



Department of Mathematics

College of Education

University of Salahaddin

Subject: Ordinary Differential Equations

Course Book – 1st and 2nd (Semester) (Year 2)

Lecturer's name: Mudhafar hamed Hamadamen

Academic Year: 2022/2023

Course Book

1. Course name	Ordinary differential equations
2. Lecturer in charge	Mudhafar hamed Hamadamen
3. Department/ College	Mathematic/Education
4. Contact	e-mail: mudhafar.hamadamen@su.edu.krd Tel:
5. Time (in hours) per week	Theory: 3 Practical:(conclusion) 1
6. Office hours	Monday(8:30-10:30)2A, (10:30-12:30) 2B ,Wednesday(8:30-10:30) 2A , (10:30-12:30)2B
7. Course code	EdM0204
8. Teacher's academic profile	<p>Biography</p> <p>Mudhafar H.H - MH mathematics teacher</p> <p>mathematics teacher work in college of education</p> <p>Kurdistan region-Iraq, Erbil</p> <p>Current: Salahaddin University college of education mathematics department.</p> <p>Education: M.Sc. in mathematics (Differential Equation).</p> <p>Summary : I am a native Kurdish speaker and graduate from Salahaddin who is working towards to rise Scientific title</p>
9. Keywords	
10. Course overview:	<p>Topics covered include solutions of ordinary differential equations ,initial and boundary value problem, including existence and uniqueness theorems, qualitative, and analytical methods of equations of first ,second and higher order, Cauchy-Euler equations, solutions by infinite series, systems of equations, and the Laplace transformation</p>
11. Course objective:	<p>: Students should be able to</p> <ul style="list-style-type: none"> •Identify and classify various types of differential equation. •Calculate general and particular solutions of first order linear differential equations by qualitative, and analytical methods, which include separation of variables, homogeneous equations, exact equations, integrating factor, and Bernoulli methods). • Determine whether unique solutions in existence and uniqueness theorems. •Create and solve Riccattis equation that problems.

- Calculate general and particular solutions of second order linear differential equations by various methods, which include reduction of order, undetermined coefficients, variation of parameters, and solutions by series.
- Define and use Laplace transforms to solve differential equations.
- Solve systems of first order linear equations using differential operator, Laplace transform, and solutions of linear systems.
- Apply solutions of first order initial value problems.
- Power series solutions.
- Classify differential equations by order, linearity, and homogeneity.
- Solve first order linear differential equations.
- Solve linear equations with constant coefficients.
- Use separation of variables to solve differential equations.
- Solve exact differential equations.
- Use variation of parameters to solve differential equations.
- Use the method of undetermined coefficients to solve differential equations.
- Determine whether a system of functions is linearly independent using the Wronskian.

12. Student's obligation1- Attendance.

2- Quiz.

3- Test about some questions in the conclusion .

4- There examinations' will be given, each %40.

5- Final examination, %60 .

13. Forms of teaching : The essence of the teaching program is prepared on papers. Elaborations and explanations of the details are done on black and white board and obligatory .For the student to achieve a level excellence in this subject; the following points should be given at most consideration:

- Class attendance on regular basis for the purpose of learning and doing class work.
- Active participation in class discussions.
- Reviewing the lecture notes and topics on weekly basis, noting the ambiguous points, if any, and requesting clarification during instructor office hours.

Giving adequate and sufficient priority of papers, pencils, eraser for writing lecture and daily tests.

14. Assessment scheme

In this system the maximum mark is (% 100) .the grading system is based on the summation of two categories of evaluations:

First, (%40) of the mark is based on the academic year effort of the student which includes:

- Three semester examinations (10×3) = %30 for which the study material is set for the topics reviewed in that particular semester.
- Quizzes and attendance (%5) .

<p>- Discussion and homework (%5).</p> <p>Second, (%60) of the mark is based on final examination that is comprehensive for the whole of the study material reviewed during the academic year and it usually accurse during the month of June . At the end of the evaluation process, if the students could not secure a minimum of ((%50), they are given a chance to repeat the final examination in September and they should be able by then to equal or exceed the ((%50) limit otherwise they will have to repeat this subject during the next academic year if it did not contradict with the administrative regulation.</p>	<p>15. Student learning outcome:</p> <ol style="list-style-type: none"> 1. Find general solutions to first-order, second-order, and higher-order homogeneous and non homogeneous differential equations by manual and technology-based methods. 2. Identify and apply initial and boundary values to find particular solutions to first-order, second-order, and higher order homogeneous and non-homogeneous differential equations by manual and technology-based methods, and analyze and interpret the results. 3. Select and apply appropriate methods to solve differential equations; these methods will include, but are not limited to, undetermined coefficients, variation of parameters, , Laplace and inverse Laplace transforms. 4. Select and apply series techniques to solve differential equations. 				
<p>16. Course Reading List and References:</p> <ul style="list-style-type: none"> • C.Ray Wylie, Differential Equations. • TynMyint-U Ordinary Differential Equations. • W.E.Boyce, Elementary Differential Equations. • D. Arnold, second edition, Differential Equations • طرق حل المعادلات التفاضلية الاعتيادية د.خالد أحمد السامرائي <p>Differential Equations, Second Edition, by J. Polking, A. Boggess and D. Arnold. Prentice Hall, 2006.</p> <p>Elementary Differential Equations, 9th edition (7th or 8th ed ok), W. E. Boyce and R.C. DiPrima, John Wiley and Sons.</p> <p>The course materials of the course consists of the above books, articles from internet, and lectures notes, make sure read all the materials and prepare will before going for the exams.</p>	<table border="1"> <thead> <tr> <th>17. The Topics:</th><th>Lecturer's name</th></tr> </thead> <tbody> <tr> <td> <p>First semester</p> <p>Week 1-5 :Introduction to Differential Equations</p> <ul style="list-style-type: none"> • Definitions and terminology • classify differential equations by order, degree, linearity, and homogeneity. • Initial-value problems <p>First-Order Differential Equations.</p> <ul style="list-style-type: none"> • Separation of variables. • Solutions by substitutions. • Homogenous Differential Equations. • Non-homogeneous Differential Equations. • Exact Differential Equations. </td><td></td></tr> </tbody> </table>	17. The Topics:	Lecturer's name	<p>First semester</p> <p>Week 1-5 :Introduction to Differential Equations</p> <ul style="list-style-type: none"> • Definitions and terminology • classify differential equations by order, degree, linearity, and homogeneity. • Initial-value problems <p>First-Order Differential Equations.</p> <ul style="list-style-type: none"> • Separation of variables. • Solutions by substitutions. • Homogenous Differential Equations. • Non-homogeneous Differential Equations. • Exact Differential Equations. 	
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<p>• Non-Exact Differential Equations.(Integrating Factor)</p> <p>Week 6-8: Linear first order Ordinary Differential Equations. (Linear,Bernollis,Riccattis ,Simultaneous).</p> <p>Week 9-10: Existence and uniqueness theorem of first order ordinary differential equations.</p> <p>Week 11-12:The reduction of higher order ordinary differential equations in to first order. Ordinary differential equations in first order and higher degree.</p> <p>Week 13-14 final exam</p> <p>Second semester</p> <p>Week 1-4:Higher order ordinary differential equations .</p> <p>A. Linearly dependent and Linearly independent solutions.wronskian method.</p> <p>B. Fundamental Solutions of Homogeneous Equations</p> <p>C. Reduction of Order</p> <p>D. Homogeneous Linear Equations with Constant Coefficients</p> <p>E. Non homogeneous Differential Equations.</p> <p>Week 5-6:How to find a particular solution of non-homogeneous ordinary differential equations with constant Coefficients.(the variation of parameters method, short method or operator methods.).</p> <p>Week 7-8:Linear higher order differential equations with variable Coefficients. Cauchy- Euler Equation.</p> <p>Week 9-10: The Laplace Transformation.</p> <p>A. Definition and Properties of the Laplace Transform.</p> <p>B. Inverse Laplace Transform.</p> <p>C. Transforms of Derivatives.</p> <p>D. Solving Initial Value Problems byusing Laplace Transforms.</p> <p>Week 11-13:The power series solution.</p> <p>A. Power Series Solutions About an Ordinary Point.</p> <p>B. Solutions About Singular Points.</p> <p>Weak 14-15 final exam</p>	
<p>18. Practical Topics (If there is any)</p>	
<p>In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture</p>	
<p>19. Examinations:</p> <p>Q1/ Is the differential equation $\bar{Y} + p(x)y = Q(x)$ exact? If</p> <p>1) $P(x) = 0$. 2) $Q(x) = 0$. 3) $P(x) = Q(x)$.</p> <p>(9Marks)</p> <p>Q2/Eliminate the arbitrary constants c_1, c_2 from $Y = e^{c_1} + c_2x$.</p> <p>(7Marks)</p> <p>Q3/Write an Integrating Factor when I is a function only of (y), and give an example.</p>	

(7Marks)

Q4/Solve the following differential equations:

1. $\frac{dx}{dt} + x = e^t$; $\frac{dy}{dt} = x$.
 2. $(y^2 + y^2x)dy + (x + y^2x)dx = 0$.
 3. $(3x^2y^2 + x + e^x)dy + (2y^3x + y + ye^x)dx = 0$.
 4. $dx = \frac{dy}{(12e^{2x}y^2 - y)}$ with the Initial condition (0,1) .
- (12Marks)

Q1/ Eliminate the arbitrary constants a, b from $y = ae^{3x} + be^x$ (8Marks)

Q2/prove or disprove:

- 1) Every homogenous differential equation is to be separable differential equation by using the relation $\frac{y}{x} = \vartheta$.
- 2) Every Separable differential equation is to be homogenous differential equation . (8Marks)

Q3/A / Match each of the following differential equations with their solution.

- | | |
|-------------------|----------------------|
| A. $y' = -2y$ | a. $y = \sin(x) + C$ |
| B. $y' = (3/x)y$ | b. $y = Ce^{-2x}$ |
| C. $y' = \cos(x)$ | c. $y = Cx^3$ |

B/ Choose the correct answered:

Which of the following second order differential equation is linear and homogenous?

- a) $x^2y'' + xy' + \sin(x)y = 0$
- b) $(1 + y^2)y'' + xy' + \sin(x)y = 0$
- c) $x^2y'' + xy' + \sin(x)y = \ln x$
- d) None of the above.

((3+4)Marks)

Q4/Solve only **THREE** branches:

- i) $(y + x + 5)y' = (y - x + 1)$

<p>ii) $\frac{dy}{dx} = (x^2 - 8xy + 16y^2)$</p> <p>iii) $(2y^7 + y^4)dx + (6xy^6 - 3)dy = 0$</p> <p>iv) $xy' - y = \sqrt{x^2 - y^2}$</p> <p>(12Marks)</p>
<p>20. Extra notes:</p> <p>Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.</p>
<p>21. Peer review پیداچوونہو دی هاوہل</p> <p>This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.</p> <p><i>(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).</i></p> <p>ئەم کۆرسبووکە دەبیئت لەلایەن هاوئێکی ئەکادیمیەو سەیر بکەیت و ناوێکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند وشەیک بنووسێت لەسەر شیاوی ناوێکی کۆرسەکە و واژووی لەسەر بکات.</p> <p>هاوئێ ئەو کەسێکە زانیاری ھەبێت لەسەر کۆرسەکە و دەبیئت پلەیی زانستی لە مامۆستا کەمتر نەبێت.</p>