Mathematics Department

College of Science

Salahaddin University-Erbil

Subject: Ordinary Differential Equations

Course Book –Year 2

B.Sc.

Academic Year: 2022/2023 (Second Semester)

Course Book

1. Course name	**Ordinary Differential Equations**
2. Lecturer in charge	**Dr. Waleed Hussain Aziz**
3. Department/College	**Mathematics/Science**
4. Contact	**E-mail: waleed.aziz@su.edu.krd**
5. Time (in hours) per week	**This course runs at 3 hours per week as a lecture and 1 hours as a tutorial.**
6. Office hours	
7. Course code	**NA**
8. Teacher's academic profile	*Name:* Assis. Prof. **Dr Waleed Hussain Aziz**. *Work Address:* Mathematics Department, College of Science, Salahaddin University-Erbil. **Employment** January 1999 – up to now: Mathematics Department, College of Science, Salahaddin University-Erbil **Qualifications & background** B. Sc., Salahaddin University-Erbil, College of Science, Mathematics Department, Iraq. M. Sc., Salahaddin University-Erbil, College of Science, Mathematics Department, Iraq. PhD, Plymouth University, Faculty of Science and Technology, School of computing and Mathematics, United Kingdom. ***General specialization:*** Mathematics-Differential Equations. ***Specific specialization:*** Qualitative Theory Differential Equations. **Assignments** 2003-2009: Assistant Lecturer, Department of Mathematics, College of Science, Salahaddin University -Erbil, Iraq. 2013: Lecturer, PhD. 2019: Assistant Professor, PhD. **Teaching Interest** Ordinary Differential Equations, Theory of Ordinary Differential Equations, Partial Differential Equations, Calculus, Finite Mathematics, Linear Algebra.

	Research interests Darboux Theory of Integrability, linearizability, Monodromy Argument, Liouvillian Integrability (Liouvillian First Integral) Algebraic Computational. **Professional membership** London Mathematical Society.
9. Keywords	Differential equations, order, degree, homogeneous, exact, linear, Bernoulli equations, Riccati equations, constant coefficients, variable coefficients, Laplace transforms, series solutions.

10. Course overview:

General Description of the module

The subject of differential equations is a very important branch of applied mathematics. Many phenomena from physics, biology and engineering may be described using ordinary differential equations. They are also used to model the behaviour of systems in the natural world, and predict how these systems will behave in the further. For instance, exponential growth (the rate of change of a population is proportional to the size of the population) is expressed by the differential equation $\frac{dP}{dt} = kP$. Newton's Law of Gravitation (acceleration is inversely proportional to the square of distance) translates to the equation $\acute{y} = -ky^2$. Many examples are found in the fields of physics, engineering, biology, chemistry and economics.

The traditional course in differential equations focused on the small number of differential equations for which exact solutions exist. However, the methods used by scientists today have changed dramatically due to computer (using different type of computational package like Maple, Mathematica, reduce, Singular, etc.). Here we will cover almost all methods for solving every kind of ordinary differential equations.

Homework

Homework will be given at every lecture. You should start working on the homework problems for a section as soon as that section is covered in class.

Although you are encouraged to consult with other students and seek help from tutor and me, homework should ultimately represent your own work. Answers unsupported by work will not receive credit. Not all problems may be graded.

Homework should be neatly handwritten or typed, on one side of the page only. Copy the problem in its original form from the lecture (book) and provide the solution to the problem.

Preliminary Reading Material

In order study this module you will need to reread your Calculus notes, especially on differentiation, integration and properties of all types of functions especially transcendental functions. Brush up on Linear Algebra, especially linearly independent and dependent.

11. Course objective:

The aim of this module is to introduce the students to the basic theory and methods of ordinary differential equations and give a competence in solving ordinary differential equations by using different methods of solution of differential equations. Moreover, students also should be able to solve various differential equations (first order and first degree, systems of first order equations, higher degree, higher order, linear and nonlinear equations. They will be faced to Laplace transform method. This method will be introduced applied to solve differential equations. They also be familiar with the series solution method to solve different kind of differential equations.

12. Student's obligation

Class attendance is mandatory. Although I do not have a rigid policy, anyone who has missed lots of class and is doing poorly in the course should not expect much sympathy from me. If you do miss a class, it is your responsibility to make up the material and make sure your homework is turned in on time.

13. Forms of teaching

Modern technological tools will use during the lecture. For instance, data show, iPad, laptop, etc..

14. Assessment scheme

Grades

Grades will be assigned on the basis of 100 points distributed as follows:
30 points carry mark test.
10 points discussion+homework.
60 points final examination.

15. Student learning outcome:

By the end of the module the student should be able to:

- ✓ The student will learn to formulate ordinary differential equations (ODEs) and seek understanding of their solutions.
- ✓ The student will recognise basic types of differential equations, which are solvable, and will understand the features of linear equations in particular.
- ✓ Students will be familiar to derive methods to solve ordinary differential equations.
- ✓ The students will be able to construct simple applied equations in various branches in science.

16. Course Reading List and References

1) Differential Equations: a modeling approach. By Frank R. Giordano and Maurice D. Weir.
2) Elementary Differential Equations. By Earl D. Rainvlle and Philip E. Bedient.
3) Elementary Differential Equations with Linear Algebra. By Ross L Finney and Donald R. Ostbery.
4) Ordinary Differential Equations. By Tyn Myint-V.
5) Differential Equations and Boundary Value Problems. By C. Henry Edward and David E. Penney.
6) Applied Differential Equations. By Murray R. Spoegel.
7) Differential Equations. By C. Ray Wylie.
8) Schaum's Outline Series, Theory and problems of Differential Equations. By Frank Ayres, JR. including 560 solved problems.
9) Schaum's: 2500 solved problem in Differential Equations. By Richard Bronson.
10) A first course in Differential Equations with Application.
11) Introduction to Differential Equations, Lecture notes. By Jeffrey R. Chasnov.
2) Schaum's Outline of Theory and problems of Laplace Transfprms. By Murray R, Spiegel,

17. The Topics:	Lecturer's name
1 Linear differential equations with constant coefficients 1.1 Linear differential equations 1.2 Linear dependence 1.3 Differential operators 1.4 General solution of a non-homogeneous differential equations 1.5 Variation of parameters 1.6 Reduction of orders 1.7 Linear differential equations with variable coefficients 1.7.1 The Cauchy and Legendre linear equations 1.7.2 Solving the Legendre linear equation 1.8 Non-linear differential equations with variable coefficients 1.8.1 Dependent variable missing (absent) 1.8.2 Independent variable missing (absent) 1.9 Second order linear differential equations with variable coefficients 1.10 How one can find the particular solution of a homogeneous differential equation with variable coefficients 1.11 Applications of Second Order Differential Equations 2 The Laplace transformation (Laplace's transform and its application to differential equations 108 2.1 Laplace Transformation	NA

2.2 Laplace transforms of some elementary functions 2.3 Laplace transform of a derivation 2.4 Inverse Laplace Transform 2.5 Initial Value Problems 2.6 Transformation of Initial Value Problems 2.7 Derivative of the Laplace transforms 3 The power series method 3.1 Power Series Method (Power Series Solutions) 3.2 Maclaurin series expansion of some elementary functions 3.3 Solutions around ordinary points 3.4 Frobenius series solution (Solutions near regular singular points)	
18. Practical Topics (If there is any)	
Not applicable.	

19. Examinations:

1. Compositional: The in-class test will test understanding of various methods of solving ordinary differential equations. It is intended that this test will also aid the student in gauging how well they understand the course content. Test questions, in general, will be similar as examples and home works that are given in the lecture notes.

2. True or false type of exams:

Not applicable.

3. Multiple choices:

Not applicable.

20. Extra notes:

Hours per week	Notice	Initial Warning	Last Warning
3	3	6	9

Note that for a semester the hours will divided by 2.

21. Peer review