**COURSE CODE:** MATH-121

**COURSE NAME:** Linear Algebra and Ordinary Differential Equations

**CREDIT HOURS:** Theory = 3

Practical = 0

Total = 3

**CONTACT HOURS:** Theory = 48

Practical = 0

Total = 48

**PREREQUISITE:** Calculus and Analytical Geometry

**MODE OF TEACHING:**

*Instruction 75%*

*Discussion/Debate 10%*

*Exercises/Tutorial 15%*

**COURSE DESCRIPTION**:

Math-121, Linear Algebra and Differential Equations, begins with some definitions and terminologies. The course is the introduction to the ordinary differential equations. The course covers the mathematical techniques to solve linear, nonlinear, homogenous, non-homogenous first order, second and higher ordinary differential equations. Applications of first and second order ODEs. Introduction of Laplace transform, inverse Laplace transform and application of Laplace transform to ODEs and system of ODEs. This course closes at the introduction to partial derivatives and partial differential equations.

**COURSE OBJECTIVES**:

The goal of Math-121 is to provide the students, with a deep understanding of ordinary differential equations as well as a strong sense of how useful the subject can be and how you can apply what you have learned in the course to your work and studies. Our aim is to provides them with a solid set of mathematical skills, a deep understanding, and a higher degree of mathematical confidence when they finish the course so that they will be well-equiped for future studies.

**RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the PLO/s:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | Engineering Knowledge: |  | 7 | Environment and Sustainability: | ☐ |
| 2 | Problem Analysis: | ☐ | 8 | Ethics: | ☐ |
| 3 | Design/Development of Solutions: | ☐ | 9 | Individual and Team Work: | ☐ |
| 4 | Investigation: | ☐ | 10 | Communication: | ☐ |
| 5 | Modern Tool Usage: | ☐ | 11 | Project Management: | ☐ |
| 6 | The Engineer and Society: | ☐ | 12 | Lifelong Learning: | ☐ |

**COURSE LEARNING OUTCOMES (CLOs):**

Upon successful completion of the course, the student will be able to:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No** | **CLO** | **Domain** | **Taxonomy Level** | **PLO** |
| 1 | To solve the problem using appropriate method, to do the analysis of the solution and to apply differential equations to model physical processes. | Cognitive | 3 | 1 |

**PRACTICAL APPLICATIONS:**

The study of differential equations is a wide field in pure and applied mathematics, physics and engineering. All of these disciplines are concerned with the properties of differential equations of various types. This course is expected to enable the students of engineering to transform the physical problems into mathematical ones and look for their solutions.

**TOPICS COVERED WITH THEIR CONTRIBUTION TO PLOs**

|  |  |
| --- | --- |
| Week | Topic |
| 1 | **Matrices**: Basic concept, Addition of matrices and its multiplication with a scalar number, Partitioning of matrices, Matrix multiplication and its properties, Special matrices, Transpose of a matrix, Adjoint and inverse of a square matrix, Row operations. |
| 2 | **Matrices**: Echelon & reduced Echelon form of matrix, Rank of matrix, Application of Matrices, Eigen values and Eigen vectors. |
| 3-4 | Introduction to ODEs , Analytical Methods to solve First Order Des;  Separable Equation |
| 5 | Exact Equation and Methods to make a Non-exact as Exact DE, Solution by substitution: Homogeneous DE, |
| 6 | Linear DE and Bernoulli’s DE |
| 7 | Ricatti’s DE and difference between linear and non-linear DE |
| 8 | Basic Theory of higher order Des; Linear DEs. Homogeneous DEs. |
| 9 | Homogeneous linear DEs with constant coefficients. |
| 10 | Non-Homogeneous linear DEs with constants coefficients. |
| 11 | Non-Homogeneous linear DEs with variable coefficients and Reduction of order |
| 12 | Undetermined coefficient method, |
| 13 | Variation of Parameters |
| 14 | The Laplace Transform: Basic Theory and its properties, inverse transform |
| 15 | Transform of Derivatives, Solving DEs. |
| 16 | Partial Differential Equations; Basic Theory, Method of separation Variable |
| 17 | Heat Equation, Laplace Equation |
| 18 | End Semester Exams |

**TEXT AND MATERIAL:**

**Textbook (s)**

1. Lecture Notes
2. Mathematics for Electrical Engineering and Computing by Mary Attenborough.
3. Differential Equations with Boundary-Value Problems by Dennis G. Zill and Michael R. Cullen.

**References Material:**

1. Calculus and Analytic Geometry by H. Anton. John Wiley and Sons

**ASSESMENT SYSTEM:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Theoretical / Instruction** |  |  | 100% |
|  | *Assignments 10%* |  |  |
|  | *Quizzes 10%* |  |  |
|  | *OHT Exams 30%* |  |  |
|  | *End Semester Exam 50%* |  |  |

|  |  |  |
| --- | --- | --- |
| Prepared By(Instructor) | Name with Sign | Ayesha Mahmood |
| Reviewed By  (LQEC) | Name with Sign |  |
| Approved By  (Assoc Dean) | Name with Sign |  |
|  |  |