Carthage Mathematics Department
Course Summary for Math 2120: Multivariate Calculus

1. Credits: 4
2. Semesters Offered: Spring
3. Text(s): *Calculus: Multivariable Calculus* (2nd ed.), by Jon Rogawski
4. Topics Covered:
    a. Calculus of curves in 2 and 3 dimensions: differentiation and integration; arc length; velocity, speed, and acceleration
    b. Elementary theory of vectors: Dot and Cross products; orthogonality and parallelism
    c. Differential calculus of multivariate scalar functions: partial and directional derivatives; the gradient; identifying and classifying critical points; absolute extrema; Lagrange's multiplier method
    d. Elementary theory of vector-valued functions
    e. Integral calculus of multivariate scalar functions: Fubini's theorem, change of coordinates theorem
    f. Elementary theory of vector fields: graphing, gradient vector fields, flow lines
    g. Integration of functions and vector fields over curves and surfaces
    h. Graphing in 3 dimensions: multivariate functions, parameterization, coordinate systems
    i. Applications to Newtonian mechanics (optional): Newton's laws, Kepler's laws, etc.
    j. Advanced integration theorems: Fundamental theorem of gradient vector fields, Green's theorem, Divergence theorem, Stokes' theorem
5. Skills Enhanced:
    a. Problem solving: Students complete several problems that apply the ideas of multivariate calculus (in physics, economics, etc.), in a multi-step process.
    b. Technical writing: Students complete 2-3 major projects (and possibly several smaller projects) in which they analyze a specific problem/issue to be solved (see part a), and integrate mathematical problem-solving with technical writing to produce a report on said problem.
    c. Computer skills: Mathematica, Wolfram Alpha, and/or Graphing Calculator (from Pacific Tech)
6. Sample Syllabus:
    Chapters 9-14. [Note: several subsections (esp. in Chapters 9 and 10) will need to be omitted in order to complete this syllabus in the allotted time.]
7. Course Goals: By the end of the course, students should be able to do the following:
    a. Calculate tangent line equations for parametric curves in Euclidean 3-space.
        i. Assessment: Exams and quizzes include questions that require this knowledge.
    b. Calculate the tangent space equation for multivariable functions.
        i. Assessment: Exams and quizzes include questions that require this knowledge.
    c. Use the Lagrange multiplier method to find extrema of multivariable functions on simple compact regions in Euclidean space.
        i. Assessment: Exams and quizzes include questions that require this knowledge.
    d. Write vector and multivariable calculus material using correct notation and appropriate form.
        i. Assessment: Homework is evaluated on correctness of writing as well as computation.
        ii. Assessment: Writing assignments are evaluated for correct notational usage, and formatting.
    e. Use the change of coordinates theorem to evaluate double- and triple-integrals.
        i. Assessment: Exams and quizzes include questions that require this knowledge.
    f. Use the fundamental theorems of vector fields (Green's, Stokes', and/or Divergence) correctly, and where appropriate.
        i. Assessment: The final exam includes questions that require this knowledge.
    g. Demonstrate sufficient knowledge of the course content.
        i. Assessment: Exams, quizzes, and homework assignments. Sufficient knowledge is required to obtain a passing grade.