Teaching Calculus II with No-Cost-to-Students Course Materials

Lake Ritter

Kennesaw State University

$\approx \pi$, 2015

Outline

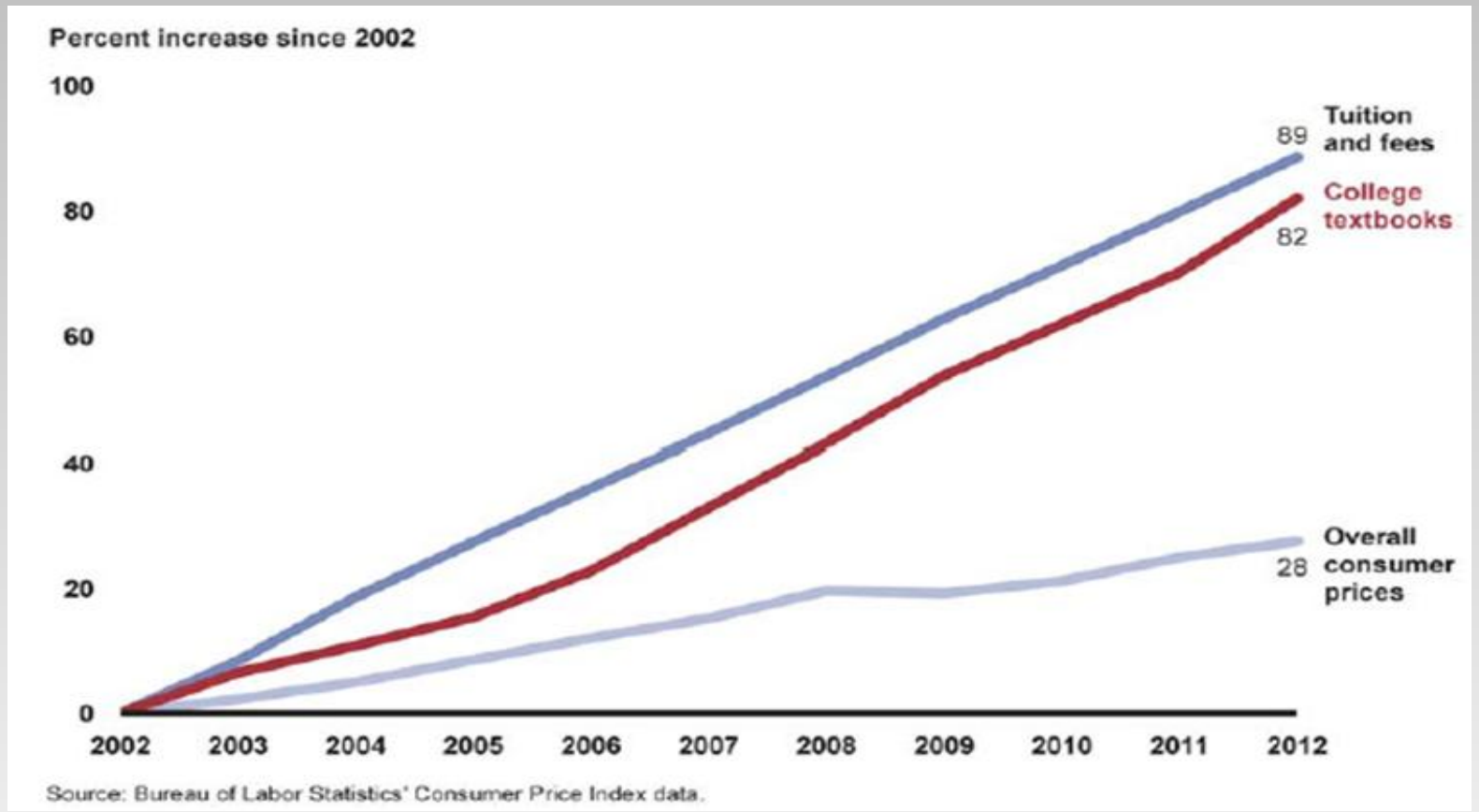
Textbook Costs

The US student loan debt hit $1.2 trillion in 2013—about $1 trillion of that in federal loans. With state and federal cuts to post-secondary education funding, the burden falls on the students in the form of rising tuition and fees.

A Goverment Accountability Office (GAO) Report to Congressional Committee estimates an

- 89% increase in college tuition & fees since 2002, and an
- 82% increase in college texts since 2002

Textbook Costs



Estimated Increases in New College Textbook Prices, College Tuition and Fees, and Overall Consumer Prince Inflation, 2002–2012 (adapted from http://www.gao.gov/assets/660/655066.pdf)

Some Interesting Stats on the Subject

- Course materials cost students about $1200 annually (The College Board[1])
- Textbook prices rise about 6% annually. (GAO report 2013[2])
- About 30% of students report not buying required text in 2013. (Lumina foundation[3])
- 94% of students who do not buy a text report concern it will affect their grade (Student PIRGs[4])

[1] http://trends.collegeboard.org/college-pricing
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Calculus Course Materials

Used books, e-books, and rentals provide students with lower cost options. Popular Calculus course materials still vary widely in price.

Stewart Calculus 7e

- On Campus: New $267.50, Used $180.00
- On web: $59.49–$239.48
- Rental: $40.00–$89.49
- WebAssign: Bundle $145.49–$330.68, Code only $34.67–$111.57

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Calculus: Early Transcendentals
Sullivan & Miranda

- On Campus: ???
- On web: $65.99–$175.74
- Rental: $34.95–$96.99
- Calcportal(?): $88.75

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Thomas' Calculus 13^{th} ed

- On web: New \$156.00–\$388.22, Used \$124.01–\$281.32
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- MyMathLab: \$23.91–\$300.35

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Open Educational Resources can provide a low-to-no cost alternative to part or all of the required materials.

Open Educational Resources OER

The William and Flora Hewlett Foundation defines OER as follows:

OER are teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge.

Common open license types include GNU Free Documentation (software documentation) and Creative Common (almost anything).

OER: Coordination

A variety of OER collaborations have been established to serve as resource clearing houses and to propose evaluation standards.

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- **BCcampus:** Created to serve the post-secondary public institutions of British Columbia. They link to various texts and offer guide lines for evaluation of materials. http://bccampus.ca/
- **UMN Open Textbook Library:** Offers a searchable library of open texts as well as a mechanism for review of open texts. http://open.umn.edu/opentextbooks/
- **MERLOT** Offers a collection of OER, content building tools, individual and campus subscriptions, and partnerships. http://www.merlot.org/

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- **OpenStax College:** Offers a variety of free college level text books. The mathematics offerings are currently limited, but the library is increasing with Precalculus added in February 2015. Allows for creation and modification of content in OpenStax CNX^{TM}with free account. ▸ http://openstax.org/
- **Community College Consortium for OER:** Hosts a library of 750+ open access texts. Provides materials on introducing OER to campuses, assessing needs, training tools, and review guidelines. ▸ http://oerconsortium.org/

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Assessment of OER

OER organizations have begun to suggest criteria for peer/editorial review when considering or **creating** open access materials for implementation. The Community College Consortium has suggested a number of review criteria[5]:

- Clarity, Comprehensibility, and Readability
- Authorship, Content Accuracy & Appropriateness
- Adaptability, Modularity
- Availability, Sustainability
- Accessibility

[5] adapted from the CCCOER website and ALG presentation on Evaluating OER

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Assessment of OER

Accessibility

Accessibility considerations may vary when creating open access materials for use outside of a single class—i.e. for distribution outside of a closed Learning Management System.

- Is web content third-party reading application friendly?
- Do web images have alternate text embedded?
- Does video content have accurate closed-caption?

OER: American Institute of Mathematics

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▸ http://aimath.org/

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According to the AIM evaluation criteria, approved texts should be

- mathematically sound,
- written in standard English, proofread and edited,
- have exercises (preferably with some solutions),
- be class-tested by faculty other than the author

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AIM approved math texts are available for a wide variety of courses including

- Liberal Arts Mathematics
- PreCalculus, Calculus, and Diff. Eqs.
- Linear Algebra, Abstract Algebra, and Number Theory
- Introduction to Proof, Real Analysis, Complex Analysis
- Discrete Structures, Combinatorics, Probability

▸ http://aimath.org/

Some AIM approved Calculus Texts

Whitman Calculus
by David Guichard and Friends

▸ Whitman Calculus: Late Transcendentals

- available for a complete Calculus I, II, and III sequence (single & multi-variable)
- comes in both Early and Late transcendental versions
- easily navigable html as well as pdf versions are available
- coordinated WebWork files are available (collected by Albert Schueller)
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- collection of three texts for Calculus I, II and III
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Some AIM approved Calculus Texts

Calculus
by Gilbert Strang

▸ Calculus, Strang

This is a scanned version of the 1991 text. Instructor resources and a study guide are available on the MITOpenCourseware site.

Vector Calculus
by Michael Corral

▸ Vector Calculus

This is a Calculus III text available in navigable pdf format. It can be purchased in print version for about $11 through Lulu.

Affordable Learning Georgia (ALG)

ALG is a USG initiative launched in 2013 to promote student success by providing affordable textbook alternatives.

ALG offers information on adoption, adaptation, and creation of OER, training and tools for finding low/no cost alternatives, and funding for programs to transform existing courses.

The current project received funding under the *Textbook Transformation Grant* program

No-Cost-to-Students Learning Materials and Course Pack Pilots

▸ Affordable Learning Georgia

No-Cost-to-Students Calculus II Pilot at KSU-Marietta

Lake Ritter & Shangrong Deng

- each teaching two sections of Calculus II in spring 2015, one with traditional Stewart 7^{th} edition, and one with an open access text combining Whitman Calculus and APEX Calculus. (Students were informed prior to enrollment via the online schedule that two sections would not be using a purchased textbook.)
- conducting surveys from participating students on (1) general textbook use and attitudes and (2) experience with the open access version.
- We will analyze student performance based on common embedded exam questions as well as DFW rates.

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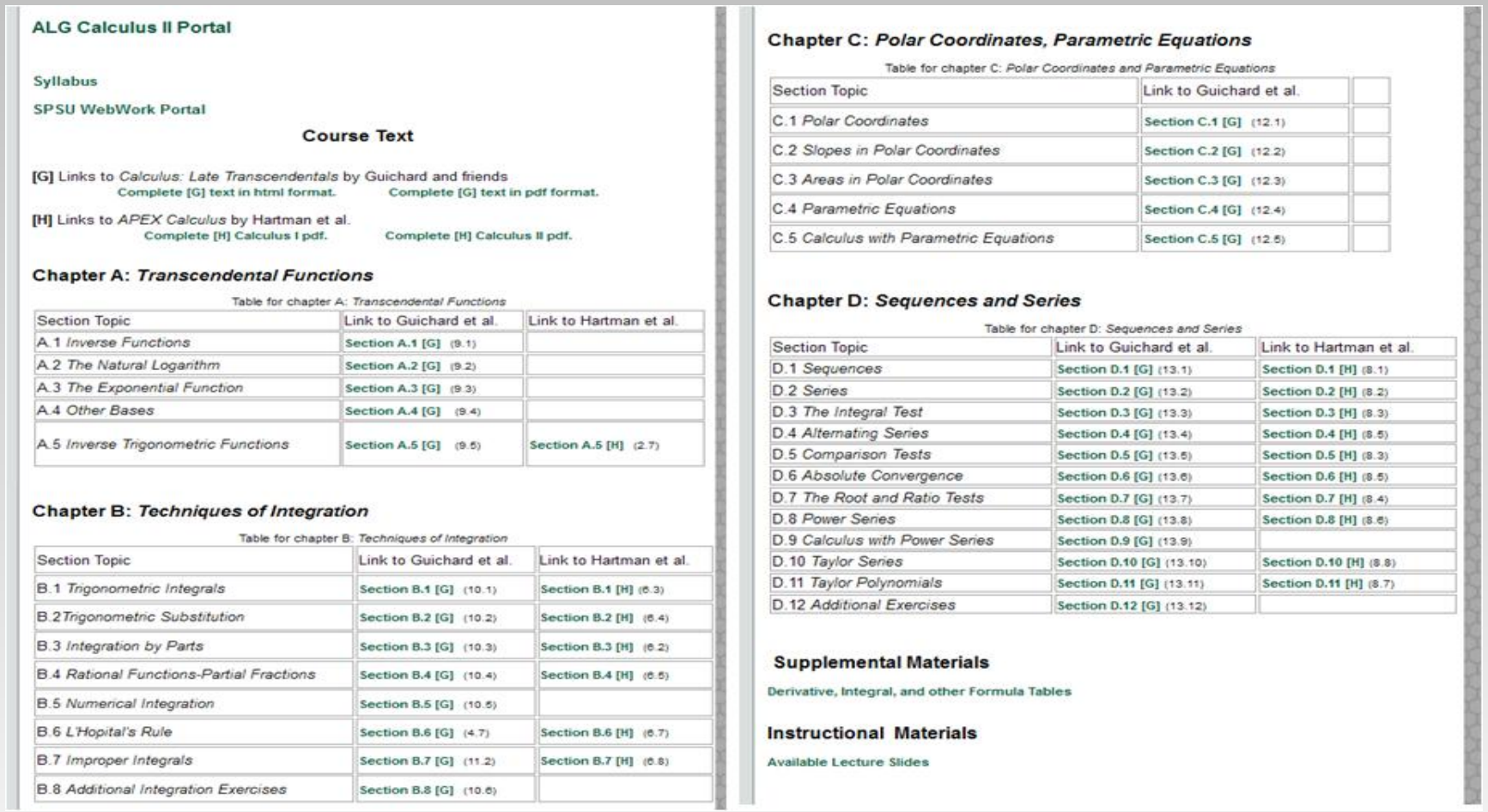
No-Cost-to-Students Textbook Portal



ALG Calculus II Portal

Syllabus

SPSU WebWork Portal

Course Text

[G] Links to *Calculus: Late Transcendentals* by Guichard and friends
Complete [G] text in html format. Complete [G] text in pdf format.

[H] Links to *APEX Calculus* by Hartman et al.
Complete [H] Calculus I pdf. Complete [H] Calculus II pdf.

Chapter A: *Transcendental Functions*

Table for chapter A: *Transcendental Functions*

Section Topic	Link to Guichard et al.	Link to Hartman et al.
A.1 *Inverse Functions*	Section A.1 [G] (9.1)	
A.2 *The Natural Logarithm*	Section A.2 [G] (9.2)	
A.3 *The Exponential Function*	Section A.3 [G] (9.3)	
A.4 *Other Bases*	Section A.4 [G] (9.4)	
A.5 *Inverse Trigonometric Functions*	Section A.5 [G] (9.5)	Section A.5 [H] (2.7)

Chapter B: *Techniques of Integration*

Table for chapter B: *Techniques of Integration*

Section Topic	Link to Guichard et al.	Link to Hartman et al.
B.1 *Trigonometric Integrals*	Section B.1 [G] (10.1)	Section B.1 [H] (6.3)
B.2 *Trigonometric Substitution*	Section B.2 [G] (10.2)	Section B.2 [H] (6.4)
B.3 *Integration by Parts*	Section B.3 [G] (10.3)	Section B.3 [H] (6.2)
B.4 *Rational Functions-Partial Fractions*	Section B.4 [G] (10.4)	Section B.4 [H] (6.5)
B.5 *Numerical Integration*	Section B.5 [G] (10.5)	
B.6 *L'Hopital's Rule*	Section B.6 [G] (4.7)	Section B.6 [H] (6.7)
B.7 *Improper Integrals*	Section B.7 [G] (11.2)	Section B.7 [H] (6.8)
B.8 *Additional Integration Exercises*	Section B.8 [G] (10.6)	

Chapter C: *Polar Coordinates, Parametric Equations*

Table for chapter C: *Polar Coordinates and Parametric Equations*

Section Topic	Link to Guichard et al.	
C.1 *Polar Coordinates*	Section C.1 [G] (12.1)	
C.2 *Slopes in Polar Coordinates*	Section C.2 [G] (12.2)	
C.3 *Areas in Polar Coordinates*	Section C.3 [G] (12.3)	
C.4 *Parametric Equations*	Section C.4 [G] (12.4)	
C.5 *Calculus with Parametric Equations*	Section C.5 [G] (12.5)	

Chapter D: *Sequences and Series*

Table for chapter D: *Sequences and Series*

Section Topic	Link to Guichard et al.	Link to Hartman et al.
D.1 *Sequences*	Section D.1 [G] (13.1)	Section D.1 [H] (8.1)
D.2 *Series*	Section D.2 [G] (13.2)	Section D.2 [H] (8.2)
D.3 *The Integral Test*	Section D.3 [G] (13.3)	Section D.3 [H] (8.3)
D.4 *Alternating Series*	Section D.4 [G] (13.4)	Section D.4 [H] (8.5)
D.5 *Comparison Tests*	Section D.5 [G] (13.5)	Section D.5 [H] (8.3)
D.6 *Absolute Convergence*	Section D.6 [G] (13.6)	Section D.6 [H] (8.5)
D.7 *The Root and Ratio Tests*	Section D.7 [G] (13.7)	Section D.7 [H] (8.4)
D.8 *Power Series*	Section D.8 [G] (13.8)	Section D.8 [H] (8.6)
D.9 *Calculus with Power Series*	Section D.9 [G] (13.9)	
D.10 *Taylor Series*	Section D.10 [G] (13.10)	Section D.10 [H] (8.8)
D.11 *Taylor Polynomials*	Section D.11 [G] (13.11)	Section D.11 [H] (8.7)
D.12 *Additional Exercises*	Section D.12 [G] (13.12)	

Supplemental Materials

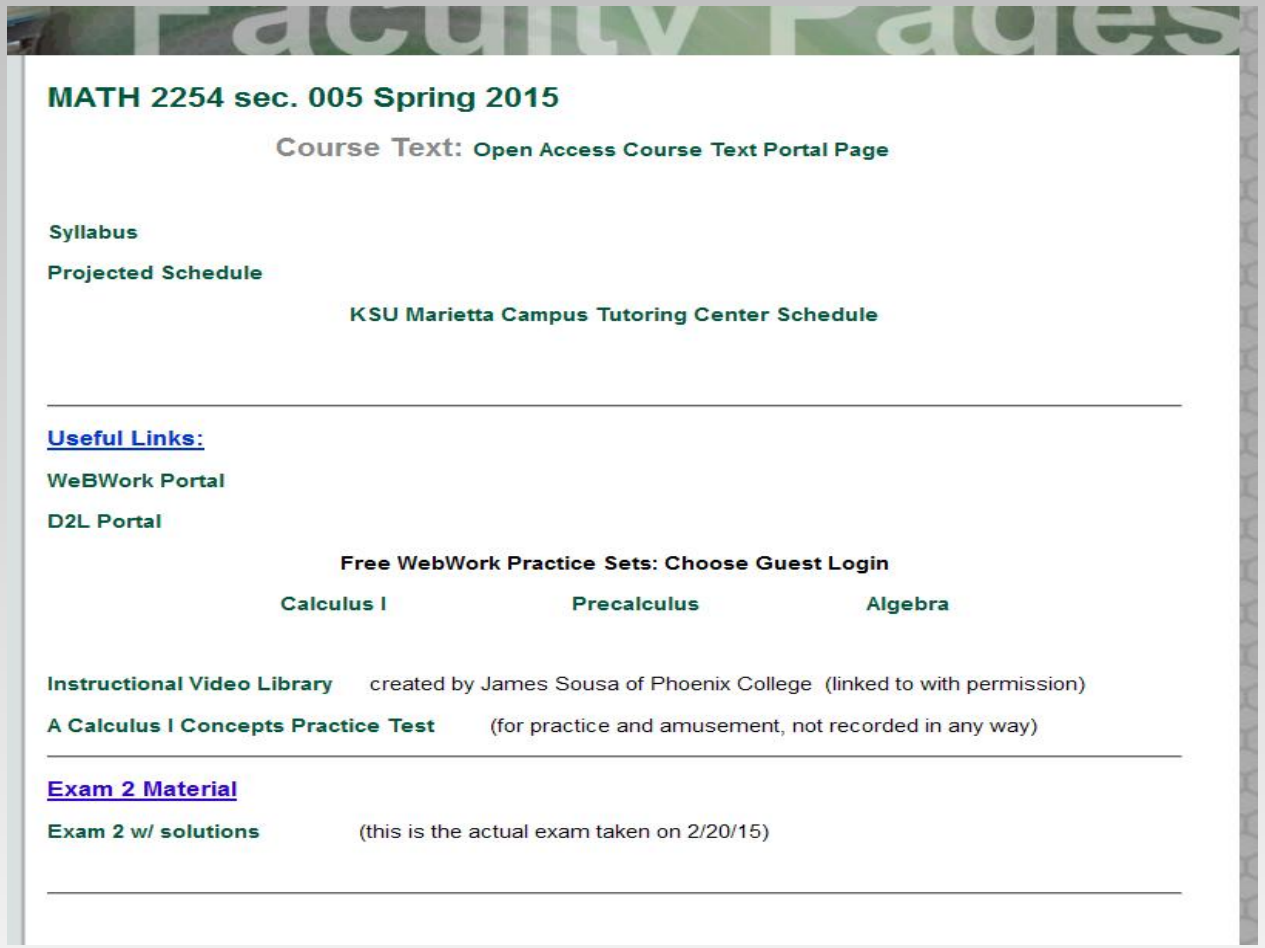
Derivative, Integral, and other Formula Tables

Instructional Materials

Available Lecture Slides

A combined text was *created* in the form of a single web portal. Due to differences, new chapter markers and titles were used. ▸ Our Text Portal

No-Cost-to-Students Textbook Portal



MATH 2254 sec. 005 Spring 2015

Course Text: **Open Access Course Text Portal Page**

Syllabus

Projected Schedule

KSU Marietta Campus Tutoring Center Schedule

Useful Links:

WeBWork Portal

D2L Portal

Free WebWork Practice Sets: Choose Guest Login

Calculus I **Precalculus** **Algebra**

Instructional Video Library created by James Sousa of Phoenix College (linked to with permission)

A Calculus I Concepts Practice Test (for practice and amusement, not recorded in any way)

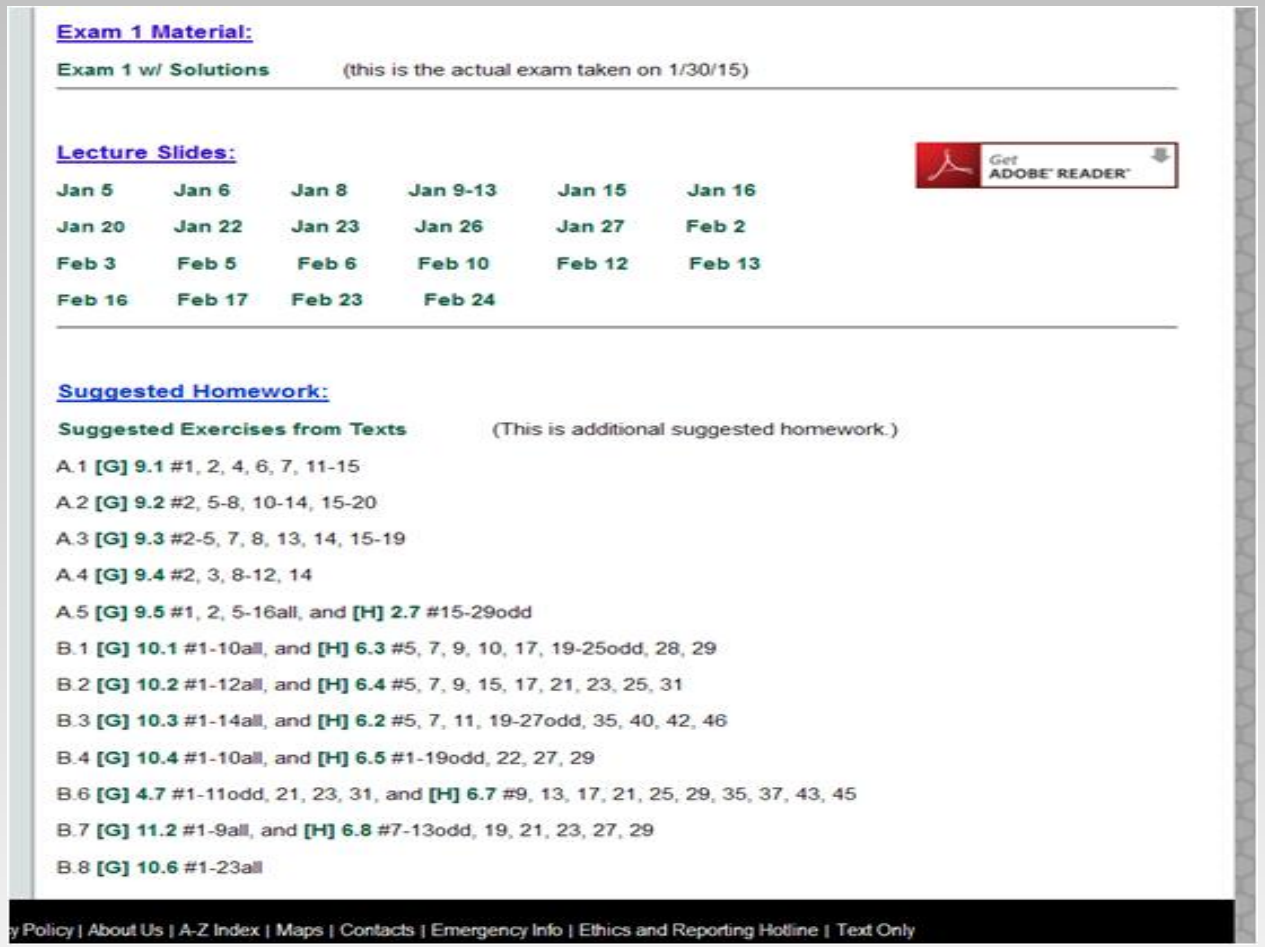
Exam 2 Material

Exam 2 w/ solutions (this is the actual exam taken on 2/20/15)

All class materials can be accessed by anyone on a page on the campus server.

▸ My Class Page

No-Cost-to-Students Textbook Portal



Exam 1 Material:

Exam 1 w/ Solutions (this is the actual exam taken on 1/30/15)

Lecture Slides:

Jan 5	Jan 6	Jan 8	Jan 9-13	Jan 15	Jan 16
Jan 20	Jan 22	Jan 23	Jan 26	Jan 27	Feb 2
Feb 3	Feb 5	Feb 6	Feb 10	Feb 12	Feb 13
Feb 16	Feb 17	Feb 23	Feb 24		

Get ADOBE READER

Suggested Homework:

Suggested Exercises from Texts (This is additional suggested homework.)

A.1 [G] 9.1 #1, 2, 4, 6, 7, 11-15

A.2 [G] 9.2 #2, 5-8, 10-14, 15-20

A.3 [G] 9.3 #2-5, 7, 8, 13, 14, 15-19

A.4 [G] 9.4 #2, 3, 8-12, 14

A.5 [G] 9.5 #1, 2, 5-16all, and [H] 2.7 #15-29odd

B.1 [G] 10.1 #1-10all, and [H] 6.3 #5, 7, 9, 10, 17, 19-25odd, 28, 29

B.2 [G] 10.2 #1-12all, and [H] 6.4 #5, 7, 9, 15, 17, 21, 23, 25, 31

B.3 [G] 10.3 #1-14all, and [H] 6.2 #5, 7, 11, 19-27odd, 35, 40, 42, 46

B.4 [G] 10.4 #1-10all, and [H] 6.5 #1-19odd, 22, 27, 29

B.6 [G] 4.7 #1-11odd, 21, 23, 31, and [H] 6.7 #9, 13, 17, 21, 25, 29, 35, 37, 43, 45

B.7 [G] 11.2 #1-9all, and [H] 6.8 #7-13odd, 19, 21, 23, 27, 29

B.8 [G] 10.6 #1-23all

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Primary homework is provided through WebWork. Additional practice exercises are suggested with links on my class page. ▸ My Class Page

Initial Impressions

The current program is in process, but we can consider preliminary impressions.

- Eleven sections of Calc II were offered; five of these filled to capacity (35) including the four sections in the study.
- 15 (10.7%) students have dropped with a grade of W (3, 4, 4, 4).
- 85 participated in an initial survey about textbooks. Among them
  - 38 (45%) would prefer a printed (non-electronic) textbook.
  - 25 (29%) have taken a math class without required material. (8 report not being able to afford it.)
  - Of those without a text, 15 reported mastering the material without it. (11 of those are in the no-cost sections.)

Initial Impressions

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Concept	Stewart	No-Cost
Der. of transcendental func.	70.1%	76.6%
Int. of transcendental func.	65.0%	87.7%
Limits of transcendental func.	70.5%	47.6%

Average score on common exam questions by concept.

Initial Impressions

The current program is in process, but we can consider preliminary impressions.

Concept	Stewart	No-Cost
Int. by Parts	87.7%	72.8%
Trig. integrals	84.0%	56.1%
Trig. substitution	62.9%	61.1%

Average score on common exam questions by concept.

Initial Impressions

The current program is in process, but we can consider preliminary impressions.

Assessment	Stewart	No-Cost
Exams (avg.)	70%	73%
HW or Quiz	77.9%	72.9%

Exam and Quiz/Homework Averages (Ritter's sections only)

Initial Impressions

The current program is in process, but we can consider preliminary impressions.

The survey results on student experience with our online combined text are not yet available. Our initial drop rate and course performance indicators don't show any significant difference between students in our traditional text sections and those using only no-cost materials.

Acknowledgements

This project is supported by USG's Affordable Learning Georgia Initiative ALG Textbook Transformation Grant R1 #7.

We also wish to thank the following parties for providing critical information and resources:

- The American Institute of Mathematics
- The Community College Consortium for Open Educational Resources
- Kennesaw State University
- Our students

This presentation with embedded links is available on Ritter's webpage http://educate.spsu.edu/lritter/research.htm .