WINONA STATE UNIVERSITY

COLLEGE OF SCIENCE AND ENGINEERING

DEPARTMENT OF MATHEMATICS AND STATISTICS

**Course Outline – MATH 313**

**Course Title:** Differential Equations

**Number of Credits:** 3

**Catalog Description:** Solution techniques for ordinary differential equations including boundary/initial value problems and systems of first-order equations. Topics include linear homogeneous and non-homogeneous differential equations, the Laplace transform, and systems of differential equations. Prerequisite: MATH 213 – Calculus II and either MATH 242 – Linear Algebra or concurrent enrollment in MATH 314 – Linear Algebra for Differential Equations.

**Possible Textbooks:**

* *Differential Equations & Linear Algebra* by Edwards & Penny
* *Differential Equations: Matrices and Models* by Bugl
* *Differential Equations & Linear Algebra* by Greenberg.

**Topics Covered:**

1. Differential Equations and Modeling
2. First-Order DEs
   1. Classifying DEs
   2. E/U Theorem
   3. Qualitative Analysis
   4. Numerical methods
   5. Analytic Methods
   6. Bifurcations
3. First Order Systems of DEs
   1. Euler's Method
   2. Eigenvalue analysis
   3. Converting DEs to systems
   4. Forced & non-autonomous systems
   5. Non-linear systems
4. Series Solutions
5. LaPlace Transforms

**Listing of Sections to be Covered:** Not applicable to this course, since there is no standard textbook. Chosen sections of any text should correspond to the topics outlined above.

**Remarks:** None.

**Approximate pace of coverage:**

**Method of Instruction:** Lecture-presentation, discussion, question-answer sessions,

use of calculators/computers, group work.

**Evaluation Procedure:** Homework, quizzes, projects, midterm exams, and a final exam.

# **General Education: Mathematics/Statistics Intensive:** *The following language should appear in the syllabus for this course.*

# This is a General Education course that satisfies the Mathematics/Statistics Intensive requirement. Mathematics 313 contains requirements and learning activities that promote students' abilities to...

1. practice the correct application of mathematical or statistical models that are appropriate to their prerequisite knowledge of those areas; and
2. make proper use of modern mathematical or statistical methods appropriate to their level of prerequisite knowledge, to include, if statistics is used in a substantive way, the use of a statistical package with graphics capability when appropriate.

**Relation of Topics Covered to Basic Skills:** In the description of class topics and requirements below, these objectives in this list are referred to by **a-b.**

* Differential Equations and Modeling. **a-b.**
* First-Order Differential Equations
  + Type of equations: autonomous, non-autonomous, linear, non-linear, separable. **a-b.**
  + Techniques for analyzing: existence/uniqueness theorem, slope fields, phase plots, numerical integration, separation of variables, integrating factors. **a-b.**
  + Bifurcations **a-b.**
* First Order Systems of Differential Equations
  + Modeling with systems. **a-b.**
  + Euler's Method with systems. **a-b.**
  + Linear systems and eigenvalue analysis. **a-b.**
  + Converting second order equations to systems. **a-b.**
  + Forcing and non-autonomous systems. **a-b.**
  + Non-linear systems, linearization, series solutions. **a-b.**
* Series Solutions. **a-b.**
* LaPlace Transforms. **a-b.**

**Minnesota Transfer Curriculum:** Not Applicable

**MnSCU Learning Outcomes:**

* Students will model physical situations with differential equations.
* Students will classify and analyze transient and asymptotic behavior of DEs using qualitative methods.
* Students will approximate the solutions to DEs using numerical methods.
* Students will solve first and second order DEs using analytic methods.
* Student will analyze linear systems of DEs using eigenvalue methods.
* Students will use linearization to analyze non-linear systems of DEs.
* Students will demonstrate proficiency in series methods and LaPlace Transform methods of solving DEs.

**Last Revised:** Spring 2013 by the Mathematics Subgroup (Double-checked Spring 2016)