Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-1 (B.Tech.)

Subject: Computational Mathematics – I- BET1CE11302

Type of course: Major (Core)

Prerequisite: Linear Algebra, Matrix operations, vectors, Differentiation, Integration, Differential Equations, Set Theory, Basic logical reasoning and mathematical foundation.

Rationale: Computational Mathematics - I is structured to emphasize conceptual understanding and real-world applications of mathematics without programming. Students explore mathematical models through simulations, Excel-based tools, visual media, and hands-on manual analysis. This approach ensures accessibility for non-computer science students while building computational thinking for engineering and applied domains.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
4	0	0	4	100	50	150

Course Content:

Sr. No	Course Content	Hrs.	% Weightage
1	**Discrete Mathematics:** Sets: Basic Laws of Set Theory, Venn Diagrams, De' Morgan rule, Functions: Types of functions, domain, range, Propositional Logic: Proposition, Negation, Conjunction, Disjunction, Implication, Biconditional. Predicate Logic, Proof Techniques. **Practical:** 1. Visualizing Set Operations 2. Exploring Functions and Their Properties 3. Truth Tables & Logical Equivalence	12	20%

Sr No.	Evaluation Methods	SEE	CCE
1	Practical	15	
2	Logic & Sets MCQ Worksheet	05	

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	3	ALA: Logic Around You: Poster or Infographic on Real-Life Logical Thinking		10		
		Total:	20	10		
2	**Graph Algorithms:** Graph Theory: Graph Representation, Paths, Trees, Euler & Hamiltonian Circuits, Graph Algorithms: BFS, DFS, Floyd-Warshall Algorithm, Minimum spanning tree: Prim's algorithm. Kruskal's algorithm. **Practical:** 1. Graph Representation and Traversals 2. Constructing and Analyzing Trees & Circuits 3. Visualization of MST Algorithms (Prim's and Kruskal's)				12	20%
	Sr No.	**Evaluation Methods**	**SEE**	**CCE**		
	1	Graph Problem Solving Task	10			
	2	Use-Case Comparison	10			
	3	Active Learning Activity: Graph Building with Pins and Strings		10		
		Total:	20	10		
3	**Linear Algebra:** Vector Spaces: Linear dependent and Linear independent, Basis, Rank, Null Space, Linear Transformations, Matrices, Determinants, System of Linear Equations (Gauss Elimination, Gauss Jordan, Trace and Nullity of Eigen values, Eigen vectors). **Practical:** 1. Visualizing Linear Independence and Basis in 2D/3D 2. Matrix Rank, Null Space & Transformation 3. Solving Systems of Linear Equations & Eigen Analysis				12	20%
	Sr No.	**Evaluation Methods**	**SEE**	**CCE**		
	1	Problem-Solving Task	15			
	2	Concept Match-Up (MCQ Matrix Quiz)	05			
	3	ALA: Rank & Dependency Card Sorting		10		
		Total:	20	10		

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<td>Calculus:
Limits, Continuity, Differentiability, Partial Derivatives, Gradient, Curl and Directional Derivatives, Solenoidal and irrotational.

Practical:
1. Exploring Limits, Continuity, and Differentiability
2. Visualizing Partial Derivatives and Gradient
3. Understanding Curl, Irrotational and Solenoidal Vector Fields

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<tr><th>Sr No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr>
<tr><td>1</td><td>Open-book Exam</td><td>20</td><td></td></tr>
<tr><td>2</td><td>Assignment:
Graph Sketching</td><td></td><td>10</td></tr>
<tr><td></td><td>Total:</td><td>20</td><td>10</td></tr>
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<td>5</td>
<td>Mathematical Modeling and Case Studies
This unit focuses on applying discrete mathematical structures to real-world engineering problems, including Proposition logic validation, network optimization with PERT and CPM.

Practical :
1. Propositional Logic Validation
2. Project Scheduling with PERT
3. Critical Path Analysis

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<tr><th>Sr No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr>
<tr><td>1</td><td>Case Study Report (Problem, Tool, Result, Conclusion)</td><td>10</td><td></td></tr>
<tr><td>2</td><td>Presentation with Visual Demonstration (Tool-based)</td><td>10</td><td></td></tr>
<tr><td>3</td><td>Viva</td><td></td><td>10</td></tr>
<tr><td></td><td>Total:</td><td>20</td><td>10</td></tr>
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Suggested Specification table with Marks:

Distribution of Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	5%	10%	40%	30%	10%	5%

Course Outcomes:

After learning the course, the students should be able to:	
CO1	Apply matrix theory and linear algebra techniques, such as LU decomposition, Eigen values, and vector spaces, to solve real-world computational problems using software tools like Excel.
CO2	Analyze multivariable functions using concepts of limits, partial derivatives, gradients, and Jacobians to interpret and optimize real-world scenarios through visualization and case studies.
CO3	Construct and validate logical arguments, set operations, and function mappings using propositional and predicate logic to model and analyze discrete structures.
CO4	Apply graph theory concepts and traversal algorithms to model, explore, and analyze real-world networks and tree structures using interactive simulations and practical case scenarios.
CO5	Develop and implement mathematical models using discrete structures and data analysis techniques to address engineering problems involving scheduling, optimization, and forecasting through tool-based simulations.

Instructional Method:

The course will be delivered using both traditional and active learning strategies suitable for Computer/IT/CE students. In addition to blackboard teaching, the instructor may also use:
Flipped learning for 10% of topics using NPTEL/SWAYAM videos followed by in-class applications.
Tool-based demonstrations with Excel, GeoGebra, Desmos, and Mathstools to visualize and solve problems.
Worksheet-based simulations for stepwise execution of numerical and matrix-based methods.
Group activities like graph construction, optimization challenges, and method comparison tasks.
Mini-projects using real or simulated data for modeling quality control, resource allocation, or regression.
Gamified quizzes and peer-assessed tasks to reinforce learning through engagement.
Virtual labs and online calculators to reduce coding dependency and support manual logic understanding.
The internal evaluation will be based on practical files, active learning assignments, projects and small-group tasks. Practical/Viva exams will be conducted at semester-end to assess applied understanding.

Reference Books:

1. Discrete Mathematical Science Structures With Applications To Computer Science By J.P. Tremblay and R.Manohar, MCGRAW Hill Education Pvt Ltd.
2. Linear Algebra and Vector Calculus, By Ravish Singh, MCGRAW Hill Education Pvt Ltd
3. Introduction To Linear Algebra With Applications, By Jim Defranza, MCGRAW Hill Education Pvt. Ltd.