**UT Math1930 Submission for OTM Calculus II – TMM 006**

**Learning Outcomes:**

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|   | Learning Outcome Description | Describe how the Courses or Programs address each outcome |
| 1 | \*Use antiderivatives to evaluate definite integrals and apply definite integrals in a variety of applications to model physical, biological or economic situations. Whatever applications (e.g. determining area, volume of solids of revolution, arc length, area of surfaces of revolution, centroids, work, and fluid forces) are chosen, the emphasis should be on setting up an approximating Riemann sum and representing its limit as a definite integral. | Students will use definite integrals to find volumes of rotation, arc lengths, centroids, work, and fluid forces. To solve for the desired quantity in these application problems, students will identify a pertinent interval of the independent variable and divide that interval into subintervals of equal width. Students will construct a formula which estimates the value of the desired quantity within each subinterval. Students will recognize the summation of subinterval estimates as a Riemann sum and an estimate of the desired quantity over the whole interval. Students will find the exact value of the desired quantity by using a definite integral to find the limit of the Riemann sum as the number of subintervals increases to infinity.  |
| 2 | Approximate a definite integral by the Trapezoidal Rule and Simpson’s Rule. | Not addressed. |
| 3 | \*Employ a variety of integration techniques to evaluate special types of integrals, including substitution, integration by parts, trigonometric substitution, and partial fraction decomposition. | Students will continue the analysis of the inverse process of differentiation, from Calc I, to develop further techniques of integration including integration by parts from the product rule. Students will develop further integration techniques by combining trigonometric identities with the method of substitution to obtain the technique of trigonometric substation; and by reversing the process of adding rational expressions by means of common denominators to obtain the technique of partial fractions. |
| 4 | \*Evaluate limits that result in indeterminate forms, including the application of L’Hôpital’s Rule. | This is addressed primarily in Calc I. In this semester the student will further apply this technique to transcendental functions and in convergence criteria for series. |
| 5 | \*Evaluate improper integrals, including integrals over infinite intervals, as well as integrals in which the integrand becomes infinite on the interval of integration. | Students will apply the integration techniques above together with the limit concept from Calc I to evaluate improper integrals, including both those over infinite intervals and those with finite singularities.  |
| 6 | Find, graph, and apply the equations of conics, including conics where the principal axes are not parallel to the coordinate axes. | These topics are addressed at the discretion of the instructor. |
| 7 | \*Determine the existence of, estimate numerically and graphically, and find algebraically the limits of sequences. Determine whether a series converges by using appropriate tests, including the comparison, ratio, root, integral and alternating series tests. | Students will review the concept of sequential limit from Calc I and then use this to begin a study of infinite series. Students will study the geometric series and obtain a closed form for its partial sums then evaluate the infinite sum by computing the limit of its partial sums. In particular students will learn the conditions which imply convergence or divergence. Students will study further explicit examples, including the harmonic series, and use these to distinguish between absolute and conditional convergence. Students will apply the explicit analysis of geometric series together with the comparison test to develop and apply further tests for convergence, including the ratio and root tests. Students will combine the comparison tests together with the concept of Riemann sum and the techniques of indefinite integral to derive the integral test for convergence of a series. |
| 8 | \*Find the nth Taylor polynomial at a specified center for a function and estimate the error term. Use appropriate techniques to differentiate, integrate and find the radius of convergence for the power series of various functions. | Students will study the expression of a function as an infinite power series, again beginning with the example of the geometric series. Students will use term-wise operations to derive the Taylor, Maclaurin, and binomial formulas; and to develop power series representations of familiar functions such as logarithmic and inverse trigonometric functions Students will employ the concepts and techniques for general series (above) determine intervals of convergence.  |
| 9 | \*Analyze curves given parametrically and in polar form and find the areas of regions defined by such curves. | Students will study parametric curves through the analysis of the motion of a particle in the plane. Students will employ the chain rule to derive expressions for the slope and concavity and use these to graph the curves. Students will review the definition of polar coordinates and then combine the parametric techniques with trigonometric identities to develop and evaluate integrals for the areas enclosed by polar graphs. |
| 10 | Perform and apply vector operations, including the dot and cross product of vectors, in the plane and space. | Students will study three-dimensional coordinate systems, with a focus on linear equations in 2 or more variables, including parametric equations. Students will interpret linear equations as dot products in a vector representation. Students will study the geometry of the dot and cross products using trigonometry and then will apply the geometry of these operations in physical situations, including force and velocity.  |
| 11 | Solve separable differential equations. Understand the relationship between slope fields and solution curves for differential equations. Use Euler’s method to find numerical solutions to differential equations. | Not addressed. |