**1. COURSE TITLE\*:** Differential Equations

2. **CATALOG – PREFIX/COURSE NUMBER/COURSE SECTION\*: MATH 2230**

**3. PREREQUISITE\*:** Math 2222 or the equivalent of two semesters of Calculus.

**COREQUISITE(S)\*: None**

**4. COURSE TIME/LOCATION/MODALITY: (*Course Syllabus – Individual Instructor Specific*)**

**5. CREDIT HOURS\*:** 4 **LECTURE HOURS\*:** 4

**LABORATORY HOURS\*:** 0 **OBSERVATION HOURS\*:** 0

**6. FACULTY CONTACT INFORMATION: *(Course Syllabus – Individual Instructor Specific)***

**7. COURSE DESCRIPTION\*:**

**T**his course is an introduction to ordinary differential equations. Topics include first-order and higher order differential equations, power series solutions, polynomial operators, Laplace transforms, and numerical methods for solving ordinary differential equations. Applications to physical problems will be emphasized.

**8. LEARNING OUTCOMES\*:**

At the completion of this course the student will be able to:

1. Solve first-order differential equations that are separable, linear or exact. (OMT020 – Outcome 1)
2. Solve first-order differential equations by making the appropriate substitutions, including homogeneous and Bernoulli equations. (OMT020 – Outcome 2)
3. Use linear or nonlinear first-order differential equations to solve application problems such as exponential growth and decay, population logistics growth, velocity, solution mixtures, two component series circuits and chemical reactions. (OMT020 – Outcome 3)
4. Understand the relationship between slope fields and solution curves for differential equations. Use a slope field and an initial condition to estimate a solution curve to a differential equation. (OMT020 – Outcome 4)
5. Solve higher-order homogeneous linear equations with constant coefficients. (OMT020 – Outcome 7)
6. Solve higher-order non-homogeneous linear equations with constant coefficients by the method of undetermined coefficients. (OMT020 – Outcome 8)
7. Solve higher-order non-homogeneous linear equations by the method of variation of parameters. (OMT020 – Outcome 9)
8. Use linear second-order differential equations to solve application problems such as spring/mass system motion problems, acceleration, or three component series circuits. (OMT020 – Outcome 10)
9. Solve application problems requiring the use of higher-order differential equations with boundary conditions. (OMT020 – Outcome 11)
10. Use power series to solve higher-order differential equations about ordinary or singular points. (OMT020 – Outcome 12)
11. Perform operations with Laplace and inverse Laplace transforms to solve higher-order differential equations. (OMT020 – Outcome 14)
12. Use polynomial operators and their inverses to solve linear differential equations.

**9.       ADOPTED TEXT(S)\*:**

*Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences*

1st Edition

By: Tenenbaum and Pollard

Dover Publications, 1985

ISBN# 0-486-64940-7

**9a: SUPPLEMENTAL TEXTS APPROVED BY FULL TIME DEPARTMENTAL FACULTY (INSTRUCTOR MUST NOTIFY THE BOOKSTORE BEFORE THE TEXTBOOK ORDERING DEADLINE DATE PRIOR TO ADOPTION) \*\*\*.**

**10. OTHER REQUIRED MATERIALS: (SEE APPENDIX C FOR TECHNOLOGY REQUEST FORM.)\*\***

A scientific calculator is required; a graphing calculator is strongly recommended. Symbolic manipulator calculators (e.g., TI–89 or TI-Nspire) are prohibited on tests.

**11. GRADING SCALE\*\*\*:**

Grading will follow the policy in the catalog. The scale is as follows:

A: 90 – 100

B: 80 – 89

C: 70 – 79

D: 60 – 69

F: 0 –

**12. GRADING PROCEDURES OR ASSESSMENTS: (*Course Syllabus – Individual Instructor Specific)***

|  |
| --- |
| *Example 1 - By Percent* |
| Homework 10%  Quizzes/Tests 90%  Total 100% |

|  |  |  |
| --- | --- | --- |
| *Example 2* | | |
| *Category* | *By Total Points* | *% of Grade* |
| Homework (20x10) | 200 | 10% |
| Quizzes/Tests  (5x360) | 1800 | 90% |
| Total | 2000 | 100% |

|  |  |  |
| --- | --- | --- |
| *Example 3* | | |
| *Category* | *By Total Points* | *% of Grade* |
| Online Quizzes | 400 | 100% |
| Online Tests  (6x100) | 600 | 15% |
| Notebook  (2x500) | 1000 | 25% |
| Midterm | 1000 | 25% |
| Final | 1000 | 25% |
| Total | 4000 | 100% |

**13. COURSE METHODOLOGY: *(Course Syllabus – Individual Instructor Specific)***

The course design provides instruction and materials to support the course objectives.  Classes may consist of a variety of means to accomplish this including but not limiting to: lectures, class discussions, small group projects, supplemental materials, and outside assignments.  Practice is an important part of the learning process.  For every one hour of class time, two additional hours of study time should be expected.

**14. COURSE OUTLINE: *(Course Syllabus – Individual Instructor Specific)***

Lessons marked with \* are optional or as needed.

**Chapter 1: Basic Concepts**

Lesson 1 How Differential Equations Originate.\*

Lesson 2 The Meaning of the Terms *Set* and *Function*. Implicit Functions. Elementary Functions.\*

Lesson 3 The Differential Equation.\*

Lesson 4 The General Solution of a Differential Equation.\*

Lesson 5 Direction Field. (OMT020 – Outcome 4)

**Chapter 2: Special Types of Differential Equations of the First Order**

Lesson 6 Meaning of the Differential of a Function. Separable Differential Equations. (OMT020 – Outcome 1)

Lesson 7 First Order Differential Equations with Homogeneous Coefficients.

(OMT020 – Outcome 2)

Lesson 8 Differential Equations with Linear Coefficients. (OMT020 – Standard 2)

Lesson 9 Exact Differential Equations. (OMT020 – Outcome 1)

Lesson 10 Recognizable Exact Differential Equations. Integrating Factors.\*

Lesson 11 The Linear Differential Equations of the First Order [Integrating factor]. Bernoulli Equation. (OMT020 – Outcome 1 & 2)

Lesson 12 Miscellaneous Methods of Solving a First Order Differential Equation.\*

**Chapter 3: Problems Leading to Differential Equations of the First Order**

Lesson 13 Geometric Problems.\*

Lesson 14 Trajectories.\*

Lesson 15 Dilution and Accretion Problems. Interest Problems. Temperature Problems. Decomposition and Growth Problems. Second Order Processes. (OMT020 – Outcome 3)

Lesson 16 Motion of a Particle along a Straight Line—Vertical, Horizontal, Inclined.

(OMT020 – Outcome 3)

Lesson 17 Pursuit Curves. Relative Pursuit Curves.\*

Lesson 17M Miscellaneous Types of Problems Leading to Equations of the First Order.\*

**Chapter 4: Linear Differential Equations of Order Greater than One**

Lesson 18 Complex Numbers and Complex Functions.\*

Lesson 19 Linear Independence of Functions. The Linear Differential Equation of Order *n*.\*

Lesson 20 Solution of the Homogeneous Linear Differential Equation of Order *n* with Constant Coefficients. (OMT020 – Outcome 7)

Lesson 21 Solution of the Non-homogeneous Linear Differential Equation of Order *n* with Constant Coefficients. (OMT020 – Outcome 8)

Lesson 22 Solution of the Non-homogeneous Linear Differential Equation by the Method of Variation of Parameters. (OMT020 – Outcome 9)

Lesson 23 Solution of the Linear Differential Equation with Non-constant Coefficients. Reduction of Order Method.\* (OMT020 – Outcome 6)

**Chapter 5: Operators and Laplace Transforms**

Lesson 24 Differential and Polynomial Operators.

Lesson 25 Inverse Operators.

Lesson 26 Solution of a Linear Differential Equation by Means of the Partial Fraction Expansion of Inverse Operators.

Lesson 27 The Laplace Transform. Gamma Function (OMT020 – Outcome14)

**Chapter 6: Problems Leading to Linear Differential Equations of Order Two**

Lesson 28 Undamped Motion. (OMT020 – Outcome 10)

Lesson 29 Damped Motion. (OMT020 – Outcome 10)

Lesson 30 Electric Circuits. Analog Computation. (OMT020 – Outcome 10)

Lesson 30M Miscellaneous Types of Problems Leading to Linear Equations of the Second Order.\* (OMT020 – Outcome 11)

**Chapter 9: Series Methods**

Lesson 37 Power Series Solutions of Linear Differential Equations.

(OMT020 – Outcome 12)

Lesson 38 Series Solution of *y*´ = *f* (*x*, *y*). (OMT020 – Outcome 12)

Lesson 39 Series Solution of a Nonlinear Differential Equation of Order Greater than One and of a System of First Order Differential Equations.\*

**Chapter 10: Numerical Methods**

Lesson 44 Starting Method. Polygonal Approximations.

Lesson 45 An Improvement of the Polygonal Starting Method.

Lesson 46 Starting Method—Taylor Series.

Lesson 47 Starting Method—Runge-Kutta Formulas. (OMT020 – Outcome 5)\*

Lesson 48 Finite Differences. Interpolation.\*

**15. SPECIFIC MANAGEMENT REQUIREMENTS\*\*\*:**

Students may be required to learn how to use a spreadsheet for the numerical methods portion of the course.

Suggested pace for the course with three tests, by Lesson (section) numbers. Lesson numbers in bold are essential learning outcomes.

Time for essential

learning outcomes (weeks) OMT020 Standard(s)

Week 1: **5, 6** 1 4, 1

Week 2: **6, 7** 1 1, 2

Week 3: **7, 8** 1 2

Week 4: **9, 11** 1 1, 2

Week 5: **11, 15** 1 2, 3

Week 6: **15, 16** 1 3

Week 7: Test 1; **20** 1/2 7

Week 8: **21** 1 8

Week 9: **22, 28** 1 9, 10

Week 10: **28, 29** 1 10

Week 11: **29, 30** 1 10

Week 12: Test 2; 24, 25

Week 13: 26, **27** 1/2 14

Week 14: 37, 38, 44

Week 15: 44, 45, 46, 47

Exam week: Test 3 or **Final**

Instruction time for essential learning outcomes: [**11 weeks (73%)]**

Instruction time for non-essential learning outcomes including operator methods and several numerical methods: **[ 3 weeks (20%)]**

Instruction time for tests (excluding exam week): **[1 week (7%)]**

**16. FERPA:\***

Students need to understand that your work may be seen by others. Others may see your work when being distributed, during group project work, or if it is chosen for demonstration purposes. Students also need to know that there is a strong possibility that your work may be submitted to other entities for the purpose of plagiarism checks.

**17. DISABILITIES:\***

Students with disabilities may contact the Disability Services Office, Central Campus, at 800-628-7722 or 937-393-3431.

**18. OTHER INFORMATION\*\*\*:**

**SYLLABUS TEMPLATE KEY**

**\*** Item cannot be altered from that which is included in the master syllabus approved by the Curriculum Committee.

**\*\*** Any alteration or addition must be approved by the Curriculum Committee

\*\*\*Item should begin with language as approved in the master syllabus but may be added to at the discretion of the faculty member.