LAGUARDIA COMMUNITY COLLEGE
CITY UNIVERSITY OF NEW YORK
DEPARTMENT OF MATHEMATICS, ENGINEERING AND COMPUTER SCIENCE

MAT 201 - CALCULUS I
PRE-REQUISITES: MAT 200 (PRECALCULUS) OR ITS EQUIVALENT BY WAIVER

CATALOG DESCRIPTION: This course is the first of a three-course sequence designed to provide students with an appreciation of the usefulness and power of calculus. It covers fundamentals of differential calculus of elementary functions and includes an introduction to integral calculus. Among the topics studied are: limits, continuity, derivatives, applications of derivatives to graphing and optimization, the Mean Value Theorem, the Area Problem, Riemann sums, indefinite/definite integrals, and the Fundamental Theorem of Calculus.

ENTRY LEVEL SKILLS: The student should understand the concept of function and have a good algebraic and graphical knowledge of elementary polynomial, trigonometric, exponential and logarithmic functions. Furthermore, the student should be able to simplify algebraic expressions and solve algebraic equations.

TEXT: ***Calculus: Early Transcendentals*** **(Eighth Edition) by James Stewart, Published by Brooks/Cole Cengage Learning (2016), ISBN: 9781285741550**

INSTRUCTIONAL OBJECTIVES: During this course, the instructor expects to:

1. Introduce the notion of limit of a function, including one-sided limits.
2. Introduce various methods of computing limits, including limit laws, the Squeeze Theorem, and L'Hospital's rule.
3. Provide students with a brief historical background on the Tangent Line Problem, and its leading to the definition of the derivative of a function.
4. Introduce the meaning of derivative of a function, both in terms of slopes of secant and tangent lines, and average and instantaneous rates of change, leading to the formal definition of derivative of a function using limits.
5. Introduce the derivatives of elementary functions, including polynomials, algebraic functions, trigonometric and inverse trigonometric functions, exponential and logarithmic functions.
6. Introduce the differentiation rules used to compute the derivatives of a sum, difference, product, quotient, and/or composition of functions.
7. Introduce special types of differentiation such as implicit differentiation and logarithmic differentiation.
8. Enable students to apply calculus to compute maxima and minima of functions and solve problems arising in applications and other fields of study that require optimizing functions.
9. Enable students to use the first and second derivatives to obtain information about the increasing/decreasing behavior of a function and/or concavity of its graph, and to use this information to sketch the graph of that function, fairly accurately.
10. Provide students with a brief historical background on the Area Problem, and its leading to the notion of definite integral.
11. Introduce the precise definition of definite integrals using limits of Riemann sums.

12. Introduce the Fundamental Theorem of Calculus and enable students to apply it to calculate definite integrals and appreciate its importance.
13. Introduce the Substitution Rule as a method for computing certain types of integrals.

PERFORMANCE OBJECTIVES: At the conclusion of this course, students will be able to:

1. Compute limits both formally and graphically, and give graphical examples of functions satisfying given limit conditions.
2. Compute limits by applying limit laws, the Squeeze Theorem, and L'Hospital's rule.
3. Define, in English sentences, the tangent line to the graph of a function at a given point, and explain how it historically led to the notion of derivative of a function.
4. Explain, in English sentenses, the meaning of derivative of a function, both in terms of slopes of tangent and secant lines, and in terms of average and instantaneous rates of change and, apply the definition of the derivative to compute it.
5. Compute derivatives of elementary functions, including polynomials, algebraic functions, trigonometric and inverse trigonometric functions, exponential and logarithmic functions.
6. Compute the derivative of a sum, difference, product, quotient, and/or composition of functions by applying differentiation rules such as the Product Rule, Quotient Rule, and the Chain Rule.
7. Compute derivatives using special methods such as implicit differentiation and logarithmic differentiation.
8. Compute maxima and minima of functions using calculus and solve optimization problems arising in applications and other fields of study.
9. Analyze a given function in order to determine its intervals of increase/decrease and intervals of concavity and use this information to draw a fairly accurate graph of that function.
10. Describe the Area Problem and its historical connection to definite integrals, interpret definite integrals as net area under the graph of a function, and compute definite integrals geometrically, when the regions consist of geometric shapes such as semi-circles, triangles, and/or rectangles.
11. Interpret and write a given definite integral in terms of limit of a Riemann sum, and vice versa.
12. Compute definite integrals using the Fundamental Theorem of Calculus and the connection between definite integrals and anti-derivatives.
13. Compute certain types of integrals using the Substitution Rule.

STUDENT LEARNING OBJECTIVES: This course fulfills the Pathways common core with the following student learning objectives:

1. Gather, interpret, and assess information from a variety of sources and points of view.
2. Evaluate evidence and arguments critically or analytically.
3. Produce well-reasoned written or oral arguments using evidence to support conclusions.
4. Identify and apply the fundamental concepts and methods of a discipline or interdisciplinary field exploring the scientific world, including, but not limited to: computer science, history of science, life and physical sciences, linguistics, logic, mathematics, psychology, statistics, and technology-related studies.

5. Demonstrate how tools of science, mathematics, technology, or formal analysis can be used to analyze problems and develop solutions.
6. Articulate and evaluate the empirical evidence supporting a scientific or formal theory.
7. Understand the scientific principles underlying matters of policy or public concern in which science plays a role.

GRADING: Your grade will be based on your performance on the quizzes, class worksheets, tests, and a final exam that the instructor will give. Class worksheets are problems that the instructor will give students to solve in class, in order to assess students' learning during that particular class. Quizzes could be based on homework assignments. The instructor may also count solutions to homework assignments as a factor in the grade. In any case, you are encouraged to work out solutions to unassigned problems (in addition to the assigned problems) to acquire more practice, which is essential for success in mathematics. You are urged to meet with the instructor frequently during the semester to discuss your progress. The table below shows how your grade will be calculated:

- **Homework and/or Class worksheets** (9 is recommended): 9%
- **Quizzes** (8 is recommended): 16%
- **Tests** (3 is recommended): 45%
- **Final Exam**: 30%

COURSE SYLLABUS AND OPTIONS: The instructor may choose one of the two options described below, to introduce course topics. The difference between the two options is just the order according to which topics are introduced in the course:

OPTION I: This option closely follows the textbook and topics are introduced in the same order that they appear in the textbook.

OPTION II: In this option differentiation and anti-differentiation are introduced first, regarded as operations on functions. That is, differentiation and anti-differentiation are operations that can be applied to a function according to certain rules, and the result is another function. After the "mechanics" of these two operations have been introduced and practiced, the instructor will introduce their "meanings" in the second part of the course. The third and last part of the course is devoted to "applications".

GENEREL POLICIES:

ATTENDANCE: Attendance is mandatory. A student who misses more than 15 minutes of a class will be marked as late by the instructor. Three lateness will be considered an absence. *More than 6 hours of unexcused absences may result in a WU or F grade.*

ACADEMIC INTEGRITY: In certain instances, at the discretion of the instructor, a student may be asked to demonstrate his/her ability of conceptually understanding the work he/she submitted. In such instances, depending on the course modality, the instructor may ask any student for a written, in-person, or oral (live video session) clarification or explanation of solutions to any assignment, including homework, quizzes, tests, final exam, etc.

Solutions submitted by students for any assignment in this course, including homework, quizzes, tests, final exam, etc., must be based on the covered material. Solutions that are based on material that was not or will not be covered in this course, or will be covered but has not been covered yet, will not be accepted and will receive no credit.

EXAMS: This course will have three Tests and one Cumulative Final Exam. Regardless of the teaching modality (in-person, hybrid, online), the Final Exam will be administered on paper in a classroom on the LaGuardia Community College campus.

COURSE SYLLABUS (OPTION I)			
Lecture	**Topics**	**Sect.**	**Section Homework Assignment**
1	The Tangent and Velocity Problems The Limit of a Function	2.1 2.2	p. 82: 1 to 8 p. 92: 1 to 9,11,16,18,21,24,27,28,32,33,36,37,40,42
2	Calculating Limits Using the Limit Laws	2.3	p. 102: 1,2,4,5,6,8,9,10,12,15,18,22,25,26,27,37,38,39,40, 46,50,51,52
3	The Precise Definition of a Limit (Optional) Continuity	2.4 2.5	p. 113: 1 to 4,11,13,14,20,21,22,26,28,29 p. 124: 1,3,4,6,8,11,14,16,18,20,21,27,28,29,36,37,39,42, 43,46,47,51 to 56
4	Limits at Infinity; Horizontal Asymptotes	2.6	p. 137: 1,2,3,4,5,8,10,13,18 to 24, 27 to 40,49,52,67
5	Derivatives and Rates of Change The Derivative as a Function	2.7 2.8	p. 148: 1,3 to 12,14,16 to 23,26,29,33,34,38,39,40,51,53,56 p. 160: 1 to 11,15,18,24,26,27,35,39,41 to 44,47 to 52
6	Derivatives of Polynomials and Exponential Functions	3.1	p. 180: 1,3,5,6,8,9,10,13,14,16,18,19,23,29,32,33,34,36,48 49,55 to 58
7	The Product and Quotient Rules Derivatives of Trigonometric Functions	3.2 3.3	p. 188: 1,3,4,6,10,11,12,14,15,20,23,28,29,32,41,44,46,50 p. 196: 1 to 9,12,13,16,18,21,22,30,39 to 43,48 to 50,52
8	**TEST 1**		
9	The Chain Rule	3.4	p. 204: 8,9,10,11,12,13,16,18,21,22,23,24,26,27,28,31,35, 36,45,48,50,53,54,59,66,72
10	Implicit Differentiation and Derivatives of Inverse Trigonometric Functions	3.5	p. 215: 2,3,8 to 20,25 to 31,35 to 40,49 to 54,57
11	Derivatives of Logarithmic Functions Related Rates	3.6 3.9	p. 223: 2 to 12,14,15,19,22,23,24,27,30,32,34,51,52 p. 249: 1,3 to 6,10,12,14,15,17,18,21,26,29,30
12	Linear Approximations and Differentials	3.10	p. 256: 4,11,13 to 17,20,21,25 to 31,36,43
13	Maximum and Minimum Values	4.1	p. 283: 1 to 6,8,10,12,13,15,16,23,27,30,34,35,36,39,42,43, 44,49,51,52,54,56,59 to 62
14	The Mean Value Theorem How Derivatives Affect Shape of a Graph	4.2 4.3	p. 291: 1,2,3,5,6,9,11,12,13,17,25,26,27 p. 300: 1,2,5,6,7,8,10,12,13,15 to 18,20,22,26,30,31,34,35, 36,38,43,45,46,52,53,55
15	Indeterminate Forms and L'Hospital's Rule	4.4	p. 311: 1 to 7,11 to 15,17,19,21,22,23,30,31,32,35,36,44, 46,47,51,53,54
16	Summary of Curve Sketching	4.5	p. 321: 4,5,11,16,18,21,22,23,26,39,44,51,54
17	Optimization Problems Newton's Method	4.7 4.8	p. 337: 4,5,6,8,12,14,15,16,21,22,27,32,36,41,42,54 p. 348: 1,3,4,5,6,8,14,20,22,24,28
18	**TEST 2**		
19	Antiderivatives	4.9	p. 355: 2,6,7,8,10,11,13 to 18,21,22,33,36,42 to 48,51 to 55
20	Areas and Distances The Definite Integral	5.1 5.2	p. 375: 1 to 4,8,13,14,18,21,22,24,25,26 p. 388: 1,2,4,5,6,17 to 20,29,30,33,34,36,38,40,41,48 to 52
21	The Fundamental Theorem of Calculus	5.3	p. 399: 1 to 5,7,8,10,11,13,14,16,18,22,29,30,32,34,35,36, 37,40,41,56,59,62,66,68,73,74,76
22	Indefinite Integrals and the Net Change	5.4	p. 408: 2,3,5,6,9 to 12,14 to 17,22,25 to 32,37,39,42,43,51, 53,56
23	The Substitution Rule	5.5	p. 418: 2,7,8,10,12,14,18,20,21,22,23,25,30,31,32,39,40, 42 to 45,4857,59,60,67,70,71,77
24	**TEST 3**		
25	**Final Exam**		

COURSE SYLLABUS (OPTION II)			
Lecture	**Topics**	**Sect.**	**Section Homework Assignment**
1	Derivatives of Polynomials and Exponential Functions	3.1	p. 180: 1,3,5,6,8,9,10,13,14,16,18,19,23,29,32,33,34,36,48 49,55 to 58
2	The Product and Quotient Rules Derivatives of Trigonometric Functions	3.2 3.3	p. 188: 1,3,4,6,10,11,12,14,15,20,23,28,29,32,41,44,46,50 p. 196: 1 to 9,12,13,16,18,21,22,30,39 to 43,48 to 50,52
3	The Chain Rule	3.4	p. 204: 8,9,10,11,12,13,16,18,21,22,23,24,26,27,28,31,35, 36,45,48,50,53,54,59,66,72
4	Implicit Differentiation and Derivatives of Inverse Trigonometric Functions	3.5	p. 215: 2,3,8 to 20,25 to 31,35 to 40,49 to 54,57
5	Derivatives of Logarithmic Functions Antiderivatives	3.6 4.9	p. 223: 2 to 12,14,15,19,22,23,24,27,30,32,34,51,52 p. 355: 2,6,7,8,10,11,13 to 18,21,22,23,36,42 to 48,51 to 55
6	The Tangent and Velocity Problems The Limit of a Function	2.1 2.2	p. 82: 1 to 8 p. 92: 1 to 9,11,16,18,21,24,27,28,32,33,36,37,40,42
7	Calculating Limits Using the Limit Laws	2.3	p. 102: 1,2,4,5,6,8,9,10,12,15,18,22,25,26,27,37,38,39,40, 46,50,51,52
8	**TEST 1**		
9	The Precise Definition of a Limit (Optional) Continuity	2.4 2.5	p. 113: 1 to 4,11,13,14,20,21,22,26,28,29 p. 124: 1,3,4,6,8,11,14,16,18,20,21,27,28,29,36,37,39,42, 43,46,47,51 to 56
10	Limits at Infinity; Horizontal Asymptotes	2.6	p. 137: 1,2,3,4,5,8,10,13,18 to 24, 27 to 40,49,52,67
11	Derivatives and Rates of Change The Derivative as a Function	2.7 2.8	p. 148: 1,3 to 12,14,16 to 23,26,29,33,34,38,39,40,51,53,56 p. 160: 1 to 11,15,18,24,26,27,35,39,41 to 44,47 to 52
12	Areas and Distances The Definite Integral	5.1 5.2	p. 375: 1 to 4,8,13,14,18,21,22,24,25,26 p. 388: 1,2,4,5,6,17 to 20,29,30,33,34,36,38,40,41,48 to 52
13	The Fundamental Theorem of Calculus	5.3	p. 399: 1 to 5,7,8,10,11,13,14,16,18,22,29,30,32,34,35,36, 37,40,41,56,59,62,66,68,73,74,76
14	Indefinite Integrals and the Net Change	5.4	p. 408: 2,3,5,6,9 to 12,14 to 17,22,25 to 32,37,39,42,43,51, 53,56
15	The Substitution Rule	5.5	p. 418: 2,7,8,10,12,14,18,20,21,22,23,25,30,31,32,39,40, 42 to 45,4857,59,60,67,70,71,77
16	Indeterminate Forms and L'Hospital's Rule	4.4	p. 311: 1 to 7,11 to 15,17,19,21,22,23,30,31,32,35,36,44, 46,47,51,53,54
17	Maximum and Minimum Values	4.1	p. 283: 1 to 6,8,10,12,13,15,16,23,27,30,34,35,36,39,42,43, 44,49,51,52,54,56,59 to 62
18	**TEST 2**		
19	The Mean Value Theorem How Derivatives Affect Shape of a Graph	4.2 4.3	p. 291: 1,2,3,5,6,9,11,12,13,17,25,26,27 p. 300: 1,2,5,6,7,8,10,12,13,15 to 18,20,22,26,30,31,34,35, 36,38,43,45,46,52,53,55
20	Summary of Curve Sketching	4.5	p. 321: 4,5,11,16,18,21,22,23,26,39,44,51,54
21	Optimization Problems	4.7	p. 337: 4,5,6,8,12,14,15,16,21,22,27,32,36,41,42,54
22	Newton's Method Related Rates	4.8 3.9	p. 348: 1,3,4,5,6,8,14,20,22,24,28 p. 249: 1,3 to 6,10,12,14,15,17,18,21,26,29,30
23	Linear Approximations and Differentials	3.10	p. 256: 4,11,13 to 17,20,21,25 to 31,36,43
24	**TEST 3**		
25	**Final Exam**		