ESSEX COUNTY COLLEGE
Mathematics and Physics Division
MTH 221 – Calculus with Analytic Geometry III
Course Outline

Course Number & Name: MTH 221 Calculus with Analytic Geometry III

Credit Hours: 4.0 **Contact Hours:** 4.0 **Lecture:** 4.0 **Lab:** N/A **Other:** N/A

Prerequisites: Grade of "C" or better in MTH 122 or placement

Co-requisites: None **Concurrent Courses:** None

Course Outline Revision Date: Fall 2010

Course Description: This course is a continuation of MTH 122, covering the theory and applications of vector differential and integral Calculus in R^2 and R^3. Topics include parametric curves, general vector fields, partial derivatives, vector differential operators, non-rectangular coordinate systems, multiple integrals, the change of variables theorems, and the vector integral theorems of Green, Gauss and Stokes.

General Education Goals: The aggregate of the core courses required for any major at ECC have the following goals:

1. **Written and Oral Communication**: Students will communicate effectively in both speech and writing.
2. **Quantitative Knowledge and Skills**: Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.
3. **Scientific Knowledge and Reasoning**: Students will use the scientific method of inquiry through the acquisition of scientific knowledge.
4. **Technological Competency/Information Literacy**: Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.
5. **Society and Human Behavior**: Students will use social science theories and concepts to analyze human behavior and social and political institutions and to act as responsible citizens.
6. **Humanistic Perspective**: Students will analyze works in the field of art, music, or theater; literature; and philosophy and/or religious studies; and will gain competence in the use of a foreign language.
7. **Historical Perspective**: Students will understand historical events and movements in World, Western, non-Western, or American societies and assess their subsequent significance.
8. **Global and Cultural Awareness of Diversity**: Students will understand the importance of global perspective and culturally diverse peoples.
9. **Ethics**: Students will understand ethical issues and situations.

Course Goals: Upon successful completion of this course, students should be able to do the following:

1. demonstrate knowledge of the fundamental concepts and theories from calculus; (GEG 2)
2. utilize various problem-solving and critical-thinking techniques to set up and solve applied problems in engineering, sciences, business and technology fields; (GEG 2)
3. communicate accurate mathematical terminology and notation in written and/or oral form in order to explain strategies to solve problems as well as to interpret found solutions; (GEG 1, GEG 2) and
4. use appropriate technology, such as graphing calculators and computer software, effectively as a tool to solve such problems as those described above. (GEG 2)

Measurable Course Performance Objectives (MPOs): Upon successful completion of this course, students should specifically be able to do the following:

1. Demonstrate knowledge of the fundamental concepts and theories from calculus:

   1.1 define vectors and their applications in R^2 *and* R^3*, including the vector differential operators* ∇f *(gradient),* $\nabla \cdot f$ *(divergence) and* ∇ *x f (curl);*
   1.2 evaluate partial derivatives, directional derivatives and total differentials to solve applications in tangent planes, extreme values and local linearity; and
   1.3 evaluate double and triple integrals, and line and surface integrals, using the change of variables theorem for multiple integrals and describe the interrelations between these integrals by using Green's Theorem, Gauss's Theorem and Stokes' Theorems

2. Utilize various problem-solving and critical-thinking techniques to set up and solve applied problems in engineering, sciences, business and technology fields:

   2.1 *determine derivatives of vector functions to find curvature and velocity and acceleration of moving objects*;
   2.2 *apply total differentials to approximate the value of multiple variables functions*;
   2.3 *calculate double and triple integrals to determine the surface area and volume of solids*; and
   2.4 *Apply line integrals and surface integrals to calculate work and flux arising in physics applications*

3. Communicate accurate mathematical terminology and notation in written and/or oral form in order to explain strategies to solve problems as well as to interpret found solutions:

   3.1 w*rite and explain solutions to related rates, optimization, work and flux of flows and other application problems involving two- and three-dimensional spaces*

Measurable Course Performance Objectives (MPOs) (continued):

4. Use appropriate technology, such as graphing calculators and computer software, effectively as a tool to solve such problems as those described above:

   4.1 *use a graphing calculator and/or web based application programs such as Applet to visualize vector fields, and graphs of functions in two- or three-dimensional spaces*; and
   4.2 *use mathematical software such as Mathematica and Maple to calculate partial derivatives and double and triple integrals*

Methods of Instruction: Instruction will consist of a combination of lectures, presentation of sample problems, clarification of homework exercises/textbook material, and general class discussion.

Outcomes Assessment: Test and exam questions are blueprinted to course objectives. Data is collected and analyzed to determine the level of student performance on these assessment instruments in regards to meeting course objectives. The results of this data analysis are used to guide necessary pedagogical and/or curricular revisions.

Course Requirements: All students are required to:

1. Maintain regular attendance; excessive absences will negatively affect student understanding and performance.
2. Complete reading and problem solving homework in a timely manner and contribute to class discussions. Mathematics cannot be understood without doing a significant amount of outside study.
3. Participate in a peer study group that meets regularly and maintains effective member communication links.
4. Take tests and exams when scheduled. **No make-ups will be permitted**. The first missed test will be recorded as a zero until the end of the semester, at which time the **final exam grade will also be used to replace the missing test grade. Grades from any other missed tests will be recorded as irreplaceable zeros**. The Comprehensive Final Exam is required and cannot be rescheduled unless some **extraordinary** event occurs and prior arrangement is made with the instructor.

Methods of Evaluation: Final course grades will be computed as follows:

Grading Components	% of final course grade
• **Optional assignments** Problem sets, research projects, etc. are designed to enhance understanding of the applications of calculus in engineering and related disciplines.	**0 – 10%**
• **3 or more Tests** (dates specified by the instructor) Tests will show evidence of the extent to which students meet course objectives, including, but not limited to, identifying and applying concepts, analyzing and solving problems, estimating and interpreting results, and stating appropriate conclusions using correct terminology.	**60 – 70%**
• **Final Exam** The **comprehensive** final exam will examine the extent to which students have understood and synthesized all course content and achieved all course objectives.	**30 – 35%**

NOTE: The instructor will provide specific weights, which lie in the above-given ranges, for each of the grading components at the beginning of the semester. Also, students may use a scientific or graphing calculator or laptop computer to enhance understanding during class or while doing homework; however, no form of technological aid can be used on tests/exams.

Academic Integrity: Dishonesty disrupts the search for truth that is inherent in the learning process and so devalues the purpose and the mission of the College. Academic dishonesty includes, but is not limited to, the following:

- plagiarism – the failure to acknowledge another writer's words or ideas or to give proper credit to sources of information;
- cheating – knowingly obtaining or giving unauthorized information on any test/exam or any other academic assignment;
- interference – any interruption of the academic process that prevents others from the proper engagement in learning or teaching; and
- fraud – any act or instance of willful deceit or trickery.

Violations of academic integrity will be dealt with by imposing appropriate sanctions. Sanctions for acts of academic dishonesty could include the resubmission of an assignment, failure of the test/exam, failure in the course, probation, suspension from the College, and even expulsion from the College.

Student Code of Conduct: All students are expected to conduct themselves as responsible and considerate adults who respect the rights of others. Disruptive behavior will not be tolerated. All students are also expected to attend and be on time all class meetings. No cell phones or similar electronic devices are permitted in class. Please refer to the Essex County College student handbook, *Lifeline*, for more specific information about the College's Code of Conduct and attendance requirements.

Course Content Outline: based on the text **Calculus: Early Transcendentals,** 6th edition, by Stewart; published by Cengage/Brooks/Cole, 2008; ISBN #: 0-53878256-0

Class Meeting (80 minutes)	Chapter/Section	
	CHAPTER 10 PARAMETRIC EQUATIONS AND POLAR COORDINATES	
1	10.1	Curves Defined by Parametric Equations
	10.2	Calculus with Parametric Curves
2	10.3	Polar Coordinates
	10.4	Areas and Lengths in Polar Coordinates
3	10.5	Conic Sections
	10.6	Conic Sections in Polar Coordinates
	CHAPTER 12 VECTORS AND GEOMETRY OF SPACE	
4	12.1	Three-Dimensional Coordinate Systems
	12.2	Vectors and Geometry of Space
5	12.3	The Dot Product
6	12.4	The Cross Product
7	12.5	Equations of Lines and Planes
8	12.6	Cylindrical and Spherical Coordinates
	CHAPTER 13 VECTOR FUNCTIONS	
9	13.1	Vector Functions and Space Curves
10	13.2	Derivatives and Integrals of Vector Functions
11	13.3	Arc Length and Curvature
12	13.4	Velocity and Acceleration
13	**Test #1** on Chapters 10, 12 & 13	
	CHAPTER 14 PARTIAL DERIVATIVES	
14	14.1	Functions of Several Variables
	14.2	Limits and Continuity
15	14.3	Partial Derivatives
16	14.4	Tangent Planes, Linear Approximation and Differentials
17	14.5	The Chain Rule
18	14.6	The Gradient Vector and Directional Derivatives
19	14.7	Extrema of Functions of Several Variables
20	14.8	Constrained Optimization and Lagrange Multipliers
21	**Test #2** on Chapter 14	
	CHAPTER 15 MULTIPLE INTEGRALS	
22	15.1	Double Integrals over Rectangles
23	15.2	Iterated Integrals
	15.3	Double Integrals over General Regions
24	15.4	Double Integrals in Polar Coordinates
25	15.5	Applications of Double Integrals - Surface Area

Class Meeting (80 minutes)	Chapter/Section	
26	15.6	Triple Integrals
27	15.7	Triple Integrals in Cylindrical Coordinates
28	15.8	Triple Integrals in Spherical Coordinates
29	15.9	Change of Variables in Multiple Integrals
	CHAPTER 16 VECTOR CALCULUS	
30	16.1	Vector Fields
31	16.2	Line Integrals
32	16.3	Independence of Path and Conservative Vector Fields (The Fundamental Theorem for Line Integrals)
33	**Test #3** on Chapters 15 & 16	
34	16.4	Green's Theorem
35	16.5	Curl and Divergence
36	16.6	Parametric Surfaces and Their Areas
37	16.7	Surface Integrals
38	16.8	Stokes' Theorem
39	16.9	The Divergence Theorem
40-41	Review for Final Exam	
42	Comprehensive **Final Exam** on all course material covered	