Differential Equations	Code & No:	MATH 205
	Credits:	3 (3,0,1)
	Pre-requisite:	MATH 126
	Co-requisite:	None
	Level:	5

Course Description:

This course includes the following topics:

Introduction to differential Equations, Classification of Differential Equations, First order Differential Equations: Separable differential Equations, Linear differential equations, Exact differential Equations, Bernoulli Differential Equations, Existence and Uniqueness of Solutions for Initial Value Problems, Linear Models (Growth and Decay, Newton's Law of Cooling/Warming, Mixture of Two Salt Solutions, Series Circuit) Nonlinear Models (Logistic Equation), Modeling With Systems Of First-Order DEs (A Predator-Prey Model). Higher order differential Equations: Initial and boundary value problem, Principle of superposition, the Wronskian, Homogeneous differential equations with constant coefficients. Reduction of order method, Undetermined coefficients method, Variation of parameters method. Modeling with higher-order differential equations (Spring/Mass Systems: Free Undamped Motion, Transient/Steady-State Solutions, Series Circuit/Analogue). Nonlinear Differential Equations, Solution of linear partial differential equations using the method of separation of variables.

Course Aims:

a) The importance of both theory and applications of ordinary differential equations (DEs).
b) To expose the student to some of the more commonly used techniques for finding explicit solutions of ordinary differential equations.
c) Studies second order differential equations for both initial value and boundary value problems;
d) To explore some of the applications of ordinary differential equations to the physical, behavioral and engineering sciences.
e) The module introduces some of the basic concepts of partial differential equations (PDEs) in simple cases where reduction to DEs is possible.

Student Outcomes (SOs):

☒(a) An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline

☒(b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution

☐(c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs

☐(d) An ability to function effectively on teams to accomplish a common goal

☐(e) An understanding of professional, ethical, legal, security and social issues and responsibilities

☐(f) An ability to communicate effectively with a range of audiences

☐(g) An ability to analyze the local and global impact of computing on individuals, organizations, and society

☐(h) Recognition of the need for and an ability to engage in continuing professional development

☒(i) An ability to use current techniques, skills, and tools necessary for computing practice.

☐(j) An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices. [CS]

☐(k) An ability to apply design and development principles in the construction of software systems of varying complexity. [CS]

☐(j) An ability to use and apply current technical concepts and practices in the core information technologies of human computer interaction, information management, programming, networking, and web systems and technologies. [IT]

☐(k) An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation, and administration of computer-based systems. [IT]

☐(l) An ability to effectively integrate IT-based solutions into the user environment. [IT]

☐(m) An understanding of best practices and standards and their application. [IT]

☐(n) An ability to assist in the creation of an effective project plan. [IT]

Course Learning Outcomes (CLOs):

The student is expected to be able to:

a) Classify differential equations.
b) Appreciate the importance of establishing the existence and uniqueness of solutions.
c) Recognize an appropriate solution method for a given problem.
d) Analytically solve a wide range of ordinary differential equations (ODEs).
e) To make mathematical models involving differential equations for problems encountered in engineering, social and physical sciences.
f) Apply the power series method to find the solutions of ODEs about ordinary and singular point.
g) Solve classical linear partial differential equations (PDEs).

SOs and CLOs Mapping:

CLO/SO	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CLO1	√	√							√					
CLO2	√	√							√					
CLO3	√	√							√					
CLO4	√	√							√					
CLO5	√	√							√					
CLO6	√	√							√					
CLO7	√	√							√					

No.	Topics	Weeks	Teaching hours
1	Introduction to differential Equations, Classification of Differential Equations, First order Differential Equations: Separable differential Equations, Linear differential equations, Exact differential Equations,	2	6
2	Bernoulli Differential Equations, Existence and Uniqueness of Solutions for Initial Value Problems	2	6
3	LINEAR MODELS (Growth and Decay, Newton's Law of Cooling/Warming, Mixture of Two Salt Solutions, Series Circuit) NONLINEAR MODELS (Logistic Equation), MODELING WITH SYSTEMS OF FIRST-ORDER Des (A Predator-Prey Model)	2	6
4	Higher order differential Equations: Initial and boundary value problem, Principle of superposition, the Wronskian, Homogeneous differential equations with constant coefficients. Reduction of order method, Undetermined coefficients method, Variation of parameters method.	2	6
5	Modeling with higher-order differential equations (Spring/Mass Systems: Free Undamped Motion, Transient/Steady-State Solutions, Series Circuit/Analogue).	2	6
6	Nonlinear Differential Equations	2	6

7	Partial differential equations, Method of separation of variables	2	6
	Total	**14**	**42**

Textbook:

- Dennis G. Zill, Warren S. Wright, and Michael R. Cullen Differential Equations with Boundary-Value Problems, Brooks/Cole, Cengage Learning Eighth Edition (2013).

Essential references:

- William E. Boyce & Richard C. DiPrima Elementary Differential Equations and Boundary Value Problems, John Wiley & Sons 10th (2012).
- Edwards, Penney, and Calvis, Differential Equations and Boundary Value Problems, 5th Ed., (2014).
- Ross, S. L. Differential Equations, 3rd ed., John Wiley and sons, New York.
- Erwin Kreyszig “Advanced Engineering Mathematics” John Wiley & Sons, Inc. 10th Edition (2011)