**Department of Mathematics**

**College of Basic Education**

**Salahaddin University-Erbil**

**Subject: System of Differential equations**

**Course Book – Third Stage**

**Lecturer's name:Hemin Qassim Rahman**

**Academic Year: 2022-2023 -Second Course**

# Course Book

| 1. Course name | Differential equations |
|---|---|
| 2. Lecturer in charge | Hemin Q. Rahman |
| 3. Department/ College | Mathematics / Basic Education |
| 4. Contact | e-mail: **hemin.rahman@su.edu.krd**<br>Tel: 0750 479 1291 |
| 5. Time (in hours) per week | Theory:   3hours in week<br>Practical: 0 |
| 6. Office hours | 6 hours in the week |
| 7. Course code | |
| 8. Teacher's academic profile | <ul><li>B. Sc. in Mathematics, Mathematics Department - College of Education – Salahaddin University - Erbil in 2003.</li><li>M. Sc. In in Mathematical Statistic. Mathematics Department - College of Science Salahaddin University - Erbil in 2009.</li><li>Main activities and responsibilities Teaching Experience: Probability & Statistics, Ordinary Differential Equation , Computer, Calculus , finite mathematic, Foundation of mathematics.</li></ul> |
| 9. Keywords | Laplace Transformation<br>**Find the general solution of** differential equations, linear differential equations<br>**Linear system solution....etc** |

**10.  Course overview:**

Definition of operator +properties +theorems , **solution LDE by using** Laplace transform, **,** Revision of Eigenvalues and Eigenvectors ,Method of solution of Second Order Homogeneous Linear systems of Ordinary Differential Equations

**11. Course objective:**

,use Laplace transform to solution of LDE,and use power series  to solution of LDE, Revision of Eigenvalues and Eigenvectors, Systems of Linear 1st-order ODE's Homogeneous with constant coefficient.

**12.  Student's obligation**

1) Schedule changes may occur during the semester any changes will be announced in class.

2) The student is responsible for all assignments, changes in assignments, or other verbal information given in the class, whether in attendance or not..

## 13. Forms of teaching

**White board and Presentation slides in Power point , Lecture notes**

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## 14. Assessment scheme

The students are required to do two exams before the final exam. There will be final exam on 60 marks . So that the final grade will be based upon the following criteria:

Mid-semester Exam: (20+20)% and ,

Final exam 60%

Total: 100%

## 15. Student learning outcome:

- identify an linear differential equation and classify it by homogeneous (or not)
- determine solution to a higher-order initial-value problem exists
- understand differences between solutions of linear and non-linear first-order differential equations
- recognize and solve homogeneous higher-order differential equations with constant or vaeiable coefficint,
- solve homogeneous linear differential equations using variation of parameters or reduction orger to first oeder
- solve nonhomogeneous linear differential equations using operator (optional)

- properties and theorem of Laplace transformation.
- Power series solution
- Revision of Eigenvalues and Eigenvectors,
- Systems of Linear 1st-order ODE's Homogeneous with constant coefficient

## 16. Course Reading List and References:

▪Key references: 1) Differential Equation by Hari Kishan

2) طرق حل المعادلات التفاضلية د.خاليد أحمد السامرائي

▪Useful references:3) Ordinary Differential Equation سلسلة شوم
                              4) Fundamentals of Differential Equation by R Kent Nagle

## 17. The Topics:

| Subject… | Week |
|---|---|
| **Ch. One:** Laplace transformation to functions | 1 |
| Properties of **:** Laplace transformation | 2 |
| Invers of **:** Laplace transformation | 3 |

| | |
|---|---|
| Solution Linear high Order Ode'swith constant coefficients using theLaplace method | 4 |
| **Ch. Two:** Solution of first order homogeneous linear systems of ODE's | 5 |
| Revision of Eigenvalues and Eigenvectors | 6 |
| Method using the Fundamental Matrix (Variation of Parameters method) | 7 |
| Solution of first order homogeneous linear systems of ODE's | 8 |
| Fundamental Matrix of a Linear System and an Exponential Matrix ,Property of a Fundamental Matrix | 9 |
| Method of solution of Second Order Homogeneous Linear systems of Ordinary Differential Equations | 10 |

## 18. Examinations

Q1. Find general solution of the system $\frac{dx}{dt} = -2x - y + 1$ and $\frac{dy}{dt} = x - 4y + 2t$

Q2.Solve the initial value problem (using laplace transformation)

$$y'' + 2y' + 5y = 0 \quad where \; y(0) = 1 \; and \; y'(0) = 5 \,.$$

Q3. Convert the DE into system DE and solving the system

$$y'' - 2y' + 4y = 0$$

## 19. Extra notes:
**Good Luck for Student**

## 20. Peer review
**Professor Dr.Azad Ibrahim Ameen**

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