DE LA SALLE UNIVERSITY
College of Science
Department of Mathematics

MATH116 – *Mathematics Analysis 4*
Prerequisite: MATH115 *Prerequisite to: ADVACA1, NUMEANL*

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

Course Description

A continuation of MATH115 (Analysis 3). It covers vectors in the plane and 3-dimensional space, directional derivatives and gradients, applications of partial derivatives to extrema of functions of several variables, evaluation of multiple integrals in spherical and cylindrical coordinates.

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 Effective Communicator Lifelong Learner Service-Driven Citizen	At the end of the course, the student will be able to draw planes and lines in 3-dimensional space, apply the calculus concepts to vector-valued functions, locate extrema of functions of two variables and apply directional derivatives and gradient in solving real world problems.

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
At the end of the course, the student will be able to draw planes and lines in 3-dimensional space, apply the calculus concepts to vector-valued functions, locate extrema of functions of two variables and apply directional derivatives and gradient in solving real world problems	Collaborative activity on exploring use of math software in sketching graphs of functions in 3-dimensional space.	End of 7th week
	Collaborative activity in locating maximum and minimum values of 2 functions of 2 variables and identifying at least 1 real world application of directional derivatives and gradient.	1 week before final exam

Rubric for assessment

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 3 quizzes, 1 final exam, Seatworks, 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	95%	65%	55%
Seatwork, Assignment, Learning Output	5%	5%	5%
Final exam	-	30%	40%

Scale:

95-100%	4.0
89-94%	3.5
83-88%	3.0
78-82%	2.5
72-77%	2.0
66-71%	1.5
60-65%	1.0
<59%	0.0

Learning Plan

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. Vectors, Planes, and Lines In Space** 1.1 Vectors in the Plane 1.2 Vectors in 3-diensional Space 1.3 Dot Product 1.4 Planes and Lines in R3 1.5 Cross Product	Week 1-4 (12 hrs)	• Introduce vectors in the plane and in 3-dimensional space and their operations. • Draw planes and lines in R3. • Find equations of planes and lines in R3. • Find the dot product and cross product of vectors and their applications.
	II. Vector-Valued Functions 2.1 Vector-Valued Functions and Curves in R3 2.2 Calculus of Vector-Valued Functions	Week 5-6 (6 hrs)	• Introduce vector-valued functions in the plane and in 3-dimensional space. • Sketch the graphs of vector-valued functions. • Compute the derivatives and integrals of vector-valued functions.
	III. Differential Calculus of Functions of More Than One Variable 3.1 Directional Derivatives and Gradients 3.2 Tangent Planes and Normal Lines to Surfaces 3.3 Extrema of Functions of	Week 7-8 (6 hrs)	• Define directional derivative and gradient of functions of two and three variables and give their applications. • Find equations of tangent plane and normal line to surfaces. • Locate relative extrema of functions of two variables and apply to real-life situations.

	Two Variables 3.4 Lagrange Multipliers		• Apply Lagrange Multiplier method to find the relative extrema of a function subject to equality constraint.
	IV. Multiple Integration 5.1 Cylindrical and Spherical Coordinates 5.2 Double Integrals 5.3 Double Integrals in Polar Coordinates 5.4 Triple Integrals 5.5 Triple Integrals in Cylindrical and Spherical Coordinates	Week 11-13 (9 hrs)	• Introduce cylindrical and spherical coordinates. • Evaluate double integrals and its applications. • Evaluate double integrals using polar coordinates. • Evaluate triple integrals in rectangular coordinates. • Evaluate triple integrals using cylindrical and spherical coordinates. Illustrate the use of iterated integrals to evaluate multiple integrals.
	FINAL EXAMINATION	**(2 hrs)**	

References

Anton, H. (2002) Calculus (7th ed.) New York: Wiley

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

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

Simmons, G.F. (1996) Calculus with Analytic Geometry (2nd ed.) New York: McGraw-Hill

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

Vargerg, D.E., Purcell, E.J. & Rigdon, S.E. (2007) *Calculus* (9th ed) Upper Saddle River, N.J.:Pearson Education International

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

April, 2014