Course Code: 24BMATM101 **Course: Mathematics-1 for Mechanical Engineering Stream**
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 **Calculus, Ordinary Differential Equations and Linear Algebra (24BMATM101)** is to 1. **Familiarize** the importance of calculus associated with one variable and two variables for Mechanical engineering. 2. **Analyze** 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	Compute the radius of curvature and apply the concept of partial differentiation to compute rate of change of multivariate functions.	Understand, Apply, Analyze
CO2	Analyse the solution of linear and non-linear ordinary differential equations.	
CO3	Get acquainted with solving equations by matrix methods	
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	PO12		PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	1		-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1		-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1		-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1		-	-	-	-

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

Course Content

	Module – 1 Calculus	No. of Lecture Hours	No. of Tutorial Hours	Self-Learning Hours
1.1	**Introduction to polar coordinates and curvature relating to mechanical engineering.** Polar coordinates, Polar curves, angle between the radius vector and tangent, angle between two curves. Pedal equations.	3	1	
1.2	Curvature and Radius of curvature-Cartesian and pedal form-Problems.	3	1	
1.3	**Applications:** Engineering Mechanics	1	1	
	Module – 2 Series Expansion and Multi Variable Calculus			
2.1	**Introduction to series expansion and partial differentiation in the field of mechanical engineering applications.** Taylor's series expansion for one variable (Statement only)–problems.	2	1	
2.2	Partial differentiation, total derivative-differentiation of composite functions. Jacobians Maxima and minima for a function of two variables. Problems, Taylor's series expansion for function of two variables.	4	1	
2.3	**Applications-** Estimating the critical points and extreme values using Lagrange's Method.	2	1	
	Module – 3 Ordinary Differential Equations of First Order			
3.1	**Introduction to first order ordinary differential equations pertaining to the applications for mechanical engineering.** Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations .Applications of ODE's-Orthogonal trajectories.	4	1	
3.2	**Nonlinear differential equations:** Introduction to general and singular solutions, solvable for p only, Clairaut's equations-Problems.	3	1	
3.3	**Applications**- Newton's law of cooling, Fluid Mechanics.	2	1	
	Module –4 Ordinary Differential Equations of Higher Order			
4.1	**Importance of higher-order ordinary differential equations in Mechanical Engineering applications.** Higher-order linear ODE's with constant coefficients-Inverse differential operator ($e^{ax}, \sin ax \ or \cos ax, x^n, e^{ax}v, xv$).	4	1	
4.2	Method of variation of parameters, Legendre homogeneous differential equations. Problems.	3	1	
4.3	Applications- Mechanical Vibrations.	1	1	
	Module –5 Linear algebra			
5.1	**Introduction of linear algebra related to Mechanical Engineering applications.** Elementary row transformation of a matrix, Rank of a matrix. Consistency and solution of a system of linear equations - Gauss-elimination method.	4	1	
5.2	Gauss-Jordan method	1	1	
5.3	Eigen values and Eigenvectors.	2		
5.4	**Applications**: Applications in finite element method.	1	1	
	Total No. of Lecture Hours	40		
	Total No. of Tutorial Hours		15	
	Total No. of Self learning Hours			0

Detailed Lesson Plan:

Sr No. of Module	Number of related learning Objectives	Weeks/ Dates	Online Mode		ICT Tool/ Platform/ LMS	Face-to-face Mode	
			Resource (OER/ URL/ IM/ CP)	Activity (Describe activity in detail)		Resource (OER/ URL/ IM/ CP)	Activity
1.1	1	1	https://youtu.be/WsQQvHm4ISw?si=56HCcIFGrDOQ6P3C	-	Smart board, Moodle	-	Group Discussion & Presentation
1.2	1	2		-		-	
1.3	1	3		-		-	
2.1	1	3		-		-	
2.2	1	4		-		-	
2.3	1	5		-		-	
3.1	2	6		-		-	
3.2	2	7		-		-	
3.3	2	8		-		-	
4.1	2	9		-		-	
4.2	2	10		-		-	
4.3	2	11		-		-	
5.1	3	12		-		-	
5.2	3	13		-		-	
5.3	3	13		-		-	
5.4	3	14		-		-	

Assessment Pattern:

Bloom's level	Continuous Internal Examination			End Semester Examination
	Test 1	Test 2	Assignment/Quiz/AAT	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyze	✓	✓		✓
Evaluate	✓	✓		✓
Create				

List of topics for Experiential learning (Assignment/Presentation/Models/Simulations with modern mathematical tools namely SCILAB/PYTHON/MATLAB)	
1	Finding partial derivatives, Jacobian and plotting the graph
2	Applications to Maxima and Minima of two variables
3	Solution of first order differential equation and plotting the graphs
4	Solutions of Second order ordinary differential equations with initial/boundary conditions
5	Solution of differential equation of oscillations of aspiring with various load
6	Numerical solution of system of linear equations, test for consistency and graphical representation

Self-learning topics identified: (Maximum of 5 topics)

1. Centre and circle of curvature
2. Euler's theorem and problems, Maclaurin's series expansion.
3. Solvable for x and y.
4. Finding the solution by the method of undetermined coefficients, Cauchy's Homogeneous differential equations.
5. Solution of a system of equations by Gauss-Jacobi iterative method.

Textbooks:

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. **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.