Applied Mathematics – I
(Civil Engineering)

Contact Hours/ Week:	3+2	Credits:	4
Total Lecture Hours:	40 + 20	CIE Marks:	50
Course Code:	AMC1	SEE Marks:	50

Course objectives:	
This course will enable students to:	
1.	**Familiarize** the importance of calculus associated with one variable and multivariable arising in engineering.
2.	**Analyze and solve** engineering problems by applying Ordinary Differential Equations.
3.	**Demonstrate** the use of analytical and numerical methods to solve the system of linear equations.
4.	**Utilize** a modern tool MATLAB for computation and visualization.

Module I: Polar Curves and Curvature
Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and radius of curvature - Cartesian, parametric, polar and pedal forms.
8 Hours Theory + 4 Hours Tutorial
Module II: Series Expansion, Indeterminate Forms and Multivariable Calculus
Statement and problems on Taylor's and Maclaurin's series expansion for one variable. Indeterminate forms - L'Hospital's rule. Partial differentiation, total derivative - differentiation of composite functions, Jacobian, Maxima and minima for the function of two variables.
8 Hours Theory + 4 Hours Tutorial
Module III: Ordinary Differential Equations of First Order
Linear and Bernoulli's differential equation. Exact and reducible to exact differential equations with integrating factors - $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)$. Orthogonal trajectories, Law of natural growth and decay.
8 Hours Theory + 4 Hours Tutorial
Module IV: Ordinary Differential Equations of Higher Order
Higher-order linear ordinary differential equations with constant coefficients, homogeneous and non-homogeneous equations (e^{ax}, $sin(ax + b), cos(ax + b)$, x^n only), Method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations. Applications: Solving governing differential equations of Mass Spring.
8 Hours Theory + 4 Hours Tutorial
Module V: Linear Algebra
Elementary row transformation of a matrix, Rank of a matrix. Echelon form, Consistency and Solution of system of linear equations - Gauss-elimination method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. Applications: Traffic flow.
8 Hours Theory + 4 Hours Tutorial

TEXT BOOKS		
1	B. S. Grewal	Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2021.
2	E. Kreyszig	Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2018.
3	Gilbert Strang	Linear Algebra and its Applications, Cengage Publications, 4th Ed., 2022.
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	N. P. Bali and Manish Goyal	A Textbook of Engineering Mathematics, Laxmi Publications, 10th Ed., 2022.
4	H. K. Dass and Er. Rajnish Verma	Higher Engineering Mathematics, S. Chand Publication, 3rd Ed., 2014.
5	David C Lay	Linear Algebra and its Applications, Pearson Publishers, 4th Ed., 2018.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	**Apply** the knowledge of calculus to solve problems related to polar curves and implementation using MATLAB.
CO2	**Apply** the concept of partial differentiation to compute rate of change of multivariate functions and implementation using MATLAB.
CO3	**Apply** the analytical methods to solve first order and first-degree differential equations and implementation using MATLAB.
CO4	**Apply** the analytical methods to solve higher order differential equations and implementation using MATLAB.
CO5	**Apply** matrix theory for solving the system of linear equations, compute eigenvalues and eigenvectors and implementation using MATLAB.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	1			1								
	CO2	3	1			1								
	CO3	3	1			1								
	CO4	3	1			1								
	CO5	3	1			1								

Level 3 - Highly Mapped, Level 2 - Moderately Mapped, Level 1 - Low Mapped