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

**MAT 203 - CALCULUS III**
**PRE-REQUISITES: MAT 202 (CALCULUS II)**

**CATALOG DESCRIPTION:** This is the third course in the calculus sequence and is designed to build upon the concepts and techniques of MAT201 and MAT202 and provide a more rigorous conceptual grounding for the entire sequence. Topics include 3-dimensional analytic geometry and vector analysis, calculus of functions of several variables including limits and continuity; partial derivatives; maxima and minima; Lagrange multipliers; double, triple, line and surface integrals; Curl and Divergence; and Green's, Stokes and Divergence Theorems.

**ENTRY LEVEL SKILLS**: The student should have good computational skills for evaluating derivatives of polynomials, rational functions, trigonometric and inverse trigonometric functions, exponential and logarithmic functions, as well as functions obtained from these by elementary operations and/or composition. The student should also have good computational skills for evaluating various types of integrals using different integration techniques, such as integration by substitution, integration by parts, trigonometric substitutions, partial fraction decomposition, etc. The student is also expected to be familiar with polar coordinates.

**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 geometry and algebra of vectors in 2- and 3-dimensions.
2. Introduce and investigate limits and continuity of functions of several variables.
3. Introduce partial differentiation and directional differentiation and their applications.
4. Provide students with the theory of relative extrema for functions of several variables, including the generalized second derivative test and the method of Lagrange multipliers.
5. Introduce iterated and multiple integrals.
6. Introduce line and surface (flux) integrals.
7. Introduce Green's, Stoke's and Divergence Theorems and their applications, via boundary/surface parameterization.
8. Familiarize students with MATLAB and enable them to use this software to solve applied Calculus III problems.

**Performance Objectives:** At the conclusion of this course, students will be able to:

1. Calculate the dot and cross products of two vectors and write equations of lines and planes in 3-space.
2. Calculate limits of functions of several variables and determine their points of continuity.
3. Calculate partial derivatives and directional derivatives of functions of several variables.

4. Locate/analyze relative extrema using partial differentiation, the generalized second derivative test and the Lagrange multipliers method
5. Compute double and triple integrals.
6. Compute line integrals and surface integrals.
7. Convert area/volume integrals to line/surface integrals, and vice versa, by applying Green's, Stoke's and Divergence Theorems.
8. Analyze and solve geometric, computational, and symbolic problems for the above topics, using MATLAB.

**MATLAB:** This Calculus III course has a MATLAB component and will include MATLAB homework and project. The instructor will *not* teach MATLAB during the class hours, but will introduce students to MATLAB and will provide them with a MATLAB booklet (e.g., notes available at http://math.sci.ccny.cuny.edu/document/show/5507) and will assign Calculus III related homework problems and a project that should be solved and completed using MATLAB. Students will use the MATLAB notes provided to them, to learn simple MATLAB commands and use them to analyze and solve the assigned Calculus III problems. MATLAB is available to all CUNY students and staff for free download. MATLAB is also installed in most computer labs in LaGuardia, including the Engineering lab, and students can use these computers to work on their MATLAB assignments.

**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.*

**GRADING:** Your grade will be based on your performance on the quizzes, class worksheets, tests, MATLAB homework, MATLAB project, 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 your instructor frequently during the semester to ask your questions and discuss your progress. The table below shows how your grade will be calculated:

- **Homework and/or Class worksheets** (10 is recommended): 10%
- **Quizzes** (5 is recommended): 15%
- **Tests** (2 is recommended): 30%
- **MATLAB Homework** (5 is recommended): 5%
- **MATLAB Project**: 10%
- **Final Exam**: 30%

| COURSE SYLLABUS | | | |
|---|---|---|---|
| **Lecture** | **Topics** | **Sect.** | **Section Homework Assignment** |
| 1 | Three-dimensional Coordinate Systems<br>Vectors | 12.1<br>12.2 | p. 796: 2,3,6,7,8,10,11,14,15,19,20,26,30,35,37,38,40<br>p. 805: 1,2,4,6,8,11,14,18,21,24,25,26,27,28,41,42 |
| 2 | The Dot Product<br><br>The Cross Product | 12.3<br><br>12.4 | p. 812: 1,4,6,7,8,10,14,19,20,22,24,25,28,30,31,32,36,43, 44,47<br>p. 821: 5,6,7,10,13,14,18,20,28,30,32,34,36,38,43,44 |
| 3 | Equations of Lines and Planes | 12.5 | p. 831: 1,3,4,9 to 12,14,18,22,25,26,28,30,33,36,38,47,48, 53,54,55,58,59,68 |
| | Cylinders and Quadratic Surfaces (Optional) | 12.6 | p. 839: 1 to 4,6,8,14,15,17,20 to 29,33,34,38,44<br>For MATLAB: 39 to 42,53 |
| 4 | Vector Functions and Space Curves<br><br>Derivatives/Integrals of Vector Functions | 13.1<br><br>13.2 | p. 853: 1 to 6,9,14,16,18,19,21 to 27,31,41 to 46<br>For MATLAB: 34,36,39,40,51<br>p. 860: 1,3,5,8,9 to 16,18,20,21,24 to 27,34 to 40,42 |
| | Arc Length and Curvature (Optional) | 13.3 | p. 868: 1,4,6,11,14,18,19,22,23,24,29,30,33,38,48 |
| | Motion in Space: Velocity and Acceleration (Optional) | 13.4 | p. 878: 1,2,4,6,8,11,13,14,16,19,20,21,37,40,41 |
| 5 | Functions of several variables | 14.1 | p. 899: 2,5,7,9 to 12,14,15,18,20,21,27,28,32,33,36,38,41, 42,46,48,49,61 to 67,69<br>For MATLAB: 57,58,74,79 |
| 6 | Limits and Continuity | 14.2 | p. 910: 1 to 6,8,11,12,13,14,16,17,18,20,26,29,32,33,37,38<br>For MATLAB: 24,28,43 |
| 7 | Partial Derivatives | 14.3 | p. 923: 1,3,4 to 10,12,16,17,19,20,27,29,32,33,36,41,42, 45,49,50,53,60,62,65,69,71,73,76<br>For MATLAB: 14,98 |
| 8 | Tangent Planes and Linear Approximation | 14.4 | p. 934: 2,3,4,6,12,13,16 to 19,26,30 to 34<br>For MATLAB: 8,10 |
| 9 | **TEST 1** | | |
| 10 | The Chain Rule | 14.5 | p. 943: 3,4,5,6,8,10,12 to 15,20,21,24,29,30,33,34 |
| 11 | Directional Derivatives and the Gradient Vector | 14.6 | p. 956: 1,4,6,8,9,10,14,15,16,18,19,20,23,24,26,28,29,32, 43,45,46,49,50 |
| 12 | Maximum and Minimum Values | 14.7 | p. 967: 1 to 4,6,9,12,15,16,19,20,22,31,34,37,43,44,45,48<br>For MATLAB: 27 to 30 |
| 13 | Lagrange Multipliers | 14.8 | p. 977: 1,4,5,6,8,10,12,17,20 to 23,25,45<br>For MATLAB: 47,48 |
| 14 | Double Integrals Over Rectangles | 15.1 | p. 999: 1,2,3,6,10,11,12,15,16,18,20,22,23,27,28,30,32,33, 36,38,40,41,42<br>For MATLAB: 45,46 |
| 15 | Double Integrals Over General Regions<br><br><br>Double Integrals in Polar Coordinates | 15.2<br><br><br>15.3 | p. 1008: 3 to 6,8 to 11,14,16,18,21,22,24,25,29,32,37,46, 47,49,50,52,55,56,58<br>For MATLAB: 41,70<br>p. 1014: 1 to 4,6 to 9,12,13,16,17,18,21,22,24,26,29,32 |
| | Applications of Double Integrals (Optional) | 15.4 | p. 1024: 1,2,4,7,9,11,16,24,27,28,29 |
| 16 | Triple Integrals | 15.6 | p. 1037: 2,5 to 10,12,13,15,16,17,19,20,22,28,29,30,33,36 |
| 17 | Triple Integrals in Cylindrical Coordinates<br>Triple Integrals in Spherical Coordinates | 15.7<br>15.8 | p. 1043: 2,4,6,7,8,10,16 to 24,29,30<br>p. 1049: 2,4,6,7,8,10,13,14,15,18 to 27,30,35,36,42,43 |
| 18 | **TEST 2** | | |
| 19 | Change of Variables in Multiple Integrals | 15.9 | p. 1060: 2,3,4,8 to 11,13 to 19,23 to 27 |
| 20 | Vector Fields<br><br>Line Integrals | 16.1<br><br>16.2 | p. 1073: 2,4,5,10 to 18,21,24,26,29 to 34<br>For MATLAB: 19,28<br>p. 1084: 2,3,5,6,7,11 to 14,17,18,20,22,39,40,41 |

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| 21 | Fundamental Theorem for Line Integrals<br>Green's Theorem | 16.3<br>16.4 | p. 1094: 1,2,3,5 to 8,10 to 14,16,17,19 to 24,26,28,31 to 32<br>p. 1101: 1 to 5,7,9,10,12,13,14,18,28<br>For MATLAB: 15,16 |
| 22 | Curl and Divergence | 16.5 | p. 1109: 1,3,4,6 to 12,14,15,17,18,19,22,25,26,27,30 |
| 23 | Surface Integrals<br><br>Stoke's Theorem | 16.7<br><br>16.8 | p. 1132: 1,2,5,6,8,9,12,14,15,17,19,20,21,23,24,26,28,31<br>For MATLAB: 33,34,35,36<br>p. 1139: 1,2,3,4,6,7,8,10,13,14,16,17,18 |
| 24 | The Divergence Theorem | 16.9 | p. 1145: 1,2,4,5,7,8,9,11,12,18,19,24,27,28<br>For MATLAB: 15,16 |
| | **Final Exam** | | |