

Ministry of Higher Education and Scientific research



**Department of Chemistry**

**College of Science**

**University of Salahaddin**

**Subject: Differential Equations**

**Course Book – Year 2**

**Lecturer's name: MSc. Namam Jalal Mahmoud**

**Academic Year: 2022-2023**

# Course Book

<b>1. Course name</b>	<b>Differential Equation</b>
<b>2. Lecturer in charge</b>	<b>MSc. Namam Jalal Mahmoud</b>
<b>3. Department/ College</b>	<b>Chemistry / Science</b>
<b>4. Contact</b>	e-mail : <a href="mailto:namam.mahmood@su.edu.krd">namam.mahmood@su.edu.krd</a>
<b>5. Time (in hours) per week</b>	<b>6 hours</b>
<b>6. Office hours</b>	<b>2</b>
<b>7. Course code</b>	
<b>8. Teacher's academic profile</b>	<p><b>4/1/2010</b> Awarded M.Sc. in Mathematics, Department of Mathematics, College of Science, University of Salahaddin-Erbil, Iraq.</p> <p><b>13/7/2010</b> Assistant lecturer at Department of Mathematics, College of Science, University of Salahaddin-Erbil, Iraq.</p> <p><b>1999</b> Awarded B.Sc. in Mathematics, Department of Mathematics, College of Science, University of Salahaddin-Erbil, Iraq. Academic staff member of Mathematics Department/ Collage of Science/ University of Salahaddin</p>
<b>9. Keywords</b>	<b>Calculus, integral</b>
<b>10. Course overview:</b>	The overall goal of the field of Differential Equation is understanding the differential equations with its solution by some methods and application of it in chemistry fields .
<b>11. Course objective:</b>	To give the students an operational understanding of geometric insight into the concepts of differential Equations and applying these concepts to problem solving.
<b>12. Student's obligation</b>	Students should actively participate in lectures and must be involved in solving exercises, as well as encouragement to express an opinion and proposals and providing reports and seminars.
<b>13. Forms of teaching</b>	All lectures are shown by data show with power point file, where it's exist for students and must using whiteboard in all lectures to give student more explanations to the subjects.
<b>14. Assessment scheme</b>	<p>Midterm exam1: 15 marks, Midterm exam2: 15 marks.</p> <p>There will be weekly tutorials, which give the students 10 .</p> <p>Final exam: 60 marks. The examination schedule will be announced by the</p>

exam board of the department of mathematics.

**15. Student learning outcome:**

A student passing the course shall be able to account for the Differential Equations problems, principles and techniques that are used to establish properties.

**16. Course Reading List and References:**

- Dennis G. Zill, **A First Course of Diff. Eq.** , 2004 .
- George B. Thomas, **Thomas' Calculus**, 11<sup>th</sup> Edition, 2005.

**17. The Topics:****Lecturer's name**

- Introduction
- Differential equation
- Order, degree and solution
- First order methods
- Separable
- Homogenous
- Linear
- Exact
- Integrating Factor
- Bernoulli
- Second Order Equations
- Linear Second Order
- Homogenous Case
- Non - Homogenous Case
- Chemistry Applications

**18. Practical Topics (if there is any)****19. Examinations:**

**Q.1)** Solve  $\frac{dy}{dx} - 3y = e^x y^3$  where  $y(0) = 1$

Solution:

$$\frac{dy}{dx} - 3y = e^x y^3$$

$$P(x) = -3, \quad f(x) = e^x, \quad n = 3$$

$$I(x) = e^{\int (1-n)P(x)dx}$$

$$I(x) = e^{\int (1-3)(-3)dx} = e^{\int -6dx} = e^{6x}$$

$$\Rightarrow I(x) = e^{6x}$$

$$I(x)y^{1-n} = \int (1-n)I(x)f(x)dx$$

$$e^{6x}y^{1-3} = \int (1-3)e^{6x}e^x dx$$

$$e^{6x}y^{-2} = -2 \int e^{7x} dx$$

$$e^{6x}y^{-2} = \frac{-2}{7}e^{7x} + C$$

$$y^{-2} = \frac{-2e^{7x}}{7e^{6x}} + \frac{C}{e^{6x}}$$

$$y^2 = \frac{1}{\left(\frac{-2}{7}e^x + \frac{C}{e^{6x}}\right)}$$

$$y(0) = 1 \Rightarrow (1)^2 = \frac{1}{\left(\frac{-2}{7}e^0 + \frac{C}{e^0}\right)}$$

$$\Rightarrow 1 = \frac{1}{\left(\frac{-2}{7} + C\right)}$$

$$\Rightarrow 1 = \left(\frac{-2}{7} + C\right)$$

$$\Rightarrow C = \frac{9}{7}$$

$$\Rightarrow y = \sqrt{\frac{1}{\left(\frac{-2}{7}e^x + \frac{9}{7e^{6x}}\right)}}$$

**Q.2)** Solve  $(2y^2x^3 + e^x)dx - (\sin(y) - yx^4)dy = 0$

Solution:

$$\frac{d(2y^2x^3 + e^x)}{dy} = 4yx^3 \quad = \quad \frac{d(-\sin(y) + yx^4)}{dx} = 4yx^3$$

⇒ The eq. is exact, and there exist a function  $F(x, y)$  such that

$$\int dF = \int (2y^2x^3 + e^x)dx$$

$$\Rightarrow F(x, y) = \frac{1}{2}y^2x^4 + e^x + K(y)$$

$$\frac{dF}{dy} = yx^4 + \frac{dK}{dy} \dots \dots \dots (*)$$

Comparison between (\*) and Q we get

$$\frac{dK}{dy} = -\sin(y)$$

$$K(y) = \cos(y) + C$$

$$\Rightarrow F(x, y) = \frac{1}{2}y^2x^4 + e^x + \cos(y) + C$$

**20. Extra notes:**

**21. Peer review**