in classes.

EXAMS: 2 Midterms: (during classes)
- Exam 1: Friday, March 4 (TBC)
- Exam 2: Friday, April 8 (TBC)

Final Exam: NECKERS 156, Wed, May 11, 8-10am (to be confirmed)

GRADING POLICY:
The course grade will be computed according to the following equi-weighting system (assuming a grader for HW):

- Homework and Quizzes: 25 % Midterm Exams: 50 % total Final Exam: 25 %
- Typically, the distribution of the final exam grades is approximately 10 % A, 25 % B, 45 % C, 20 % D and F.
- The overall grade is determined by the total collected points TSUM as follows:
  - \(F : TSUM < 45\%\), \(D : TSUM \geq 45\%\), \(C : TSUM \geq 60\%\), \(B : TSUM \geq 75\%\), \(A : TSUM \geq 90\%\)

INCOMPLETES:
The grade I ("incomplete") shall be assigned at the instructor's discretion when, due to extraordinary, documented
circumstances (like hospitalization), the student was prevented from completing the entire course. Inform the instructor
as soon as possible if something occurs which makes you think you should receive an incomplete.

At the time the incomplete is granted the student should have completed the majority of the course with a passing grade.

An agreement must reached between student and lecturer on the manner in which the incomplete will be removed.

CALCULATORS:
Hand-held calculators (like TI 86 - TI 96) and lap-top computers cannot be used during midterm exams in this course.
Since the matching of numerical data is no longer the final goal for students to do homework or finish exam questions, in this
course, reasonably, conceptually understanding of the course work must be emphasized. Students must realize that calculators
are useful tools for numerical computations, but not so for logical thinking and conceptual understanding of the course work.

COVERAGE FOR MATH 251: (tentative pace)

Weeks Sections to be Covered
1-2 Introduction, Chapter 10
3-4 Chapter 10-11
5-6 Chapter 11, Midterm I
7-8 Chapter 11-12
9-10 Chapter 12
11-12 Chapter 12-13, Midterm II
13-14 Chapter 13
15-16 Chapter 13, Review for Final

Some topics as quadric surfaces (10.6), Kepler's laws (10.9), linear differentials (11.4) are omitted (13.7.-13.9. too).

OBJECTIVES:
To acquaint the student of science, engineering or mathematics with the fundamental concepts of multi-variable calculus,
To learn about basic techniques and applications of vectors: algebra, limits, derivatives, integrals, series
To calculate dot and cross products, equations of lines, tangents in space
To introduce partial derivatives, multiple integrals, and fundamental theorems of vector calculus

OVERVIEW (Course Description):
This course is the 3rd part of a three semester course on Calculus, meant to be an elementary introduction to basic aspects
of vectors and multi-variable functions. Calculus is a very large field, and we will certainly not be able to cover all of the
important techniques in a one or two-semester course. A preliminary list of topics covered includes dot and cross products,
angle between vectors, equations of lines and planes, derivatives and integrals of vector-valued functions, particle motions,
velocity, acceleration, speed, first and higher order partial derivatives, chain rule, directional derivatives, tangent plane and,
YOUR TASK: Help us to help you! Ask questions (and also in lecture) when something in the course is giving you trouble.

The job of the lecturer is to give the "big picture" and to work on sample problems.

Your job is to go over the homework problems, come to all classes and exams, read through the text, listen carefully, and try to clear up difficulties and misunderstandings. Your active participation is needed!

MISSED EXAMS and MAKE-UPS:

Make-ups are only allowed when the student has a well documented reason of missing an exam.

That well documented reason must be indicated and shown to the lecturer before the exam takes place.

There is NO make-up on missed homeworks or quizzes.

Late turned in homeworks are usually not accepted (unless there is a reason beyond your control).

WITHDRAWALS: Last Day to drop with refund is Friday, January 31. Withdrawals with a 'W' on your transcript with no refund can be made till April 3. (Last day to register is Sunday, January 24) (All Dates by SALUKINET, TBC)

FREE TUTORING (TBC): in College of Science Study Area - Sunday 7-9pm & Monday - Thursday 4-9pm

HOMEWORK & QUIZZ PROBLEMS (MATH 251, Spring 2016): (TBC, Only Hardcopies accepted)

Week 1: Sec. 10.1.: 2, 8a, 10, 16, 28 — 10.2.: 4, 6, 8, 18, 18 (due on 01/29/16)
Week 2: Sec. 10.3.: 2, 8, 14, 18, 44 — 10.4.: 2, 4, 8, 16, 44 — 10.5.: 2, 4, 18, 48, 50
Week 3: Sec. 10.6.: 4, 6, 8, 28, 30 — 10.7.: 2, 4, 14, 48, 60 — 10.8.: 2, 14, 16, 34, 36
Week 4: Sec. 10.9.: 2, 8, 12, 18, 22 — 11.1.: 2, 4, 18, 32, 50 — 11.2.: 4, 8, 22, 30, 32
Week 5: Sec. 11.3.: 8, 14, 18, 62, 66 — 11.4.: 2, 14, 22, 26, 16 — 11.5.: 2, 6, 18, 34, 38
Week 6: Sec. 11.6.: 2, 4, 10, 18, 24 — 11.7.: 4, 10, 18, 26, 40
Week 7: Sec. 11.8.: 2, 12, 16, 38, 44 — 12.1.: 2, 8, 18, 24, 28
Week 8: Sec. 12.2.: 2, 8, 18, 26, 38 — 12.3.: 4, 6, 10, 24, 28
Week 9: Sec. 12.4.: 2, 4, 8, 14, 22 — 12.5.: 2, 4, 12, 22a, 40
Week 10: Sec. 12.6.: 2, 4, 10, 22, 28 — 12.7.: 2, 4, 8, 10, 22
Week 11: Sec. 12.8.: 2, 6, 10, 12, 20 — 13.1.: 2, 22, 24, 26, 28, 30
Week 12: Sec. 13.2.: 2, 4, 10, 20, 34 — 13.3.: 2, 8, 12, 18, 20
Week 13: Sec. 13.4.: 2, 4, 8, 14, 18 — 13.5.: 2, 6, 16, 22, 28
Week 14: Sec. 13.6.: 4, 16, 32, 34, 40 — 13.7.: 2, 8, 16, 24, 38
Week 15: Sec. 13.8.: 2, 4, 8, 12, 13 — 13.9.: 4, 6, 18, 24, 26

SOME FURTHER ADVICE: Don't get behind. The course is cumulative and the speed of lectures is much higher than at high school level. What you didn't understand in week three will haunt you for the rest of the course. Your success in the course depends to a large extent on the number of exercises you work out. The more exercises you do better you will learn the material. There are quite a number of homework problems assigned. You might not have time to do them all. If you have time it is a good idea to also try doing some problems which are not assigned. Some problems not assigned might turn up on quizzes, hour exams, or the final exam. Make use of office hours of the lecturer (me!), if you are unable to meet during regular office hours, make arrangements to meet at another time.

Week 16: Sec. 13.6.: 2, 4, 10, 20, 34 — 13.7.: 2, 8, 16, 24, 38
Week 17: Sec. 13.8.: 2, 4, 8, 12, 13 — 13.9.: 4, 6, 18, 24, 26

SOME FURTHER ADVICE: Don't get behind. The course is cumulative and the speed of lectures is much higher than at high school level. What you didn't understand in week three will haunt you for the rest of the course. Your success in the course depends to a large extent on the number of exercises you work out. The more exercises you do better you will learn the material. There are quite a number of homework problems assigned. You might not have time to do them all. If you have time it is a good idea to also try doing some problems which are not assigned. Some problems not assigned might turn up on quizzes, hour exams, or the final exam. Make use of office hours of the lecturer (me!), if you are unable to meet during regular office hours, make arrangements to meet at another time. If things are going badly you might discuss the reasons and improvements with your lecturer in detail. If you have had a strong grasp of calculus in high school the first weeks may seem very easy. But this is deceptive, and there is the distinct danger that overconfidence will lead to disaster.

The Mathematical Life of the Well Organized and Well Prepared Student:

Goes to all lectures; listens carefully; makes notices; tries to understand the professor Does assignment and works through the notes (textbook, etc.) the same day Makes a note what is not understood, ask questions (there is no stupid question!) Gets uncertainties resolved after lecture or the next day by the professor or other sources Carefully reviews for exams; outlines material; works on representative problems ON-LINE HELP RELATED TO CALCULUS: You can make use of the following webpages

SPRING BREAK: March 12-20

EMERGENCY PROCEDURES: Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on BERT's website at www.bert.siu.edu, Department of Safety's website www.dps.siu.edu (disaster drop down) and in Emergency Response Guideline pamphlet. Know how to respond to each type of emergency.

It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.
### Henri Schurz's Symbol Page of the Course

**Calculus III, Math 251, Southern Illinois University**

**Last Update: 08/18/2011**

**Instructor:** Henri Schurz  
**Office:** Neckers 265  
**Office Phone:** 453-6580

I'll try to condense the most important math symbols in just one page.

#### Most Commonly Used Mathematical Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Verbal Meaning</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\emptyset$</td>
<td>empty set</td>
<td>$\emptyset = { }$ a week has 8 days</td>
</tr>
<tr>
<td>${a, b, c}$</td>
<td>a set with elements $a$, $b$, $c$</td>
<td>${2, 4, 6, 8, \ldots}$, ${A, B, C, \ldots, Z}$</td>
</tr>
<tr>
<td>$+\infty$</td>
<td>infinity</td>
<td>$+\infty$, $-\infty$</td>
</tr>
<tr>
<td>$\forall$</td>
<td>for all</td>
<td>$\forall x &lt; +\infty$</td>
</tr>
<tr>
<td>$\exists$</td>
<td>it exists, there is, there exists</td>
<td>$a \in A, \omega \in \Omega, 1 \in \mathbb{N}, y \in {x, y, z}$</td>
</tr>
<tr>
<td>$\mathbb{N}$</td>
<td>set of positive integers including $0$</td>
<td>$\mathbb{N} = {0, 1, 2, \ldots}$ (natural numbers)</td>
</tr>
<tr>
<td>$\mathbb{Z}$</td>
<td>set of all integers</td>
<td>$\mathbb{Z} = {0, \pm 1, \pm 2, \pm 3, \ldots}$</td>
</tr>
<tr>
<td>$\mathbb{R}$</td>
<td>set of all real numbers</td>
<td>$\mathbb{R} = (-\infty, +\infty)$</td>
</tr>
<tr>
<td>$\mathbb{R}^d$</td>
<td>set of all $d$ dimensional vectors $x = (x_1, x_2, \ldots, x_d)$</td>
<td>$\mathbb{R}^d = {x : x = (x_1, \ldots, x_d), x_i \in \mathbb{R}}$</td>
</tr>
<tr>
<td>$\mathbb{Q}$</td>
<td>set of all rational numbers $x = \frac{p}{q}$</td>
<td>$\mathbb{Q} = {x \in \mathbb{R} : x = \frac{p}{q}$ and $p, q \in \mathbb{Z}}$</td>
</tr>
<tr>
<td>$\implies$</td>
<td>implies that, follows that</td>
<td>$x \in \mathbb{Q} \implies \exists p, q \in \mathbb{R}$</td>
</tr>
<tr>
<td>$\iff$ or &quot;iff&quot;</td>
<td>if and only if, equivalent to</td>
<td>$Z \cap \mathbb{N} = \mathbb{N}, {1, 2} \cap {2, 4} = {2}$</td>
</tr>
<tr>
<td>$A \cap B$</td>
<td>$A$ intersected with $B$ or intersection of $A$ and $B$</td>
<td>$Z \cap \mathbb{N} = \mathbb{N}, {1, 2} \cap {2, 4} = {2}$</td>
</tr>
<tr>
<td>$A \cup B$</td>
<td>union of sets $A$ and $B$</td>
<td>$Z \cup \mathbb{N} = \mathbb{Z}, {1, 2} \cup {2, 4} = {1, 2, 4}$</td>
</tr>
<tr>
<td>$A^c$ or $C_S(A)$</td>
<td>complement of $A$ related to basis set $S$</td>
<td>$\mathbb{Q}^R = {x : x$ irrational number$}$</td>
</tr>
<tr>
<td>$S$ or $\Omega$</td>
<td>sample space or set of all (measurable) events</td>
<td>$S = {1, 2, 3, 4, 5, 6}$</td>
</tr>
<tr>
<td>$\mathbb{P}(A)$</td>
<td>probability of event $A$</td>
<td>$\mathbb{P}({1}) = \frac{1}{6}$ for fair dice</td>
</tr>
<tr>
<td>$\mathbb{E}[X]$</td>
<td>expectation or average value of $X \in {x_1, x_2, \ldots, x_n}$</td>
<td>$\mathbb{E}[X] = \sum_{i=1}^{n} x_i p_i$</td>
</tr>
<tr>
<td>$A = (a_{i,j}) \in \mathbb{R}^{m \times n}$</td>
<td>matrix $A$ with real entries $a_{i,j} \in \mathbb{R}$, and $m$ rows, $n$ columns</td>
<td>$A = \begin{pmatrix} 0 &amp; 3 \ 5 &amp; x \end{pmatrix}$, i.e. $a_{11} = 0, a_{12} = 3, n = 2$</td>
</tr>
<tr>
<td>$b \in \mathbb{R}^n$</td>
<td>$b$ is a column vector with $n$ real entries $b_i \in \mathbb{R}$</td>
<td>$b = \begin{pmatrix} 1 \ 0 \end{pmatrix} \implies b_1 = 1, b_2 = 0$</td>
</tr>
<tr>
<td>$b^T, A^T$</td>
<td>transpose of vector $b$, transpose of matrix $A$</td>
<td>$b = (10)^T = \begin{pmatrix} 1 \ 0 \end{pmatrix}$</td>
</tr>
<tr>
<td>$Ax = b$</td>
<td>a system of linear equations</td>
<td>$3x_1 + 2x_2 = 1$</td>
</tr>
<tr>
<td>$\sim$</td>
<td>proportional to</td>
<td>$2x_1 + 3x_2 = 0$</td>
</tr>
<tr>
<td>$\exp(g(x))$</td>
<td>exponential to the power $g(x)$</td>
<td>$F(x) \sim x$ i.e. $\exists k \forall x \in \text{dom}(F)$: $F(x) = kx$</td>
</tr>
<tr>
<td>$\approx$</td>
<td>approximately</td>
<td>$\exp(x) = e^x, \exp(-2x) = e^{-2x}$</td>
</tr>
<tr>
<td>$N(x_0)$</td>
<td>small neighborhood of $x_0$</td>
<td>$\exp(x) \approx 1 + x$ for $x \in N(0)$</td>
</tr>
<tr>
<td>$(a, b)$</td>
<td>open interval of reals between $a$ and $b$</td>
<td>$N(0) = (-\varepsilon, +\varepsilon)$ for small $\varepsilon &gt; 0$</td>
</tr>
<tr>
<td>$[a, b]$</td>
<td>closed interval of reals between $a$ and $b$</td>
<td>$[-1, 2) = {x \in \mathbb{R} : -1 &lt; x &lt; 2}$</td>
</tr>
<tr>
<td>$(a, b), [a, b)$</td>
<td>half open intervals between $a$ and $b$</td>
<td>$[-1, 2) = {x \in \mathbb{R} : -1 \leq x &lt; 2}$</td>
</tr>
<tr>
<td>$f : \mathbb{R} \rightarrow \mathbb{R}$</td>
<td>a function $f$ mapping from $\mathbb{R}^1$ to $\mathbb{R}^1$</td>
<td>$f : \mathbb{R} \rightarrow \mathbb{R}, f(x) = \ln(x)$ if $x &gt; 0$</td>
</tr>
<tr>
<td>$\text{dom}(f)$</td>
<td>domain of definition of $f$</td>
<td>$\text{dom}(\exp) = \mathbb{R}, \text{dom}(\ln) = (0, +\infty)$</td>
</tr>
<tr>
<td>$\text{ran}(f), \text{im}(f)$</td>
<td>range of $f$, image of $f$</td>
<td>$\text{ran}(\exp) = (0, +\infty)$</td>
</tr>
<tr>
<td>$f^{-1}$</td>
<td>inverse of one-to-one function $f$, i.e. $f^{-1}(f(x)) = x$</td>
<td>$f = \exp, f^{-1} = \ln$</td>
</tr>
<tr>
<td>$\mathbb{C}$</td>
<td>set of complex numbers $z$</td>
<td>$\mathbb{C} = {z : z = a + bi, a, b \in \mathbb{R}}$</td>
</tr>
<tr>
<td>$i$</td>
<td>imaginary unit $i$</td>
<td>$i^2 = -1, i^3 = i$</td>
</tr>
<tr>
<td>$\text{Im}(z), \text{Re}(z)$</td>
<td>imaginary part of $z$, real part of $z$</td>
<td>$\text{Re}(1 + 2i) = 1, \text{Im}(1 - 2i) = -2$</td>
</tr>
<tr>
<td>$\sum_{i=1}^{n} a_i$</td>
<td>sum of numbers $a_i$, i.e. $\sum_{i=1}^{n} a_i = a_1 + \ldots + a_n$</td>
<td>$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}, \sum_{i=0}^{q} q^2 = \frac{q^2 - q^3}{1-q}$ if $q &lt; 1$</td>
</tr>
<tr>
<td>$\frac{df}{dx}$</td>
<td>&quot;ordinary&quot; derivative</td>
<td>$d \arctan(x)/dx = 1/(1 + x^2)$</td>
</tr>
<tr>
<td>$\frac{\partial f(x, y)}{\partial x}$</td>
<td>partial derivative of $f$ w.r.t. $x$</td>
<td>$\partial f(x, y)/\partial x = 2x$</td>
</tr>
<tr>
<td>$\nabla f(x, y)$</td>
<td>gradient of $f : \mathbb{R}^n \rightarrow \mathbb{R}^1$ (vector of derivatives)</td>
<td>$\nabla (x/y) = (1/y, -x/y^2)$</td>
</tr>
</tbody>
</table>