Math 129: Calculus II

1. Instructor Information:
   - Name: Colin Clark ("Colin")
   - Office: Math 615
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   - Personal Webpage: http://math.arizona.edu/~clark
2. Course Websites:
   - D2L: http://d2l.arizona.edu
   - Course Webpage: http://math.arizona.edu/~calc

Math 129 - Calculus II

3. Study Resources
   - Office Hours: (Me!) Math 615
     - Mo. 1.00p - 1.45p
     - Tu. 11.00a - 11.45a
     - We. 3.00p - 3.45p
     - Th. 10.00a - 10.45a
   - Tutoring Room: (Staffed by Math instructors) MTL 121
     - Mo.-Th. 11.00a - 4.00p
     - Fr. 11.00a - 2.00p.
   - Problem Session: Math 196N
     - Mo. 3.00p - 4.50p.

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4. Requirements
   - Text: Calculus Single Variable, Sixth Edition
     - Authors: Hughes-Hallett et al.
     - Publisher: Wiley.
   - WebAssign:
     - Class key is arizona 7794 4998.
     - Either: Bundled with text book from bookstore
     - Or: Purchase online (http://webassign.net) 14 day grace.
   - Calculators:
     - A graphing calculator will be needed.
     - I recommend models like the TI-83 or TI-84.
     - Models that can perform symbolic calculations (also known as CAS) are NOT allowed on exams and quizzes.

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5. Worksheets
    - One worksheet per day. Start in class, finish for homework.
    - Designed to become course notes. (Keep them in a binder!)
    - Three parts . . .
        1. Challenging problems from the current section.
        2. Problems designed to
        3. Quiz - (In class)

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6. WebAssign
   - Can be the most beneficial, or the most unproductive, part of the course. It's up to you.
   - Read "Things to know about WebAssign" on d2l.
   - Assignments pertaining to each mid-semester exam will be re-opened three days before the exam for you to practice and to improve your score by a maximum of 3 points per assignment.
     - Do WA promptly, while still acclimating the material and the immediate feedback is most valuable.
     - Eligible for good scores when the material is eventually understood, even if it takes a little longer to digest the concepts behind the hardest problems.

Quiz - August 23

Tell me something interesting about the person sitting next to you.

Integration by Substitution: Application Problems

3. $\int e^{3x}\,dx$ Set $w =$

Integration by Substitution: Application Problems

3. $\int e^{3x}\,dx$ Set $w = 3x$

13. $\int x^2(1+2x^3)^2\,dx$ Set $w =$

Integration by Substitution: Application Problems

3. $\int e^{3x}\,dx$ Set $w = 3x$

13. $\int x^2(1+2x^3)^2\,dx$ Set $w = (1+2x^3)$

21. $\int \frac{1}{\sqrt{4-x}}\,dx$

27. $\int \sin^6(5\theta)\cos(5\theta)\,d\theta$

29. $\int \frac{(\ln(z))^2}{z}\,dz$

37. $\int \frac{1+e^x}{\sqrt{x+e^x}}\,dx$

Integration by Substitution: Synthesis Problems

1. Find the exact average value of $f(x) = 1/(x+1)$ on the interval from $x = 0$ to $x = 2$. Sketch a graph showing the function and the average value.

2. Explain why $\int \sqrt{x+1}\,dx$ and $\int \frac{\sqrt{1+\sqrt{x}}}{\sqrt{x}}\,dx$ are different expression of the same problem.

Quiz - August 25, 2016

1. Find the integral.

$$\int \frac{e^{\sqrt{y}}}{\sqrt{y}}\, dy$$

2. Integration by substitution or integration by parts?

$$\int \frac{x}{1+x^2}\, dx$$

3. How many exams do we have this semester?

Integration by Parts

1. $\int t \sin(t)\, dt$

2. $\int t\, e^{5t}\, dt$

Integration by Parts

Find the anti-derivative

1. $\int x \ln(x)\, dx$

2. $\int x \left(\ln(x)\right)^2 dx.$

3. $\int x \left(\ln(x)\right)^4 dx$

Integration by Parts

Find the anti-derivative

1. $\int x^2 \ln(x) dx$

2. $\int x^4 \ln(x) dx$

Integration by Parts

Find the anti-derivative

1. $\displaystyle\int \frac{t+7}{\sqrt{5-t}}\,dt$

2. $\displaystyle\int^{29} x^3 e^{x^2}\,dx$

3. $\displaystyle\int_0^1 \arctan(y)\,dy$

Definite Integrals

1. Evaluate the integral exactly.

$$\int_1^e \frac{1}{z}\left[\ln(z)\right]^2 dz$$

2. Evaluate the integral exactly.

$$\int_1^e z\left[\ln(z)\right]^2 dz$$

Integration by Parts

a. Evaluate the integral $\int s \arcsin(s^2)\, ds$

b. Check your answer using differentiation.

c. Use item (a) to evaluate the integral $\int_0^1 s \arcsin(s^2)\, ds$ exactly.

d. Evaluate the integral $\int_0^1 s \arcsin(s^2)\, ds$ numerically, and use this to check your answer to item (b).

Integration by Parts

1. Use integration by parts to find the antiderivative:
$$\int \cos^2(x)dx$$

Quiz - August 30, 2016

Quiz - August 30, 2016

1. Use the table to evaluate the integral.

x	0	1	e	3
$f(x)$	5	7	10	11
$f'(x)$	2	4	9	12

$$\Rightarrow \quad \int_1^3 \frac{f'(x)}{f(x)}\,dx$$

2. Use integration by parts (twice) to find the antiderivative

$$\int z^2 \cos(\pi z)\,dz$$

3. Complete the square

$$y = x^2 + 6x + 14$$

Integration by parts

1. Use integration by parts to find the antiderivative

$$\int z^3 \sin(\pi z)\, dz$$

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Section 7.3 - Tables for Integration - Polynomials

1. Use the table to find the antiderivative:

$$\int (t^2+1)e^{-2t}\,dt$$

Section 7.3 - Tables for Integration - Polynomials

1. Use the table to find the antiderivative:

$$\int (t^2+1)e^{-2t}\,dt$$

2. Use the table to compute the integral:

$$\int t^7 e^{-t^2}\,dt$$

Section 7.3 - Tables for Integration - Quadratics

- $\int \frac{1}{3+y^2}\,dy$

Section 7.3 - Tables for Integration - Quadratics

- $\int \frac{dx}{9x^2+16}$

Section 7.3 - Tables for Integration - Quadratics

- $\int \frac{dy}{4-y^2}$

Section 7.3 - Tables for Integration - Quadratics

- $\int \frac{t^2+1}{t^2-2t-4}\,dt$

Section 7.3 - Tables for Integration - Quadratics

- $\int \frac{1}{\sqrt{s^2+6s+8}}\,ds$

Section 7.3 - Tables for Integration - Trig

How would you solve $\int \sin^2(x)\cos(x)dx$?

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Section 7.3 - Tables for Integration - Trig

How would you solve $\int \sin^2(x)\cos(x)dx$?

How would you solve $\int \sin^2(x)\cos^3(x)dx$?

Which problem is harder $\int \sin^2(x)\cos^3(x)dx$ or $\int \sin^2(x)\cos^2(x)dx$?

Section 7.3 - Tables for Integration - Trig

1. $\int \frac{1}{\sin^3(3s)} ds$

Announcements - September 1,2016

- Exam 1: Thursday, September 15
  - In class
  - 50 minutes
  - Sections 7.1-7.5
- Practice Test: Saturday or Sunday before the exam.
  - time TBA, location TBA.
  - 50 minutes practice test.
  - 50 minutes discussion.
  - Attendance optional.
  - Bring a laptop / tablet.

Quiz - September 1, 2016

Quiz - September 1, 2016

1. Which method, substitution or integration by parts, would be more effective for the integral below?

$$\int \left[\ln(3x)\right]^2 dx$$

   Either: identify the appropriate w and then calculate dw.
   Or: identify u and v' and calculate the corresponding u' and v.

2. Use the tables, to find

$$\int (2t)^3 \cos(5t)\, dt$$

3. True or False:

$$\frac{5}{(x-1)^2(x+1)} = \frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{C}{x+1}$$

Integration with Algebraic Identities

Structure of the partial fraction decomposition: (Must be memorized!)

Integration with Algebraic Identities

Identify the structure of the partial fraction decomposition:

1. $\dfrac{x+1}{6x+x^2}$
2. $\dfrac{1}{w^4-w^3}$
3. $\dfrac{8}{y^3-4y}$
4. $\dfrac{2}{s^4-1}$

Integration with Algebraic Identities

Split the function $\dfrac{20}{25-x^2}$ into partial fractions.

Integration with Algebraic Identities

Split the function $\dfrac{2y}{y^3 - y^2 + y - 1}$ into partial fractions.

Integration with Algebraic Identities

Split the function $\dfrac{2(1+s)}{s(s^2+3s+2)}$ into partial fractions.

Integration with Algebraic Identities

Find the area under the curve

$$y = \frac{x^4 + 3x^3 + 2x^2 + 1}{x^2 + 3x + 2}$$

between $x = 1$ and $x = 5$.

Integration with Algebraic Identities

Find the antiderivative of $\dfrac{2(1+s)}{s(s^2+3s+2)}$.

Integration with Algebraic Identities

Calculate the integral $\int \frac{x}{(x-a)(x-b)}\,dx$ for $a \neq b$ and for $a = b$, without using tables.

Not the Quiz - September 6, 2016

1. Pick the best entry from the table to solve:
   - $\int \frac{1}{1-w^2}\,dw$
   - $\int \frac{1}{1+x^2}\,dx$
   - $\int \frac{1}{\sqrt{1+y^2}}\,dy$
   - $\int \frac{1}{\sqrt{1-z^2}}\,dz$

Announcements - September 6, 2016

- Exam 1: Thursday, September 15
  - In class
  - 50 minutes
  - Sections 7.1-7.5
- Practice Test: Monday before the exam.
  - Time 6.00pm - 8.00pm, Location Math 402. (TBA)
  - 50 minutes practice test.
  - 50 minutes discussion.
  - Attendance optional.
  - Bring a laptop / tablet.

Quiz - September 6, 2016

1. Comment to your neighbor which of the following resources have been most useful to you so far?
   a. Office Hours.
   b. Math Department Tutoring.
   c. Think Tank Tutoring.
   d. Study group of classmates.
   e. Working through examples from the ebook.

2. Split the rational function into partial fractions

$$\frac{3x}{(x-1)(x-4)}$$

7.4b - Trig Identities

1. (Example #7 from the book)

$$\int \frac{1}{\sqrt{4-x^2}}\,dx$$

7.4b - Trig Identities

2. (Problem #61 from the book)

$$\int \frac{}{x^2\sqrt{4-x^2}}\,dx$$

7.4b - Trig Identities

3. (My own problem)

$$\int \sqrt{25+4x^2}\,dx$$

7.4b - Trig Identities

4. (Problem #69 from the book)

$$\int_0^3 \frac{1}{\sqrt{9+x^2}}\,dx$$

Not the Quiz

- Judy Hopps, Nick Wilde, Benjamin Clawhauser, Ms. Bellwether and Chief Bogo each try to decompose the expression below and they each get a different result:

$$\frac{2x^3+6x^2-1x-30}{(x-3)(x+2)^2}$$

  - Who is right?
  - What is the fastest way to check?

Announcements - September 8, 2016

- Exam 1: Thursday, September 15
  - In class
  - 50 minutes
  - Sections 7.1-7.5
- Practice Test: Monday September 12.
  - Time 6.00pm - 8.00pm, Location Math 402.
  - 50 minutes practice test.
  - 50 minutes discussion.
  - Attendance optional.
  - Bring a laptop / tablet if you have one.

7.4b - Trig Substitution

4. Complete the square, and then use a substitution to find the antiderivative $\int_4^7 \frac{1}{(z^2-8z+25)^{3/2}}\,dz$

Quiz - September 8, 2016

Quiz - September 8, 2016

1. Use Trig substitution and a triangle to calculate

$$\int \frac{2s}{\sqrt{4-9s^2}}\,ds$$

2. Catch the error:

$$\frac{5x-2x^3}{(x-3)^2(x-2)} = \frac{A}{(x-3)} + \frac{B}{(x-3)^2} + \frac{C}{(x-2)}$$

7.5 - Riemann Sums

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2. Compute the right Riemann sum with 3 subdivisions to estimate the integral $\int \frac{x}{\sqrt{4+x^2}}\,dx$.
3. Compute the average of the left and right Riemann sums with 3 subdivisions to estimate the integral $\int \frac{x}{\sqrt{4+x^2}}\,dx$ using the trapezoid rule.

7.5 - Over and under estimates

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1. Show that a left sum will underestimate the area under an increasing function.
2. Show that a right sum will underestimate the area under a decreasing function.
3. When will the trapezoid rule underestimate the area under a function? When it is concave down.

7.5 - Midpoint Rule

1. Use the trapezoid method with $n = 2$ to approximate

$$\int_0^{10} e^{-0.1x}\, dx$$

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7.5 - Best Estimates

1. Estimate $\int_0^{10} f(x)g'(x)dx$, given that $f(x) = x^2$ and that g is differnetiable everywhere with values given by:

x	0	2	4	6	8	10
$g(x)$	2.3	3.1	4.1	5.5	5.9	6.1

- End of Unit 1