Marshall University
Syllabus

Course Title	*Calculus with Analytic Geometry I (CT)*
Course Number	*MTH 229- Section 301- CRN 3073*
Semester/Year	Intersession 2016
Days/Time	MTWRF 10:30am- 2:15pm
Location	SH 509
Instructor	Dr. Michael Otunuga
Office	WAEC 3229
Office Hours	MTWRF 9-10am; 2:30-3:30pm; others by appointment. To make an appointment, email in advance when possible.
Phone	304 696-3049
E-Mail	otunuga@marshall.edu
Textbook	**Calculus**, Early Transcendental , 3rd edition by Jon Rogawski
Core Credits	This course fulfils a Core I: CT requirement (Integrative Thinking; Critical Thinking; Communication Fluency; Inquiry Based thinking and Quantitative Thinking *and* a Core II: Math requirement
Course Description	A brief but careful review of the main techniques of limits, derivatives and integrals of elementary functions of one variable, including transcendental functions. Applications of derivatives and integrals. Using graphing calculators and Mathematica to help solve problems.
Calculator	TI-83 or higher, graphing calculators may not be allowed for some problems in exam
University Policies	By enrolling in this course, you agree to the University Policies listed below. Please read the full text of each policy be going to www.marshall.edu/academic-affairs and clicking on “Marshall University Policies.” Or, you can access the policies directly by going to http://www.marshall.edu/academic-affairs/?page_id=802 Academic Dishonesty/ Excused Absence Policy for Undergraduates/ Computing Services Acceptable Use/ Inclement Weather/ Dead Week/ Students with Disabilities/ Academic Forgiveness/ Academic Probation and Suspension/ Academic Rights and Responsibilities of Students/ Affirmative Action/ Sexual Harassment See the University Academic Calendar (http://www.marshall.edu/calendar/academic/) for course withdrawal dates.

Description as a Critical Thinking "CT" Course:

Description as a Critical Thinking "CT" Course:	This course fulfills five of seven Cores I "CT" core domains. Primarily, it fulfills the core domain of **integrative thinking** through the use of mathematical and abstract thinking techniques of calculus to teach students how to construct and evaluate mathematical terms like limits, derivatives and integrals symbolically, how to approximate limits, derivatives and definite integrals from graphical data, and how

	to apply calculus techniques to find local and global extrema and further analyze the behavior of functions. Also, it fulfills the core domain of **creative thinking.** Students are able to solve a given problem using various approach and different methods discussed in class. Also, it requires students to be able to write arguments on whether or not the properties in a definitions/argument hold true for given specific mathematical examples. The course also fulfils the core domain of **communication fluency** by requiring students to be able to develop oral, written and/or visual communication skills in explaining the meaning of limits, derivatives and integrals, to be able to apply these definitions to specific problems and to write arguments on whether or not the properties in these definitions hold true for given specific mathematical examples. Furthermore, this course fulfills the core domain of **inquiry based thinking** by teaching student how to formulate, derive or model a problem using certain hypothesis. Students will evaluate/study certain problem, analyze the problem with reasonable conclusion. Lastly, this core fulfills the core domain of **quantitative thinking** by teaching students how to analyze real world problems in science, engineering and other field quantitatively, come up with a model that best describe the problem and investigate validity of the model.

Course Goals:	➢ An understanding of fundamental concepts of calculus and an appreciation of its applications ➢ Developing critical thinking skills by applying calculus skills to real world problems ➢ Obtaining an understanding of the theory in science and engineering mathematics ➢ Being able use technology to help solve problems. ➢ Satisfying program requirements for mathematics, science, and engineering majors

How each student learning outcome will be practiced and assessed in the course

MTH 229 Student Learning Outcomes	How students will practice each outcome in MTH 229	How student achievement of each outcome will be assessed in MTH 229
Students will be able to identify and graph standard algebraic functions. (**communication fluency**)	Students will complete homework, classwork, and quizzes to get practice and feedback.	Students' understanding of functions will be evaluated through questions on 3 in-class tests, 1 project and the comprehensive final exam.
Students will be able to communicate mathematics in writing and orally. (**communication fluency**)	Students will complete brief, low-stakes writing assignments as part of daily classwork and quizzes. Students will engage in peer review of written and oral explanations of concepts.	Students will be assessed on written communication through questions on 3 in-class tests, 1 project and the comprehensive final exam.
Students will be proficient at finding limits, derivatives and integrals of functions. Students will understand the concept of functions and their applications. **(integrative thinking)**	Students will complete homework, classwork, and quizzes to get Practice and feedback.	Students will be assessed on solving equations through questions on 3 in-class tests, 1 project and the comprehensive final exam.
Students will be able to develop mathematical model to solve real world problem. **(creative, inquiry based and quantitative thinking)**	Student will complete assigned mathematical projects.	Students will be assessed on their modeling skills on 1 take home project.
Students will be able to analyze real world problems in science, engineering and other field quantitatively. (**quantitative thinking)**	Students will complete homework, classwork, and quizzes to get Practice on modeling questions.	Students will be assessed on Model analysis, derivation and verification through questions on 1 project.
Student will be able to interpret symbolic and numerical results to answer real-world questions, and recognize when a result is invalid in the real world. (**quantitative thinking)**	Students will complete homework, classwork, and quizzes to get Practice on modeling questions.	Students will be assessed on Model applications through questions on 1 project.
Students will be able to select a function to model a physical example and apply calculus techniques to make Predictions (**inquiry based thinking)**	Students will complete projects, homework and quizzes to get practice and feedback	Students' understanding of applied calculus will be evaluated through questions on 1 project.

Course Requirements / Due Dates

<u>Attendance</u>: Attendance is **compulsory** for this class. Coming late to class and leaving class early will be counted as unexcused absent.

<u>Homework</u>: Homework will be assigned online on WebWork.

<u>Quizzes</u>: There will be a total of five brief quizzes. Make-up quizzes are only given in the event of a university-excused absence.

<u>Tests</u>: There will be 2 in-class tests during the semester, and a comprehensive Final Exam. If you know in advance that you will have an excused absence on a test date, please inform me on time and make arrangements to take the test early. Make-up exams will only be given in the event of a university-excused absence.

<u>Final Exam</u>: The final exam will be on **Friday June 3, 2016**. Please make travel arrangements accordingly. Make-up/early tests will not be available to accommodate individual travel plans.

Grading Policy

Attendance	50 points
Quizzes	100 points
Homework	150 points
Two major exams	200 points
Final (comprehensive) exam	150 points

The grading scale is rigid.

90.00 – 100	A
80.00 – 89.99	B
70.00 – 79.99	C
60.00 – 69.99	D
Below 60.00	F

Tentative Course Schedule

Week	Dates Spring 2016	Approximate schedule : Sections covered and topics	Actual Date Covered
1	5/9	1.1 triangle inequality; interval notation; distance formula; equation of circle; ways to represent a function; finding **domain** and **range** of a function **vertical line test** of whether y is a function of x on a graph **increasing** and **decreasing** functions; **even** and **odd** functions sketching transformations of graphs: horizontal and vertical shifts, horizontal and vertical scaling	
		1.2 linear functions; point-slope and slope intercept form for lines quadratic functions; quadratic formula; completing the square	
		1.3 polynomial functions; rational functions and how to find their domains exponential functions and logarithmic functions with base a constructing new functions from algebra and composition	
2	5/10	1.4 right triangle definitions of trig functions: SOH CAH TOA radians vs. degrees unit circle definitions of cosine and sine and the other trig functions graphs of trig functions; basic trig identities	
		1.5 **one to one** function; **horizontal line test** solving for the **inverse function** for a 1 to 1 function sketching the graph of an inverse function by reflecting across the line y=x restricting the domain to define inverse for sine, cosine and tangent	
		1.6 logarithmic functions and algebraic properties of logarithms solving exponential and logarithmic equations	
Week	**Dates**	**Approximate schedule : Sections covered and topics**	Actual Date Covered
3	5/11	2.1 average vs. instantaneous velocity **average rate of change** as slope of a **secant** line **instantaneous rate of change** as a limit of average rate of change	
		2.2 demonstrating the concept of a limit: using tables of values to estimate Limits; tables of values can give misleading answers about limits determining a limit by looking at the graph of a function notation for **one-sided limits**: from right side $\lim_{x\to a^+} f(x)$, and from left side $\lim_{x\to a^-} f(x)$ ways a limit can fail to exist: the right hand and left hand limits don't agree the limit is ∞ or $-\infty$; how infinite limits are related to **vertical asymptotes**, finding vertical asymptotes	
		2.3 properties of limits rules for limits of polynomial functions, rational functions, and trig functions	

4	5/12	2.4 definition of **continuity** at a point: three conditions must be satisfied using the definition of continuity and properties of limits to show continuity at a given point; identifying on a graph ways a function can have a discontinuity one sided continuity; types of discontinuity points; finding discontinuity points of rational and piecewise functions; classes of continuous functions using laws of continuity to build continuous functions using substitution method for finding limits of continuous functions 2.5 finding limits of piecewise functions where the pieces join limits of functions which agree with another function at all, but possibly one point: cancellation and rationalization techniques for $\frac{0}{0}$ **type limits** 2.6 using **Squeeze Theorem** and a geometrical argument to prove $\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1$ important limits with trig functions	
Week	**Dates**	**Approximate schedule : Sections covered and topics**	Actual Date Covered
5	5/13-16	2.7 definition of $\lim_{x \to \infty} f(x) = L$ and $\lim_{x \to -\infty} f(x) = L$ how horizontal asymptotes are related to limits at infinity limits at infinity for basic polynomial functions and rational functions techniques for calculating limits at infinity 2.8 **Intermediate Value Theorem** and applications to locating zeros of functions 2.9 **formal** $\varepsilon - \delta$ **definition** of limit; demonstrating a limit on a graph by finding the value of δ, given a specific value of ε; using the $\varepsilon - \delta$ definition to **prove** that the limit of a function exists; formal $\varepsilon - \delta$ definition of right hand and left hand limits **Exam 1**	
6	5/17-18	3.1 **slope of tangent line** is the limit of slope of secant line using definition of derivative: $f'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$ to algebraically compute derivatives and to estimate numerical value of derivatives when *h* is small using derivative to find **slope**(and **equation**) of **tangent lines** 3.2 interpreting derivative as a function of x $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ **Leibniz notation** and operator notation for derivatives **rules for derivatives**: constant rule, power rule, constant multiple rule, sum & difference rules formula for the derivative of natural exponential function e^x differentiability implies continuity; how a function can fail to be differentiable 3.3 **product rule** and **quotient rule** for derivatives	

7	5/19	3.4 applications of derivatives: instantaneous rate of change, instantaneous velocity, marginal cost 3.5 notation for **2nd** and **higher order derivatives** higher derivatives of polynomials and exponential functions **acceleration** and **jerk** 3.6 derivatives of sine and cosine derivatives of other trig functions	
__**Week**__	__**Dates**__	**Approximate schedule : Sections covered and topics**	
8	5/20	3.7 **Chain Rule** power rule combined with chain rule using chain rule with the other rules for derivatives 3.10 & 3.8 finding derivatives by **Implicit Differentiation** using implicit differentiation to compute slope of tangent line at a given point using implicit differentiation to find derivatives of inverse functions, e.g. **inverse trig functions** 3.9 formula for the derivative of general exponential function b^x change of base formula for logarithms formula for the derivative of $\ln x$ and $\log_b x$ definitions of the 6 basic **hyperbolic functions** how hyperbolic identities compare to trig identities derivatives of hyperbolic functions	
9	5/23	3.11 applying chain rule to **related rates** word problems **Exam 2** 4.1 **linearization** of a function: using the tangent line to approximate the function computing **differentials** and using them to approximate errors and **relative error**	
11	5/24	4.2 recognizing **absolute** extrema vs. **local extrema** on a graph **Extreme Value Theorem** for absolute extrema of any continuous function on closed interval Fermat's Theorem for local extrema definition of a **critical point** local extrema can only occur at critical numbers, but there are critical numbers which don't have local extrema 3-step method of finding absolute max and min of a function on a closed interval **Rolle's Theorem** 4.3 proving the **Mean Value Theorem**	

		using Mean Value Theorem to help prove a function has exactly one real root using Mean Value Theorem to prove $f'(x)=0$ on an interval implies f is constant there using **1st derivative sign charts** to determine **increasing** and **decreasing** behavior **1st Derivative (Sign Chart)Test** for local extrema 4.4 using **2nd derivative sign charts** to determine **concavity** and **points of inflection** the **2nd Derivative Test for Local Extrema**: recognizing when it's inconclusive	
Week	**Dates**	**Approximate schedule : Sections covered and topics**	
12	5/25-26	4.5 using **L'Hopital's Rule** to find limits of $\frac{0}{0}$ *and* $\frac{\infty}{\infty}$ indeterminate forms finding limits of products and differences indeterminate forms 4.6 using 1st and 2nd derivative sign charts to sketch graph of polynomial, rational , and other types of functions graphs which have horizontal, vertical and slant asymptotes 4.7 solving **max-min word problems** **justifying** that your answer is an absolute extremum : if there is only one local extremum on an interval, then that local extremum is absolute	
13	5/27	4.8 **Newton's Method** for approximating zeros of a function examples where Newton's Method fails 4.9 definition of an **antiderivative** finding the most general antiderivative **indefinite integrals** and integral notation basic rules for integration: integrals for polynomial and trig functions using initial conditions to find **particular solutions** to 1st order differential equations 5.1 **sigma notation** for summations some basic formulas for summations, Bernoulli's formula **inscribed** and **circumscribed** rectangles left endpoint and right endpoint and midpoint approximations of area beneath curves	
14	5/30-31	5.2 **Riemann sums**	

		computing definite integral by taking limit of Riemann sums properties of definite integrals , including comparison theorem 5.3 using 1st **Fundamental Theorem of Calculus** to evaluate definite integrals 5.4 using **2nd Fundamental Theorem of Calculus** to find derivative of definite integrals with respect to variables in the limits of integration	
Week	**Dates**	**Approximate schedule : Sections covered and topics**	
15	6/1	5.5 **Net Change Theorem**: definite integral of a derivative gives the total change in the function evaluating more definite integrals displacement as the integral of velocity 5.6 **method of u-substitution** for indefinite and definite integrals application to integrating even and odd functions 5.7 Defining natural logarithm as integrals indefinite integrals with formulas involving inverse trig functions 5.8 law of natural growth and natural decay using exponential growth and decay models to represent population growth and radioactive decay	