DE LA SALLE UNIVERSITY
College of Science
Department of Mathematics

CALCBIO – Calculus for Biologists
Prerequisite: TRIGBIO *Prerequisite to:*

Instructor: _____ **Contact details:** _____
Consultation Hours: _____ **Class Schedule and Room:** _____

Course Description

This introductory course familiarizes the students with basic Calculus concepts such as limits, continuity, derivatives, and integrals, and some of their applications to the life sciences.

Learning Outcomes

On completion of this course, the student is expected to present the following learning outcomes in line with the Expected Lasallian Graduate Attributes (ELGA)

ELGA	Learning Outcome
Critical and Creative Thinker	• Define the concept of the limit of a function, and apply the theorems on limits to evaluate the limits of given functions. • Define continuity of a function and visualize the graphical representation of the concept of limit and continuity of function. • Define the derivative of a function and apply appropriate differentiation formulas to evaluate the derivative of various types of functions. • Develop the ability to give different interpretations of derivative such as derivative as slope of tangent line and derivative as rate of change. • Sketch the graphs of varying types of functions using derivatives. • Develop the ability to interpret and analyze problems such as optimization and related rates problems in a logical and systematic manner by applying various mathematical theories and techniques. • Define the concepts of the differential and relate this to solving approximation problems. • Illustrate the process of anti-differentiation or basic techniques of indefinite integration. • Define definite integral and show applications of this in solving varieties of problems like finding area of plane region. • Develop the ability to interpret and analyze problems such as exponential growth and decay problems, population growth problem and work efficiency problem in a logical and systematic manner by applying various mathematical theories and techniques.
Effective Communicator	• Explain clearly the steps in solving the problems given by the teacher. • Participate actively in class discussions. • Present coherent solutions to given problems. • Use appropriate and precise mathematical terms and symbols. • Interpret the results and relate it to real life applications. • Explain at least one application of the derivative. • Distinguish between absolute and relative extrema. • Use straightforward arguments like presenting counterexamples, methods of indirect, direct proof and others. • Express difficulties encountered in learning or understanding various concepts in the course.
Reflective Lifelong Learner	• Build new ideas from basic principles. • Recognize relationships between mathematics and other disciplines. • Understand that mathematics is not a “spectator” sport and that it is a sequential and handy tool once one uses it with success. • Reinforce positive work habits like patience, perseverance and industry in doing exercises. • Recognize problems in real-life situations which can be solved with the aid of concepts learned in class. • Discover solutions to overcome difficulties encountered in

	understanding various lessons in class.
Service-Driven Citizen	• Develop and exhibit the values of honesty, patience, courage, cooperation, self-reliance and appreciation of the work of others. • Acquire the discipline to conquer difficulties not only in Mathematics but also in real life. • Exhibit faith by doing what is right and giving one's best in performing any assigned task. • Show concern for the community through sharing of know-how and resources during group discussion.

Final Course Output

As evidence of attaining the above learning outcomes, the student is required to submit the following during the indicated dates of the term.

LEARNING OUTCOME	Required Output	DUE DATE
• Cooperate and work productively in a group study • Show concern for the community through sharing of know-how and resources during group discussions.	Collaborative activity on solving optimization problems, rate of change and related rates problems.	1 week before final exam
• Appreciate the relevance of mathematics as an effective tool in solving real-life problems. • Present solutions to problems neatly, orderly and accurately. • Gain confidence by doing what is right and giving their best in performing assigned tasks.	Collaborative activity on utilizing integral to solve law of growth and decay problems	1 week before final exam

Rubric for assessment

Collaborative Activity on Solving Systems optimization problems, rate of change and related rates problem.

CRITERIA	Excellent/4	Satisfactory/3	Developing/2	Needs Improvement/1
Understanding (50%)	The solution shows a deep understanding of the problem including the ability to identify the appropriate mathematical concepts and information necessary for its solution.	The solution shows that student has a broad understanding of the problem and the major concepts necessary for its solution.	The solution is not complete indicating that parts of the problem are not understood.	There is no solution, or the solution has no relationship to the task.
Strategies and Procedures (15%)	Uses a very efficient strategy leading directly to a solution. Applies procedures accurately to correctly solve the problem and verifies the result.	Uses strategy that leads to a solution of the problem. All parts are correct and a correct answer is achieved.	Uses a strategy that is partially useful, leading some way toward a solution but not to a full solution of the problem. Some parts may be correct but a correct answer is not achieved.	No evidence of a strategy or procedure uses strategy that does not help solve the problem.
Communication (10%)	There is a clear, effective explanation, detailing how the problem is solved. There is a precise and appropriate use of mathematical terminology and notation.	There is a clear explanation and appropriate use of accurate mathematical representation.	There is some use of appropriate mathematical representation but explanation is incomplete and not clearly presented.	There is no explanation or the solution cannot be understood or it is unrelated to the problem.

Integration (10%)	Demonstrates integration of the concepts presented.	Demonstrates some integration of the concepts presented.	Demonstrates limited integration of the concepts presented.	Demonstrates no integration of the concepts presented.
Accuracy of Computations/ Solutions (15%)	Computations/solutions are correct and explained correctly .	Computations/solutions are correct but not explained well.	Computations/solutions have some errors.	Incorrect computations/ solutions

Additional Requirements

At least 4 quizzes, 1 final exam, Seatwork, Assignments, Recitation, Group Work

Grading System

	FOR EXEMPTED STUDENTS (w/out Final Exam)	FOR STUDENTS with FINAL EXAM	
		with no missed quiz	*With one missed quiz*
Average of quizzes	90%	60%	50%
Seatwork, Assignment, Learning Output	10%	10%	10%
Final exam	-	30%	40%

Scale:

95-100%	4.0
88-94%	3.5
82-87%	3.0
76-81%	2.5
70-75%	2.0
64-69%	1.5
60-63%	1.0
<59%	0.0

Learning Outcome	Culminating Topics	Week No.	Learning Activities
At the end of the course, the students will apply appropriate mathematical concepts, processes, tools, and technologies in the solution to various conceptual and real-world problems.	**I. FUNCTIONS, LIMITS AND DERIVATIVE** 1.1 Limits Intuitive Definition of a Limit Evaluating Limits using graph Properties of Limits Indeterminate Form $\frac{0}{0}$ Limit at Infinity pp 111-114 #1 to 86 1.2 One-sided Limits and Continuity Evaluating One-sided limits Continuity of a Function at a Number Properties of Continuous Functions pp 126-127 #1 to 60 1.3 The Derivative Slope of a Tangent Line Average Rate of Change Instantaneous Rate of Change Derivative of a Function Differentiability and Continuity pp 146-147 # 9 to 39	Weeks 1-4	• Give an overview of the nature of limits and its role in calculus *Outside activity:*The students may be asked to read the discussion on the nature of limits at the website *analyzemath.com/c/calculus/limits* • Introduce the concept of limits using intuitive and graphical approach • Use appropriate theorems in evaluating limit of several types of functions • Discuss continuity of functions at a point and on an interval and its implications • Introduce the notion of tangent line to a curve at a point using graphical and intuitive approach • Define the derivative of a function and relate it to the concept of the slope of the tangent line to a curve at a point. • Examine relationship between continuity and differentiability • *Pre-discussion exercises, instruction add-ons and practice exercises may be taken from the following sites* • analyzemath.com/calculus/limits • archives.math.utk.edu/visual.calculus • tutorial.math.lamar.edu Review Exercises: pp153-155 # 1-35, 47, 51

	II. DIFFERENTIATION
	2.1 Basic Rules of Differentiation
	pp 165-166 #1 to 36, 41 to 52, 61, 62, 68, 70, 71 , 73 to 76
	2.2 Product Rule and Quotient Rule
	pp 177-179 # 1 to 55, 60,63
	2.3 Chain Rule
	pp 189-190 # 1 to 54, 63 to 66, 71 to 73, 77, 78, 80
	2.4 Higher Order Derivative
	p 213 #1 to 28
	2.5 Implicit Differentiation and Related Rates
	pp 225-228 # 1 to 40, 50 to 65
	2.6 Differentials
	pp 235-236 # 1 to 18, 29 to 33
		Weeks 5-7	• Apply differentiation theorems on algebraic and trigonometric functions
			• Discuss the chain rule as applied to algebraic functions and the chain rule in general
			• Discuss implicit differentiation for implicit functions
			• Illustrate the interpretation of derivative as rate of change and its various practical applications
			• Relate implicit differentiation to solving related rates problems
			• Discuss approximations using differentials
			
			• *Pre-discussion exercises, instruction add-ons and practice exercises may be taken from the following sites*
			  • analyzemath.com/calculus
			  • archives.math.utk.edu/visual.calculus
			  • tutorial.math.lamar.edu
			
			Review Exercises:
			pp 240-243 # 1-50, 60,61, 65

	III. APPLICATIONS OF DERIVATIVE
	3.1 Applications of First Derivative
	Increasing and Decreasing Functions
	Relative Extrema
	Critical Number
	First Derivative Test
	pp 257-260 # 1 to 7, 3 to 69
	3.2 Applications of Second Derivative
	Concavity
	Points of Inflection a
	Second Derivative Test
	pp 276-280 #1 to 9, 29 to 76
	3.3 Optimization I
	Absolute Extrema on a Closed Interval
	pp 306-307 # 1 to 28, 64 to 66, 69, 73, 74
	3.4Optimization II
	Maximization Problems
	Minimization Problems
	pp 319-320 # 1 to 16
		Weeks 8-9	• Illustrate and distinguish the difference between local and absolute extrema
			
			• Expose students to different applications of relative and absolute extrema
			
			• Discuss important concepts in analyzing the behavior of functions
			
			• *Pre-discussion exercises, instruction add-ons and practice exercises may be taken from the following sites*
			  • analyzemath.com/calculus
			  • archives.math.utk.edu
			  • tutorial.math.lamar.edu
			
			Review Exercises:
			pp 324-326 # 1-32, 46, 47, 48

	IV. EXPOENTIAL & LOGARITHM FUNCTIONS 4.1 Differentiation of Exponential Function pp 365-369 # 1 to 34, 58 to 62, 68 to 70, 75 to 81 4.2 Differentiation of Logarithmic Function pp 377-379 1 to 54, 65 to 66,71, 84 to 89 4.3 Exponential Function as Mathematical Model Exponential Growth Exponential Decay Learning Curves Logistic Growth Functions pp 387-391 # 1 to 35	Weeks 10-11	• Discuss derivatives of transcendental functions • Discuss the various applications of exponential function to processes of growth and decay, learning curve and logistic growth Review Exercises: pp 395-396 # 15-32, 49, 50, 52, 55, 56, 58
	V. INTEGRATION 5.1 Antiderivative and Rules of Integration pp 406-407 # 9 to 50 5.2 Integration by Substitution pp 418-419 # 1 to 50, 55 to 65 5.3 Area and Definite Integral (Geometric interpretation using a single curve) 5.4 The Fundamental Theorem of Calculus Evaluating Definite Integral p 439 # 1 to 40 5.5 Evaluating Definite Integrals Properties of the Definite Integral p 449 # 1 to 28 p 452 # 74 to 76	Weeks 11-13	• Define Anti-derivative • Establish basic rules of integration • Discuss integrals of transcendental functions and its applications to processes of growth and decay • Set up the geometric interpretation of the definite integral • Present graphical interpretation of the applications of definite integrals in finding area of plane region Review Exercises: pp 481-484 # 1-32, 45, 53, 54, 56, 71
	FINAL EXAMINATION	3 hours	

P.S. Number of hours for quizzes are already included in the total time allotted for the topics.

TEXTBOOK :***Applied Calculus for the Managerial, Life, and Social Science (A Brief Approach), (9th edition)*** **by Soo T. Tan**

References

Edwards, C.H. and Penney, D.E. (2008) *Calculus: Early Transcendentals* (7th ed.) Upper Saddle River, NJ: Pearson/Prentice Hall.

Hoffman, L.D. and Bradley, G.D. (2010) *Calculus for Business, Economics and the Social and Life Sciences (10th ed).* Boston: McGraw-Hill Higher Education

Larson, R.E, Hostetler, R. & Edwards, B.H. (2008) *Essential Calculus: Early Transcendental Functions*. Boston: Houghton Mifflin

Leithold, L. (2002) The Calculus 7 (Low Price Edition) Addison-Wesley

Smith, Robert T., Minton, Roland B. (2012), *Calculus*, New York : McGraw Hill

Tan, Soo T. (2012) *Applied Calculus for the Managerial, Life, and Social Sciences : A Brief Approach*, Australia : Brooks/Cole Cengage Learning

Waner, Stefan, Costenoble,Steven R. (2007) *Applied Calculus,*. Belmont, CA : Thomson Brooks/Cole.

Online Resources

Free Calculus Tutorials and Problems Accessed October 11, 2012 from http://analyzemath.com/calculus/
Visual Calculus Accessed October 11, 2012 from http://archives.math.utk.edu/visual.calculus
tutorial.math.lamar.edu
Dawkins, P. (2012) *Paul's Online Math Notes* Accessed October 11, 2012 from http://tutorial.math.lamar.edu

Class Policies

1. The required minimum number of quizzes for a 3-unit course is 3, and 4 for 4-unit course. No part of the final exam may be considered as one quiz.
2. Cancellation of the lowest quiz is not allowed even if the number of quizzes exceeds the required minimum number of quizzes.
3. As a general policy, no special or make-up tests for missed exams other than the final examination will be given. However, a faculty member may give special exams for
   A. approved absences (where the student concerned officially represented the University at some function or activity).
   B. absences due to serious illness which require hospitalization, death in the family and other reasons which the faculty member deems meritorious.
4. If a student missed two (2) examinations, then he/she will be required to take a make up for the second missed examination.
5. If the student has no valid reason for missing an exam (for example, the student was not prepared to take the exam) then the student receives 0% for the missed quiz.
6. Students who get at least 89% in every quiz are exempted from taking the final examination. Their final grade will be based on the average of their quizzes and other prefinal course requirements. The final grade of exempted students who opt to take the final examination will be based on the prescribed computation of final grades inclusive of a final examination. Students who missed and/or took any special/make-up quiz will not be eligible for exemption.
7. Learning outputs are required and not optional to pass the course.
8. Mobile phones and other forms of communication devices should be on silent mode or turned off during class.
9. Students are expected to be attentive and exhibit the behavior of a mature and responsible individual during class. They are also expected to come to class on time and prepared.
10. Sleeping, bringing in food and drinks, and wearing a cap and sunglasses in class are not allowed.
11. Students who wish to go to the washroom must politely ask permission and, if given such, they should be back in class within 5 minutes. Only one student at a time may be allowed to leave the classroom for this purpose.
12. Students who are absent from the class for more than 5 meetings will get a final grade of 0.0 in the course.
13. Only students who are officially enrolled in the course are allowed to attend the class meetings.

Approved by:

DR. ARTURO Y. PACIFICADOR, JR
Chair, Department of Mathematics