

Ministry of Higher Education and Scientific research



Department of Mathematics

College of Education

University of Salahaddin

Subject: Partial differential equations

Course Book – (Third Year)

Lecturer's name: Dr. Adnan Ali Jalal

Academic Year: 2024/2025

Course Book

1. Course name	Partial differential equations
2. Lecturer in charge	Adnan Ali Jalal
3. Department/ College	Mathematics/Education
4. Contact	e-mail:adnan.jalal@su.edu.krd Tel: (optional)07504228383
5. Time (in hours) per week	Theory: 3 Discussion:
6. Office hours	6
7. Course code	
8. Teacher's academic profile	e.g Webpage, Blog, Moodle... or few paragraphs about not less than 100 words
9. Keywords	Partial Differential Equation, Quasilinear, Charpit's method, Higher order Partial D.E.
10. Course overview: Partial differential equations occur in advanced studies in applied mathematics, physics and engineering.	
11. Course objective: The aim of this course is to learn the students the importance of Partial differential equations, the difference between these equations and ordinary differential equations. Also, this course demonstrates the area of using partial differential equations specially students in physical and engineering science, since, these equations arise in solving problems which is of great importance in applications. Students should be able to <ul style="list-style-type: none"> •Identify and classify various types of differential equation. •Partial Differential Equation (PDE). <ul style="list-style-type: none"> • Order and Degree of Partial differential equation. •Linear Partial differential equation (LPDE). <ul style="list-style-type: none"> •Origin of first-order partial differential equations. Elimination of arbitrary constants. Elimination of an arbitrary function. •Linear PDE of first order. •Method of Characteristic. •Equivalent set of ODEs. •Quasilinear Equations. <ul style="list-style-type: none"> •Interpretation of Quasilinear Equation. •General solution. • Methods to find solutions. • Application, Integral Surface Passing Through a Given Curve, Surface Orthogonal to a Given Systems of Surfaces. • Nonlinear First-Order PDEs. Charpit's method non-linear PDE of fist order. • Special types of non-linear first-order PDEs. • Second-order Linear Partial Differential Equation, linear PDE with constant coefficients. <ul style="list-style-type: none"> • Fourier series. 	

12. Student's obligation

Tests will be closed book, closed notes: you cannot receive help on the tests from anyone except me. Home works are also to be pledged. We may deviate from this slightly during the semester and allow you to discuss questions with your classmates, but assume you are to work alone (and without answer guides!) unless you hear otherwise.

Quizzes and written home assignments	10%
Midterm exams	30%
Final exam	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

1- 10% from quiz after each section.

2- 5% from example classes.

3- 25% from midterm test.

4- 60% from final Examination.

15. Student learning outcome:

The student learns new types of equations called Partial differential equations and special Partial differential equations, which occur in physical and engineering applications.

16. Course Reading List and References:

1. Elements of Partial Differential Equations (2006) Ian N. Sneddon
2. Basic Partial Differential Equations, Bleecker.
3. A Text book of differential equation, N. Kapoor pita bar publishing Company (p) LTP., WewDelhi.
- 4.

17. The Topics:
FIRST SEMESTER

**Lecturer's
name**

<u>Date</u>	<u>Subjects</u>
Week 1	Chapter 1: Introduction, how to study Partial D.E. Definition of partial differential equations.
Week 2	Classification Of First Order Partial Differential Equations
Week 3	Origin of partial differential equations
Week 4	The Origin of Second order Equations
Week 5	Chapter Two: Partial differential equations of the first order.
Week 6-7	Methods for solving Lagrange's auxiliary equations
Week 8	Integral surfaces passing through a given curve
Week 9	Surfaces Orthogonal to a Given System Of Surfaces
Week 10	Chapter Three: Nonlinear Partial Differential Equations of the First Order, Charpit's method.
Week 11	Special methods of Charpit's method
Week 12	Charpit's general formula
Week 13	Jacobi's method.
Week 14	Exam

<u>SECOND SEMESTER</u>		
<u>Date</u>	<u>Subjects</u>	Adnan Ali Jalal 3 hours
Week 1	Chapter Four: P.d.e. of the second order	
Week 2	Homogenous p.d.e. with constant coefficients	
Week 3	Rule's for finding complimentary function	
Week 4	Rule's for finding particular integral	
Week 5	General method to find particular integral	
Week 6-7	Non-homogenous linear p.d.e. with constant coefficients.	
Week 8	Chapter Five: Special linear p.d.equations	
Week 9	One dimensional Heat equation	
Week 10	One dimensional wave equation.	
Week 11-12	Laplace equation in two dimension	
Week 13	Methods of solutions	
Week 14	Exam	
18. Practical Topics (If there is any)		
19. Examinations:		
1. Compositional:		
In this type of exam the questions usually starts with Explain how, What are the reasons for...?, Why...?, How....? With their typical answers Examples should be provided		
2. True or false type of exams:		
In this type of exam a short sentence about a specific subject will be provided, and then students will comment on the trueness or falseness of this particular sentence. Examples should be provided		

3. Multiple choices:

In this type of exam there will be a number of phrases next or below a statement, students will match the correct phrase. Examples should be provided.

4. Exam Forms:

Q1\ Form the PDE by eliminating arbitrary function from $z = f(x * y) + (x + y)$.

Q2\ Find the complex Fourier series of the $f(x) = \frac{A}{T} x$, for $f(x + T) = f(x)$.

Q3\ Solve the PDE $(p^2 + q^2)x = pz$.

Q4\ $\left(\frac{\partial^3 z}{\partial x^3} - \frac{\partial^2 z}{\partial x^2} \frac{\partial z}{\partial y} - \frac{\partial^2 z}{\partial y^2} \frac{\partial z}{\partial x} - \frac{\partial^3 z}{\partial y^3} \right) = e^x * \cos 2y$.

Q5\ $(2x^3 - z)z dx + 2x^2 yz dy + x(x + z)dz = 0$.

Q6\ Find the complex Fourier series of the $f(x) = e^x$, $-\pi < x < \pi$ for $f(x + 2\pi) = f(x)$.

Q7\ Solve the Pfaffian differential equation $2(z + px + qy) = yp^2$.

Q8\ $r - s - 2t = (2x^2 + xy - y^2) \sin xy - \cos xy$.

Q9\ $\left(\frac{\partial^2 z}{\partial x^2} - \frac{\partial z}{\partial x} \frac{\partial z}{\partial y} - 2 \frac{\partial^2 z}{\partial y^2} \right) = (y - 1)e^x$.

Q10\ Form the PDE by eliminating arbitrary function from the following relation

$$z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$$

Q11\ $\left(\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial y^2} \right) = \tan^3 x \tan y - \tan x \tan^3 y$.

Q12\ Form the PDE by eliminating arbitrary function from $z = f(x * y) + g(x + y)$.

Q13\ Using complex form find the Fourier series of the function $f(x) = x^2 + y^2$, defined on the interval $[-1,1]$.

Q14\ Solve the PDE $z(xy + z^2)(px - qy) = x^4$

Q15\ $(y + 1)(z + 2)dx + (x + 3)(z + 2)dy + (x + 3)(y + 1)dz = 0$.

20. Extra notes:

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.

21. Peer review

پیداچوونہوہی ھاوہل

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.

(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).