**NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES**

**LAHORE CAMPUS**



Differential Equations (Calculus-II)-MT 1006 Outline according to OBE

Spring-2022

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Outline of Differential Equations (Calculus-II)

Dr. Mubashar Baig - Coordinator Math Courses in CS Department

Signature for Final Approval

DEPARTMENT OF SCIENCES & HUMANITIES

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| **Department** | | Department of Computer Science | **Dept. Code** | CS | | |
| **Course Title** | | Differential Equations(Calculus-II) | **Course Code** | MT-1006 | | |
| **Pre-requisite(s)** | | Calculus & Analytical Geometry | **Credit Hrs.** | 3 | | |
| **Moderator** | | Dr. Hira Iqbal | | | | |
| **Course Instructor(s)** | | Dr. Akhlaq Ahmad Bhatti(BCS-2H), Dr. Hira Iqbal (BCS-2M, 2C), Abdul Hafeez Shaikh (BCS-2J, 2B), Dr. Tauseef Saeed (BCS-2D, 2E), Dr. Tayyaba Tehreem (BCS-2F,2G), Ms. Aisha Rashid (BCS-2K, 2L), Ms. Sara Asghar (BCS-2A, 2N), Mr. Muzamil Hanif (BDS-2C), Mr. M. Rizwan (BDS-2A,2B). | | | | |
| **Note:** | | It is a tentative schedule of the course. It may vary (if required). | | | | |
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| **Course Objective** | | The objective is to impart training to the students in this important branch of Mathematics. Students are expected to learn, Convergence/Divergence of Series, system of linear equations & Differential Equations arising from different Physical systems. Attempt will be made to introduce the students how to solve Linear systems, Ordinary & Partial Differential Equations using different techniques. Concept of Fourier Series will also be explained for PDE’s solution. | | | | |
|  | | | | | | |
| **No.** | **Assigned Program Learning Outcome (PLO)** | | | | **Level** | **Tool** | |
| 01 | An ability to identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science and engineering sciences. | | | | R |  | |
| *I = Introduction, R = Reinforcement, E = Evaluation.*  *A = Assignment, Q = Quiz, M = Midterm, F=Final, LA=Linear Algebra, DE=Differential Equation.* | | | | | | |
| **No.** | **Course Learning Outcome (CLO) Statements** | | | | **Tools** | |
| 01 | * Solution of infinite sequences & series using different methods. | | | | Q1, A1, M1, F | |
| 02 | * Solution of different type of ODE’s using different methods. | | | | A2, M1, Q2, M2, F | |
| 03 | * Solution of some basic ODE’s like Linear, Exact, Bernouli etc. | | | | A2, Q2, M2, F | |
| 04 | * Existence/Independence of solutions of Initial/Boundary value problems for first & second order ODE’s through different techniques. | | | | Q2, M2, A2, Q3, F | |
| 05 | * Solution of PDE’s by Fourier series using orthogonal set of functions. | | | | Q3, A3, M2, F | |
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| **Text Book(s)** | **Title** | Thomas Calculus / A first course in Differential Equations (DE) with modeling applications / Differential Equations with boundary-value problems. |
| **Authors** | G. B. Thomas / Dennis G. Zill (DE) (Latest Editions). |
| **Ref. Book(s)** | **Title** | Elementary Differential Equations (DE) with applications. |
| **Author** | C. H. Edwards. David, E. |

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| --- | --- | --- | --- |
| **Week** | **Course Contents** | **Chapter** | **CLO** |
| 01 | **Infinite Sequences and Series**  10.1 Introduction to Sequences  10.2 Infinite series | 10 (13th Edition) | 01 |
| 02 | 10.3 The integral test  10.4 Comparison tests | 10 (13th Edition) | 01 |
| 03 | 10.5 Absolute convergence; The ratio and root test  10.6 Alternating series and conditional convergence  **Quiz#1** | 10 (13th Edition) | 01 |
| 04 | 10.7 Power series  10.8 Taylor and Maclaurin series | 10 (13th Edition) | 01 |
| 05 | **1st Order Differential Equations:**  2.1 Basic concepts, formation and solution of differential equations by direct integration and by separating the variables. Direction Fields.  2.2 Separable variables. | 2 (9th Edition) | 02 |
| 06 (Mon-Wed) | **MID TERM-I** |  |  |
| 07-09 | 2.3 Linear Equations.  2.4 Exact Equations.  **Solution by Substitution**  2.5 Equations (Homogeneous & Bernoulli’s DE) reducible to linear equations & Riccati.  3.1 01st order ODE’s arising from Real life problems.  3.3 01st order ODE’s arising from Real life problems. | 02 (9th Edition)  03 (9th Edition) | 03-05 |
| 10-12 | **2nd & Higher Order Differential Equations**  4.1 Initial and Boundary value problem, Existence of a unique solution. Homogeneous DEs’, Linear Dependence and Independence. Wronskian and non-homogeneous Linear Differential Equation.  4.2 Reduction of order.  **Quiz#2**  4.3 Homogeneous Linear Equations with Constant Coefficients.  4.4 Undetermined coefficients-Superposition approach.  4.5 The operator D, Inverse operator 1/ D, Solution of differential equations by operator D methods, Special cases.  4.5 Undetermined coefficients-Annihilator approach.  4.6 Variation of parameters.  4.7 Cauchy Euler equation. | 04 (9th Edition) | 06, 07 |
| 13 | **Partial Differential Equations**  12.1 Basic concepts and formation of partial differential equations.  Linear homogeneous partial differential equations and relations to ordinary differential equations.  12.2 Classical Equations & Boundary Value Problems.  12.3 Heat Equation  12.4 Wave Equation  12.5 Laplace Equation | 12(3rd Edition) | 08 |
| 14  (Thu-Sat) | **MID TERM II** |  |  |
| 15-16 | **Orthogonal Functions and Fourier Series**  11.1 Orthogonal Functions  11.2 Fourier Series  **Quiz#3**  11.3 Fourier Cosine & Sine Series (Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients.)  11.4 Sturm-Liouville Problem. | 11 (3rd Edition) | 09 |
|  | **Series Solutions of Linear Equations: (**If time permits**)**  6.2 Solution about ordinary point & Singular points. | 09th edition |  |
|  | **FINAL EXAM** |  |  |

**Evaluation Scheme & Marks Distribution: Relative grading scheme will be used for final assignment of grades. Marks distribution is given below.**

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| --- | --- | --- |
| **Assessment Tools** | **Total No.** | **Weightage** |
| Quizzes | 3 (at least) | 10% |
| Assignments | 3(at least) | 8% |
| Homework | As per instructor advice. | 7% |
| Mid Term Exam | 2 | 25% |
| Final Exam | 1 | 50% |

**Note:**

1. **Reaching 10 minutes late after the class starts will not be considered present.**
2. **Late submission of home work/Assignments will not be marked and rewarded.**
3. **Relative grading scheme will be followed in the course.**

**Important links:**

**Fourier Series:** <https://www.youtube.com/watch?v=8yEE2YURbAo&list=PLlXfTHzgMRUK56vbQgzCVM9vxjKxc8DCr&index=31>