College of Arts and Science

MA 306 Differential equations

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| **Instructor:** | **Dr. David Brown** |
| **Office:** | Alumni 74 |
| **Office Hours:** | MWF: 12:30, 2:00 pm T 1:30 pm Al 314 |
| **Email:** | [ddbrown@bju.edu](mailto:ddbrown@bju.edu) |
| **Textbook:**  **Calculator:** | *Any edition of Zill/Cullens Advanced Engineering Mathematics or Differential Equations Textbook. I have proved an online copy. If you want to buy a copy you can, I would recommend a copy of the Advanced Engineering Book*  TI 89 or TI CAS Nspire |

**Catalog Description: MA 306.** Ordinary Differential Equations, methods of solutions and applications, higher order linear equations, series solutions, systems of linear equations, Laplace transforms, and numerical solutions.

**Context:** The faculty of the Division of Mathematical Sciences has developed five broad goals and has aligned these goals with the Bob Jones University Institutional Goals (IG) and the goals of the Bible and Liberal Arts Core (BLA). We believe these goals support the IG/BLA of the University.

*This course also supports one or more of the following goals of the Division of Mathematical Sciences (DG):*

1. Mature the student in the theory and applications of mathematics and computer science.

2. Provide the student the required mathematical and computing background to function and contribute effectively in today’s technological society.

3. Provide the student a platform for continued learning and development of his God-given abilities.

4. Instill in the student a desire to use his abilities in service to Christ.

5. Provide an appropriate liberal arts complement to a wide variety of majors.

*This course also supports one or more of the following goals for a Mathematics Major (MM):*

1. Graduates will exhibit maturity in the development and implementation of mathematical procedures.
2. Exhibit independent and abstract thought and make judgments about the value of innovative developments from a Biblical world view.
3. Display understanding of what constitutes mathematics, including its role within the framework of Biblical Truth.
4. Provide a solid foundation for graduate studies in mathematics.

**Course Content:** This course will cover the following content:

1. First-Order Differential Equations:
2. Definition of and solution methods for First-Order DE’s of the following types:

* Separable
* Linear
* Exact
* Bernoulli
* homogenous

1. Solving Initial/Boundary Value versions of the above DE’s
2. Higher Order Linear Differential Equations:
3. Solution methods for solving both homogeneous and non-homogeneous General Linear DE’s with the following:

* Reduction of Order
* Auxiliary Equations
* Undetermined Coefficients
* Variation of Parameters
* Cauchy-Euler

1. Solving initial/boundary value versions of the above types of DE’s
2. Systems of Linear Differential Equations:
3. Representation of Systems in Matrix (Linear Algebra) form
4. Solutions methods for solving general homogeneous Systems include the following:

* Operator Method
* Distinct Real Eigenvalues
* Repeated Eigenvalues
* Complex Eigenvalues

1. Solution methods for solving general nonhomogeneous Systems include the following:

* Undetermined Coefficients
* Variation of Parameters

1. Solving initial/boundary value versions of both homogenous and nonhomogenous Systems of Linear DE’s.
2. Laplace Transforms:
3. Definition of Laplace Transforms and its application to a variety of functions
4. Definition of Inverse Laplace Transforms and its application to a variety of functions

**BIBLICAL MANDATE FOR THIS COURSE**

The source of wisdom and knowledge is the Lord and a keen mind is a gift from God. Mathematical study should reflect the greatness of God and increase Christlikeness in the believer (Colossians 1:17 and Philippians 2:5). God has given man the capacity to reason mathematically and expects a Christian to be able to reason logically (Isaiah 1:18). The study of mathematics develops the God-given ability to reason. A Christian needs to discern truth and all ideas should be filtered through a biblical worldview. Also, mathematics is the study of the underlying structure of the universe and its intelligent design. Mathematics is an avenue of studying the God-created universe in its complexity, harmony, and precision. In this way the Christian can fulfill his God-given mandate found in Genesis 3:28 to exercise dominion over the earth.

The study of mathematics from a Christian perspective helps a person know God better and imitate Him more closely. The student sees the consistency of God in the consistency of His universe. Because of this consistency, he is able to model a physical law and study it through mathematics. The study of mathematics also helps the Christian to develop Christlike character traits such as diligence, honesty, precision, perseverance, and humility.

**Homework:** Homework will be due the day of quiz or test. Find the homework on the homework page of Canvas. Make sure the homework is neat, well-organized, in order, and legible. Write BIG. Make sure there are no frayed or rough edges to the paper. You may work together on homework. Answers are provided. Make sure you understand the homework before you take the test.

**Take-Homes:** Each Take-home is to be your **own** work. You may not work together or discuss the take-homes with other at all. Do not attempt to find solutions to them online or in other books in the library. You will be required to sign a statement at the end of each take-home stating that you received no improper help on the take-home. You may ask me a question. Make sure the take-home is neat, well-organized, in order, and legible. Write BIG. Disorganized take-home will receive a lower grade. Illegible problems will receive a 0. Make sure there are no frayed or rough edges to the paper.

**Grading Scale:** 90% - 100 % A

80% - 90% B

70% - 80% C

60% - 70% D

**Grade Distribution:** The grade will be based **approx**. on the following.

1. Chapter 1a quiz(Intro to Diff EQ) 30 pts.

2. Chapter 1a H.W. 10 pts.

2. Chapter 2 Test (First Order ODE’s) 100 pts.

3. Chapter 2 H.W. 20 pts.

4. Chapter 2 Take Home 70 pts

5. Chapter 3/4 quiz(Higher Order Diff EQ) 30 pts.

6. Chapter 3/4 Test 100 pts.

7. Chapter 3/4 H.W. 30 pts.

8. Chapter 3/4 Take Home. 70 pts

9. Chapter 10/8Test (Systems) 100 pts.

10. Chapter 10 H.W. 20 pts.

11. Chapter 10 Take Home 70 pts

12. Chapter 4/7 Quest(Laplace Transforms) 40 pts.

13. Chapter 4 H.W. 20 pts

14. Final Exam 150 pts

Total 860 pts.

**Schedule:** Below is a **tentative** schedule. Be flexible. Homework is due day of test.

Jan 15 Quest Chapter 1

Jan 29 Test Chapter 2

Feb 5 Take-home Chapter 2 is due

Feb 12 Quiz Chapter 3

Feb 26 Test Chapter 3

March 4 Take-home Chapter 3 is due

April 1 Test Chapter 10

April 8 Take-home Chapter 10

April 22 Quiz Chapter 4

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