COURSE CODE	**MATH-108**	
COURSE NAME	**DIFFERENTIAL EQUATIONS**	

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CREDIT HOURS   Theory: 03
                        Practical: 00
                        Total: 03
CONTACT HOURS   Theory: 48
                        Practical: 00
                        Total: 48
PREREQUISITE   (It is a Pre-requisite course for GIE-342 GIS Applications and GIE-414 Land use Planning)

MODE OF TEACHING:

Two hours of lecture per week   100%

COURSE DESCRIPTION:
The course reviews the concepts of basic calculus, including matrices, first order differential equations, second order differential equations and partial differential equations.

COURSE OBJECTIVES:
This course encompasses the basic mathematical concepts related to differential equations, describe different types of analytical methods for solution of differential equations, and formulate different engineering problems in the form of differential equations

RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):
The course is designed so that students will achieve the PLOs:

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

COURSE LEARNING OUTCOMES:

No.	CLO	Domain	Taxonomy Level	PLO
1	Use ordinary differential equations and optimum methods to solve linear systems	Cognitive	3	1

TOPICS COVERED:
Theory:

Week	Topic
1-2	**Basic Concepts and Modeling**: Linear Differential equations, Non-Linear, Differential equations, Solutions of differential equations, General solutions, Particular solutions, Initial and boundary value problems, Degree, and order of ODEs, Formulation of first-order ODEs: Case studies related to finding age of fossils, mixing problems and free fall motion, finding temperature of a building, RL, RC circuits, Airplane take-off problem, Population dynamics and logistic equations etc.
3-4	**Analytical Methods of Solution for First-order ODEs:** Variable separable method, Reduction to variable separable form, Homogeneous equations, Differential equations reducible to homogeneous form, Solution of the related ODE models by these methods, Exact equations, Integrating factors, Linear equations and related examples, Bernoulli's equations, Orthogonal trajectories, and solution of the related ODE models by these methods.
5-6	**Mathematical Models Based on Second-order ODEs:** Formulation of a single RLC circuit, Spring mass systems, Earthquake model of a single-story building, Bungee Jumper model, Bridge collapse problem etc.
7-8	**Analytical Methods of Solution for Second-order ODEs: Homogeneous** linear ODEs, Method of reduction order, Wronskain determinant to check independence of the solution, and related examples, Cauchy-Euler equations and related examples, non-homogeneous linear ODEs, Method of undetermined coefficients, Method of variation of parameters and related example, Analytical solution of the related ODE models by these methods
9-10	**Series Solution for Second-order ODEs:** Series solution of ODEs and convergence tests, Series solution of Legendre equation, Frobenious method of solution for Bessel equation and related applications
11-12	**Laplace Transform:** Laplace Transform, Derivation of Basic formulae, Inverse Laplace Transform, first shift theorem, Laplace transform of integrals and derivative, Solution of second order ODEs by Laplace Transform, Unit step function and its Laplace transform, second shift theorem, Convolution, Application of Laplace transform to a system of ODEs and related applications
13-15	Partial Differential Equations: Partial Differential Equations and their types, Applications of partial differential equations in Engineering, Method of Separation of Variables Method (MSVM) and solution of wave equation by the MSVM, Method of Separation of Variables Method (MSVM) and solution of heat equation by the MSVM
16	**ESE**

TEXT AND MATERIAL:
Textbook (s)/ References Material:
1. Advanced Engineering Mathematics by Erwin Kreyzig, John Wiley &Sons Inc. Latest Edition

2. A First Course on Differential Equations with Modelling Applications by D. G. Zill, Latest Edition, Brooks/Cole Publishers.
3. Differential Equation with Boundary Value problems by D. G. Zill, M. R Cullen Latest Edition, Brooks/Cole Publishers.
4. An Introduction to Mathematical Modelling by Bender, E.A., Latest Edition, Wiley, New York

ASSESMENT SYSTEM:

1. **CLOs Assessment**

Cognitive	Psychomotor	Affective
Spreadsheet	-	-

2. **Relative Grading**

Theoretical/Instruction			100%
	Assignments10%		
	Quizzes10%		
	OHT Exams30%		
	End Semester Exam50%		
Total			**100%**