



COURSE SYLLABUS

1. **COURSE TITLE**

Ordinary Differential Equations

2. **COURSE CODE**

MATH2043

3. **PRE-REQUISITE**

MATH1063 Linear Algebra II and MATH1083 Calculus II

4. **CO-REQUISITE**

Nil

5. **NO. OF UNITS**

3

6. **CONTACT HOURS**

42

7. **MEDIUM OF INSTRUCTION (MOI)**

English

8. **OFFERING UNIT**

Applied Mathematics Programme, Division of Science and Technology

9. **SYLLABUS PREPARED & REVIEWED BY**

Prepared by: Dr. Xiaoyi CHEN;

Reviewed by: Dr. Sherry ZHOU

10. **AIMS & OBJECTIVES**

1. To introduce various forms of ordinary differential equations and their solution methods using analytical techniques.
2. Topics include first order, second order and higher order scalar ODE, systems of first order ODE, Laplace transform for initial value problems.

11. **COURSE CONTENT**



Topics

1. Introduction
 - 1) Formulation and Classification of Differential Equations
 2. First Order Differential Equations
 - 1) Linear Equations
 - 2) Separable Equations
 - 3) Exact Equations
 - 4) Substitution Methods
 - 5) Existence and Uniqueness Theorems
 - 6) Direction field
 - 7) Modeling with Differential Equations
 3. Linear Differential Equations
 - 1) Homogeneous Equations with Constant Coefficients
 - 2) Theory of Linear Homogeneous Equations
 - 3) Complex Roots
 - 4) Repeated Roots; Reduction of Order
 - 5) Method of Undetermined Coefficients
 - 6) Variation of Parameters
 - 7) Modeling: Mechanical Vibrations
 - 8) Higher Order Equations
 4. The Laplace Transform
 - 1) Definition of the Laplace Transform
 - 2) Solve Initial Value Problems
 - 3) Step Functions
 - 4) Impulse Functions
 - 5) Convolutional Integral
 5. Systems of First Order Linear Equations
 - 1) Introduction
 - 2) Basic Theory of Systems of First Order Linear Equations
 - 3) Homogeneous Linear Systems with Constant Coefficients
 - 4) Complex Eigenvalues
 - 5) Fundamental Matrices
 - 6) Repeated Eigenvalues
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7) Nonhomogeneous Linear Systems

12. COURSE INTENDED LEARNING OUTCOMES (CILOS) WITH MATCHING TO PILOS

Programme Intended Learning Outcomes (PILOs)

| Programme Title: Bachelor of Science (Honours) in Applied Mathematics | |
|--|---|
| PILO | Upon successful completion of the Programme, students should be able to: |
| PILO 1 | Evaluate the principles, concepts and theories of fundamental mathematics. |
| PILO 2 | Identify problems solvable by applied mathematics in business or other fields and develop critical solutions using appropriate academic and professional knowledge. |
| PILO 3 | Use mathematical software and computer programming/algorithms to solve problems in scientific, engineering, business and other practical fields. |
| PILO 4 | Develop appropriate mathematical models and enhance performance of such models through comparisons and refinements of alternative approaches. |
| PILO 5 | Communicate and practice effectively as a professional mathematician both in team and independent working context. |

CILOs-PILOs Mapping Matrix

| Course Code & Title: MATH2xx3 Ordinary Differential Equations | | |
|--|---|--------------------------|
| CILO | Upon successful completion, students should be able to: | PILO(s) Addressed |
| CILO 1 | Solve ordinary differential equations | PILO 1-3 |
| CILO 2 | Model certain real-life problems mathematically into system of ODE and apply classical solution techniques to find their solutions. | PILO 1-4 |
| CILO 3 | Articulate the importance of differential equations and their applications to real-life problems. | PILOs 4-5 |

13. TEACHING & LEARNING ACTIVITIES (TLAS)

| CILO No. | TLAs |
|-----------------|---|
| CILO 1,2 | <ul style="list-style-type: none">● Lectures : Three hours of lectures will be given per week. This is a very standard course on differential equations. Instructor will explain |



| CILO No. | TLAs |
|----------|--|
| | <p>the concept, definition, theory and proofs to students.</p> <ul style="list-style-type: none">● Tutorials : One hour of tutorials will be given per week. Assignments will be given to students to strengthen their concepts. Solutions to assignment will be given and discussed in tutorials.● Assignments and Quizzes : Assignments and quizzes will be given to students regularly to strengthen their analytical, problem solving and critical thinking skills. |
| CILO 3 | <ul style="list-style-type: none">● Group Discussion : To enhance students' ability to model realistic situations by ordinary differential equations and to solve them analytically to obtain meaningful answers, some challenging questions will be given in class. Students will be required to discuss them by groups, and instructors will guide students to solve problems.● Assignments : Assignments will be given to students regularly to strengthen their analytical, problem solving and critical thinking skills. |

14. ASSESSMENT METHODS (AMS)

| Type of Assessment Methods | Weighting | CILOs Addressed | Description of Assessment Tasks |
|----------------------------|-----------|-----------------|--|
| Assignment & Quizzes | 30% | 1-3 | <p>Quizzes will test and reward students' facility with computational techniques and concepts from lectures and readings</p> <p>Assignments are designed to measure students' understanding of the basic theory.</p> |
| Group project | 20% | 3 | <p>Group project is designed to measure students' ability to apply the knowledge learned in class to real life.</p> |
| Final Examination | 50% | 1-3 | <p>The examination will test the students' understanding of concepts and theorems, and the ability to apply comprehensive knowledge to some practical problems.</p> |

15. TEXTBOOKS / RECOMMENDED READINGS



TEXTBOOK:

W.E. Boyce and R.C. DiPrima (2012), *Elementary Differential Equations and Boundary Value Problems*, 10th Edition, John Wiley & Sons

RECOMMEND READINGS:

1. B. Bai, D. P. Choudhury, H. I. Freedman, *Course in Ordinary Differential Equations*, Alpha Science, U.K., 2013.
2. Dennis G. Zill, *A First Course in Differential Equations with Modelling. Applications*, Cengage Learning, 10th edition, 2012.
3. K. A. Stroud and Dexter Booth, *Differential Equations*, Industrial Press, Inc., 2004.
4. C. Henry Edwards and David E. Penney, *Differential Equations Computing and. Modelling*, Pearson, 4th edition, 2007.
5. R. Bronson, G. B. Costa, *Schaum's Outline of Differential Equations*, McGraw-Hill Education; 4th edition, 2014.
6. W. A. Adkins, M. G. Davidson, *Ordinary Differential Equations*, Springer, 2012.
7. K. B. Howell, *Ordinary Differential Equations: An Introduction to the Fundamental*, CRC Press; 1st edition, 2015.
8. D. G. Schaeffer, J. W. Cain, *Ordinary Differential Equations: Basics and Beyond*, Springer; 1st edition, 2016.
9. J. C. Robinson, *An Introduction to Ordinary Differential Equations*, Cambridge University Press; 1st edition, 2004.
10. P. Blanchard, R. L. Devaney, G. R. Hall, *Differential Equations*, Cengage Learning; 4th edition, 2011.