Course Title & Number: MAT*H268 Calculus III - Multivariable

Competency Area: **QUANTITATIVE REASONING** (Goal: Students will learn to recognize, understand, and use the quantitative elements they encounter in various aspects of their lives. Students will develop a habit of mind that uses quantitative skills to solve problems and make informed decisions.)

Faculty submitting the Learning Outcomes: Jane Wampler, Harry Burt, Ruth Urbina-Lilback ***Date***: 3/7/13

[Instructions: *Please match the Learning Outcomes in the left hand column to those of the course you are submitting for Gen Ed approval. List the corresponding course outcomes in the right hand column to indicate a match*.]

BOR TAP's Learning Outcomes	Corresponding Outcomes for Course Named Above
1. Represent mathematical and quantitative information symbolically, graphically, numerically, and verbally.	F1. Define and sketch vector fields. Determine whether a vector field is conservative.
2. Apply quantitative methods to investigate routine and novel problems. This includes calculations/procedures, mathematical and/or statistical modeling, prediction, and evaluation.	B3. Eliminate parameters. Eliminate the parameter in a set of parametric equations. B4. Find parametric equations for a graph. Find parametric equations to represent a curve. B5. Find the derivative in parametric form. B6. Find arc length and areas of surfaces of revolution. B8. Find slope in polar form. B9. Find area and arc length in polar coordinates. B10. Solve applied problems. Solve applied problems using Kepler's Laws. C2. Find the length and direction of a vector. C3. Find sums and differences of vectors. C4. Calculate the dot product. C5. Define a vector-valued function. C5.1 Analyze and sketch a space curve given by a vector-valued function. C6. Find limits of, differentiate, and integrate vector-valued functions. C7. Calculate the cross product of two vectors. C8. Graph lines, planes, surfaces, curves, and vector-valued functions in

	space. C8.2. Find the arc length and curvature of a space curve. C9. Solve applied problems. D4. Find the limit of a function of two variables. D6. Take partial derivatives of functions of several variables. D7. Find differentials of functions of several variables. D8. Use the chain rule and implicit partial differentiation. Use the chain rule and implicit partial differentiation on functions of several variables. D9. Find directional derivatives and gradients. D10. Find equations for tangent planes and normal lines to surfaces. D11. Find extrema of functions of two variables. D12. Solve optimization problems. E1. Integrate with respect to a given variable. E2. Find areas by iterated integrals. E3. Evaluate double integrals. E4. Find volumes by double integrals. E5. Find areas of polar regions. E6. Calculate mass, center of mass, and moments of inertia. E7. Use multiple integration to calculate surface area. E8. Evaluate triple iterated integrals and apply results to finding volumes, centers of mass, and moments of inertia. F2. Find the curl and divergence of a vector field. F3. Evaluate line integrals and use the fundamental theorem of line integrals. F4. Use Green's Theorem to evaluate line integrals. F6. Find the area of a parametric surface. F7. Evaluate surface integrals. F8. Use the Divergence Theorem to evaluate integrals. Use the Divergence Theorem to evaluate surface integrals in terms of triple integrals. F9. Use Stokes's Theorem to evaluate integrals. Use Stokes's Theorem to evaluate line integrals in terms of surface integrals.
3. Interpret mathematical and quantitative information and draw logical inferences from representations such as formulas, equations, graphs,	B4. Find parametric equations for a graph. Find parametric equations to represent a curve. B10. Solve applied problems. Solve applied problems using Kepler's

tables, and schematics.	Laws. C5.1. Analyze and sketch a space curve given by a vector-valued function. D12. Solve optimization problems. F4. Use Green's Theorem to evaluate line integrals. F8. Use the Divergence Theorem to evaluate integrals. Use the Divergence Theorem to evaluate surface integrals in terms of triple integrals. F9. Use Stokes's Theorem to evaluate integrals. Use Stokes's Theorem to evaluate line integrals in terms of surface integrals.
4. Evaluate the results obtained from quantitative methods for accuracy and/or reasonableness.	Evaluate the results obtained from quantitative methods for accuracy and/or reasonableness.
	Additional Outcomes A1. Write equations of parabolas, ellipses, and hyperbolas in standard form. A2. Graph conic sections. B1. Define a plane curve. B2. Sketch graphs of parametric equations. B7. Plot points and graphs using polar coordinates. C1. Plot vectors in two and three dimensions. C8.1. Define Tangent Vectors and Normal Vectors. D1. Define functions of two and three variables. D2. Find the domain of a function of several variables. D3. Sketch the graph of a function of two variables. D5. Discuss the continuity of functions of two and three variables. F3.1. Define Independence of Path F5. Define and sketch parametric surfaces.