

**Centre for High Energy Physics
Faculty of Science
University of the Punjab, Lahore
Course Outline**



Program	BSCP	Course Code	CPHY 204	Credit Hours	3
Course Title	Differential Equations				
Course Introduction					
Any scientific theory or a physical problem can be viewed as differential equation (or a system of differential equations). This course is an introduction to the various types of ordinary differential equation. Various techniques for solving 1 st , 2 nd and higher order differential equations are a focus of this course. Besides this, various applications of differential equations in science and engineering are discussed.					
Learning Outcomes					
On the completion of the course, the students will: <ul style="list-style-type: none"> 1. Learn the classification of differential equations. 2. Learn how to mathematical model real life problems in the form of differential equations. 3. Learn techniques of solving various differential equations. 4. Get familiarize with different differential equations used in physics. 					
Course Content					
Week 1	Classification of differential equations				
	Initial value and Boundary value problems				
Week 2	General first order ordinary differential equation (FODE)				
	Normal form of FODE				
Week 3	Integrating factor & exact FODE				
	General first order ordinary linear differential equation (FOLDE);				
Week 4	Applications of FOLDE				
	Non- linear FODE.				
Week 5	Ordinary differential equations (ODE's) of first order (FO) and higher degree (HD)				
	Separable first order (FO) equations.				
Week 6	Methods of solution				
	General properties of second order ordinary linear differential equation (SOLDE);				
Week 7	Linearity; Superposition				
	uniqueness & related theorems;				
Week 8	SOLDE with constant coefficients.				
	The Wronskian, inhomogeneous SOLDE				
Week 9	Exact homogeneous SOLDE,				

	The Riccati Equation		
Week 10	Higher order ordinary linear DE with constant coefficients		
	Homogeneous nth-order ordinary linear differential equation (NOLDE)		
Week 11	Method of characteristic roots		
	Inhomogeneous NOLDE and transfer function		
Week 12	Method of undetermined coefficients		
	Applications in physics.		
Week 13	Cauchy-Euler Differential Equation		
	Transformation of the Euler-Cauchy differential equation into a linear differential equation with constant coefficient		
Week 14	Linear system of equations		
	Homogeneous first order systems with constant coefficients		
Week 15	Euler's method for homogeneous linear system		
	Eigen value method for homogeneous linear system		
Week 16	SODE's with variable Coefficients.		
	Solution using Liouville formula		
Textbooks and Reading Material			
<ol style="list-style-type: none"> 1. Differential Equations, A system Approach by Jack Goldberg, <i>Prentice-Hall International</i> (1998). 2. Differential Equations with Applications and Programs, S. B. Rao, <i>Universities Press, India</i> (1996). 3. Elementary Differential Equation and Boundary Value Problems, C.H. Edward, <i>Prentice- Hall International</i> (1996). 4. Foundations of Mathematical Physics by Sadri Hassani, <i>Prentice-Hall International</i> (1991). 			
Teaching Learning Strategies			
The instructor is required to make use of Mathematica/Maple/Python to teach the concepts through visualization/animation and symbolic/numerical calculations. The students are required to solve a large portion of related exercises/questions/problems of the main textbooks.			
Assignments: Types and Number with Calendar			
At least two assignments and two quizzes. A course project may also be assigned.			
Assessment			
Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.

2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.