Mathematics Department

College of Science

Salahaddin University-Erbil

Subject: Dynamical Systems I

Course Book –Year 3

B.Sc.

Academic Year: 2023/2024

Course Book

1. Course name	**Dynamical Systems I**
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. Mathematical Review (MathSciNet).
9. Keywords	System of equations, eigenvalue, eigenvector, Existence Theorem, Uniqueness Theorem, Lipschitz condition, Boundary value problems, Strum-Liouville theory.

10. Course overview:

General Description of the module

This Module is designed for students to learn about the dynamical systems such as solutions of systems, existence, uniqueness theorems and boundary value problems (Strum-Liouville theory).

Theory of differential equations deals with the study of the behaviours of solutions of differential equations. The principal theme of theory of differential equations is, therefore, the investigation of local and global topological properties of phase portraits on the plane or on the higher dimensions. dynamical systems heavily use geometry, linear algebra, algebra, topology, differential geometry and other branches of mathematics. We also investigate Strum-Liouville through initial value problems, boundary value problems as well as eigenproblems.

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

Ordinary differential equations, calculus, linear algebra.

11. Course objective:

Students who have successfully taken this module should be aware of recognition and solving systems of equations by standard methods and exponential matrix. The existence and uniqueness of solutions of differential equations are also studied. The students also must be able to convert a second order differential equations to a Strum-Liouville form and gain information on its solution.

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:
20 points carry mark test.
10 points discussion
5 points homework
5 points assignment
60 points final examination.

15. Student learning outcome:

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

- ✓ The student will recognize basic types of systems of differential equations, which are solvable, and will understand the features of linear system in particular.
- ✓ Students will be familiar to derive methods to solve of differential equations.
- ✓ The students will be able to check whether an equation has a solution and whether it is unique.
- ✓ The students also will be able to convert a second order differential equations to a Strum-Liouville.

1. Review of some concepts 1.1 Revision of Eigenvalues and Eigenvectors 1.2 Characteristic equation 1.3 Linear dependence/independent of vectors 2. System of equations 2.1 Introduction 2.2 Fundamental Matrix 2.3 Homogeneous linear system 2.4 non-Homogeneous linear system 2.5 Exponential matrix 3. Existence and Uniqueness Theorem 3.1 Existence and Uniqueness of solutions of differential equations. 3.2 Lipschitz condition. 3.3 Existence Theorem: The method of successive approximation. 3.4 Uniqueness Theorem. 4. Boundary value problems (Strum-Liouville theory). 4.1 Introduction 4.2 Initial value problems 4.3 Boundary value problems 4.4 Eigenproblem 4.5 Strum-Liouville theory 4.6 conversion of a second order differential equations to a Strum-Liouville 4.7 Some properties of regular Strum-Liouville problems	NA
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

21. Peer review