Applied Mathematics

Course Code	Credit Hours
MATH- 214	3-0

Course Description

This course covers essential mathematical techniques for engineering applications, beginning with the System of Linear equations and Applications with real-world civil engineering case studies. The Eigenvalues and Eigenvectors explore the concepts and applications of linear algebra in constructing curves and surfaces. Linear Programming introduces optimization principles. Basic concepts and Modelling cover linear/ non-linear differential equations and initial/ boundary value problems. Analytical methods for first-order ODEs, separable variable, homogeneous, exact, and linear equations are discussed, alongside applications such as mixing problems and temperature prediction. The subsequent section investigates the analytical methods for second order ODEs covering homogeneous and non-homogeneous, Cauchy-Euler equations, with practical applications in earthquake modeling and bridge collapse scenarios. The course concludes with an exploration of Laplace Transform and its applications in solving second-order ODEs.

Text Book:

1. Introductory Linear Algebra by Bernard Kolman and David R. Hill
2. Introductory Linear Algebra by Howard Anton and Chris Rorrers
3. Advanced Engineering Mathematics by Erwin Kreyzig
4. Differential Equation with Boundary Value Problems by D. G. Zill and M. R. Cullen
5. A First Course on Differential Equation with Modelling Applications by D. G. Zill
6. An Introduction to Mathematical Modelling by E. A. Bender

Reference Book:

Prerequisites:

Nil.

ASSESSMENT SYSTEM FOR THEORY

	Without Project (%)	With Project/Complex Engineering Problems (%)
Quizzes	15	10-15
Assignments	10	5-10

Mid Terms	25	25
Project	-	5-10
End Semester Exam	50	45-50

ASSESSMENT SYSTEM FOR LAB

Lab Work/ Psychomotor Assessment/ Lab Reports	70%
Lab Project/ Open Ended Lab Report/ Assignment/ Quiz	10%
Final Assesment/ Viva	20%

Teaching Plan

Week No	Topics/Learning Outcomes
1-2	Overview of linear system of equations, Cases of unique solution, no solution and infinite solutions, Echelon form, Gauss elimination method
3-4	Relevant engineering case studies such as network analysis, traffic flows, finding max stress in compound cylinder, Applications of linear systems in force balancing of structures Eigenvalues and eigenvectors, Applications of linear Algebra
5-6	Eigen Values problem, Constructing curves and surfaces, Introduction to linear programming, Optimization, Graphical Method, Simplex Method
7	Optimization problems in Engineering, Transportation Model, Assignment model, Transshipment Model
8	Degree and order of ODEs, Linear/Non-linear differential equations, Solutions of differential equations, Initial and Boundary value problems, Variable separable, Homogenous equations
9	MSE
10	Solution of the related ODE models by these methods, Exact equations, Integrating factor, Linear equations, and related examples, Bernoulli Equations
11-12	Mixing problems and free fall motion, finding temperature of a building and logistic equations, etc, Homogenous linear ODEs
13-14	Method of reduction of order, Wronskian determinant to check independence of the solution and related examples Cauchy-Euler equations

	and related examples, non-homogenous linear ODEs, Method of variation of Parameters and related examples
15	Earthquake model of single-story building and bridge collapse problems etc
16	Laplace transforms, Inverse Laplace transform, shifting theorem, Laplace transform of derivatives, Solution of second order ODE by Laplace transform
17-18	**End Semester Exam**

Practical: Nil.

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