

# BVM ENGINEERING COLLEGE [AN AUTONOMOUS INSTITUTION]

## 2ME01: NUMERICAL METHODS AND ANALYSIS

CREDITS - 4 (LTP:3,1,0)

### Course Objective:

To introduce numerical techniques used in engineering analysis.

### Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
L	T	P		Theory		Practical		
			ESE	CE	ESE	CE		
3	1	0	4	60	40	20	30	150

### Course Contents:

Unit No.	Topics	Teaching Hours
1	<b>Error Analysis:</b> Floating point number representation, Round-off errors and truncation errors in numerical computation, error propagation, and numerical instability.	06
2	<b>Roots of Equations:</b> Bracketing Methods: Bisection method, Regula-Falsi method, Open Methods: Newton-Raphson method, Secant method, Brent's Methods, Multiple roots, Error Analysis.	05
3	<b>Solution of Simultaneous Linear Equations:</b> Gauss Elimination with backward substitution, Gauss-Jordon and Gauss Seidel method, LU Decomposition and Matrix Inversion, Error Analysis and System Condition.	04
4	<b>Polynomial Interpolation:</b> Lagrange methods, Forward/Backward/Central Difference Operators, Properties of Operators, Newton's forward and backward interpolation formulae, Gauss's forward and backward difference formulae, Interpolation with unequal interval: Newton's divided difference formula. Case Studies	07
5	<b>Numerical Integration and Differentiation:</b> Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Gauss quadrature. Newton's Forward-difference, Backward-difference and Divided-difference formula. Case Studies.	09
6	<b>Numerical Solution of Ordinary Differential Equations:</b> Initial-Value and Boundary-Value Problems, Single Step and Multi-Step Methods, Taylor series method, Euler's method, Euler's modified method, Runge-Kutta method of 2nd, 3rd and 4th orders, Multistep methods: Predictor and Corrector methods, Case Studies.	09
<b>Total</b>		<b>40</b>

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### **List of References:**

1. Steven Chapra and Raymond Canale, “*Numerical Methods for Engineers*”, 6<sup>th</sup> edition, Tata McGraw-Hill.
2. Balagurusamy E., “*Numerical Methods*”, Prentice Hall of India.
3. Steven C Chapra, “*Applied Numerical Methods with MATLAB*”, 3<sup>rd</sup> edition, Tata McGraw Hill Publishing Co Ltd.
4. Sastry S. S., “*Introductory Methods of Numerical Analysis*”, 5<sup>th</sup> edition, Prentice Hall of India.
5. Rao V. Dukkipati, “*Applied Numerical Methods Using MATLAB*”, New Age International Publishers.
6. Erwyn Kreyszig, “*Advanced Engineering Mathematics*”, 10<sup>th</sup> edition, John Wiley and Sons, 2008.

### **Course Outcomes (COs):**

At the end of this course students will be able to ...

1. Evaluate errors associated with computations.
2. Demonstrate the numerical techniques for root finding.
3. Demonstrate the numerical techniques for accurate and efficient solution of linear system of equation.
4. Demonstrate the numerical techniques to interpolate data-points.
5. Apply numerical techniques to solve integration and differentiation equation used in mechanical engineering.
6. Apply numerical techniques to practical problems in mechanical engineering.