Course Code: 1BMACV101 **Course: Applied Mathematics-I for Civil Engineering**
Credits: 4 **L:T:P:S 3:2:0**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 Hrs **Max. Marks: 100**

Prerequisites if any	
Learning objectives	The goal of the course **(1BMACV101)** is to **1. Familiarize** the importance of calculus associated with one variable and two variables for civil engineering. **2. Analyse** Civil engineering problems by applying Ordinary Differential Equations. **3. Develop** the knowledge of Linear Algebra refereeing to matrices.

Course Outcomes:
On the successful completion of the course, the student will be able to

	Course Outcomes	Bloom's level
CO1	Apply foundational concepts of calculus and differential equations to analyse geometric properties of curves.	Understand, Apply, Analyse
CO2	Solve first and higher-order ordinary differential equations, and model physical phenomena in science and engineering.	
CO3	Apply the principles of linear algebra to solve systems of linear equations, determine eigenvalues and eigenvectors, and analyse real-world problems.	
CO4	Develop familiarity with modern mathematical tools namely SCILAB/PYTHON/MATLAB and stimulates creative problem solving through experiential learning.	

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	-	-	-	-	-	-	3		3	-	-	-
CO2	3	2	3	2	-	-	-	-	-	-	3		3	-	-	-
CO3	3	2	3	2	-	-	-	-	-	-	3		3	-	-	-
CO4	3	2	-	-	3	-	-	-	-	-	-		3	2	-	-

Strong: 3 **Medium: 2** **Low: 1**

Course Content

	Module – 1 Polar Curves and Curvature	No. of Lecture Hours	No. of Tutorial Hours	Self-Learning Hours
1.1	Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations.	3	1	
1.2	Angle between the radius vector and the tangent-Pedal equations.	2		
1.3	Curvature and radius of curvature - Cartesian forms.	2	1	
1.4	Curvature and radius of curvature - pedal forms.	1		
	Module – 2 Series Expansion, Indeterminate Forms and Multivariable Calculus			
2.1	Statement and problems on Taylor's and Maclaurin's series expansion for one variable.	2	1	
2.2	Partial differentiation, total derivative.	2	1	
2.3	Differentiation of composite functions, Jacobian.	2		
2.4	Taylor's series expansion for two variables.	1	1	
2.5	Maxima and minima for the function of two variables.	1		
	Module – 3 Ordinary Differential Equations(ODEs) of First order			
3.1	Solution of ODE- Geometrical representation. Bernoulli's differential equation.	2	1	
3.2	Exact differential equations.	1		
3.3	Reducible to exact differential equations with integrating factors - $\frac{1}{N}\left(\frac{\partial N}{\partial X}-\frac{\partial M}{\partial Y}\right)$ *and* $\frac{1}{M}\left(\frac{\partial N}{\partial X}-\frac{\partial M}{\partial Y}\right)$.	2	1	
3.4	Orthogonal trajectories (Cartesian and polar forms).	2		
3.5	Law of natural growth and decay.	1		
	Module –4 Ordinary Differential Equations of Higher Order			
4.1	Higher-order linear ordinary differential equations with constant coefficients, homogeneous equations.	2	1	
4.2	Undetermined coefficient method.	2		
4.3	Method of variation of parameters.	2	1	
4.4	Legendre's homogeneous differential equations.	1	1	
4.5	Applications: Solving governing differential equations of Mass Spring.	1		
	Module –5 Linear Algebra			
5.1	Elementary row transformation of a matrix, Rank of a matrix.	2	1	
5.2	Consistency of a matrix.	1		
5.3	Solution of system of linear equations - Gauss-elimination method.	2		
5.4	Solution of system of linear equations - approximate solution by Gauss-Seidel method.	1	1	
5.5	Eigenvalues and Eigenvectors.	2		
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		12	
	Total No. of Self learning Hours			0

Text Books:

1) B.S.Grewal: "Higher Engineering Mathematics", Khanna publishers, 44thEd. 2021.
2) E.Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.

Reference Books:

1. **B. V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **Tom Apostol** "Calculus: One variable calculus with an introduction to Linear Algebra", Vol. 1, Wiley publications, 2nd edition, 2007.
4. **Tom Apostol** "Calculus: Multi-Variable Calculus and Linear Algebra with applications to differential Equations And Probability, Vol.2, Wiley publications, 2nd edition, 2007

Online Resources:

1. https://www.youtube.com/watch?v=ixDGaEqWuA0.
2. https://www.youtube.com/results?search_query=nptel+linear+algebra