Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology Semester-3
(B.Tech.)

Subject: Computational Mathematics – II – BET1CE13307

Type of course: Major (Core)

Prerequisite:

Rationale: Computational Mathematics - II aims to build an applied understanding of advanced mathematical concepts used in engineering. The course includes modules on probability, numerical methods, optimization, and graph theory, presented through a practical lens. Emphasis is on simulations, conceptual clarity, and step-wise calculations using visual tools like Excel or graph paper and online Tools to prepare students for real-world data-driven tasks.

Teaching and Examination Scheme:

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

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation;; LWA - Lab Work Assessment; V – Viva voce; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities.

Course Content:

Sr. No	Course Content	Hrs.	% Weightage
1	**Probability, Statistics for Data Science Applications:** Probability, Types of probability: Conditional Probability, total Probability, Bayes' Theorem, Random Variables, Expectation, Mean, Variance, Standard deviation, Probability Distributions: Binomial Distribution, Normal Distribution, Poisson Distribution , Mean, Mode, Median. **Practical:** 1. Visualizing Probability Distributions 2. Conditional Probability & Bayes' Theorem Simulation 3. Descriptive Statistics – comparison of central tendencies	12	20%

	Sr No.	**Evolution Methods**	**SEE**	**CCE**	
	1.	Statistical Reasoning Quiz	15		
	2.	Data Plotting & Distribution ID Task	05		
	3.	**Active Learning Assignment:** Predictive Chart Making: Regression Use Case		10	
		Total:	20	10	
2	**Numerical Methods & Approximation Techniques:** Root Finding Algorithms: Bisection, Newton-Raphson, Secant Method, Interpolation and Approximation: Lagrange Interpolation: Newton forward and Newton backward, Newton's Divided Difference, Numerical Differentiation and Integration: Trapezoidal, Simpson's 1/3 Rule, Simpson's 3/8 Rule. **Practical:** 1. Graphical Exploration of Root Finding Methods- GeoGebra 2. Interpolation of Tabulated Data 3. Numerical Integration – Area Under the Curve				**12**	**20%**
	Sr No.	**Evolution Methods**	**SEE**	**CCE**	
	1.	Practical	10		
	2.	Assignment: One Problem, Many Paths: A Numerical Methods Exploration	10		
	3.	Viva		10	
		Total:	20	10	
3	**Numerical Solution for Ordinary Differential Equations:** Ordinary Differential Equations (ODEs): Euler's Method, Runge-Kutta Methods: second order and fourth order method, Taylor Series, Maclaurin Expansion & Approximations. **Practical:** 1. Visualizing Euler's Method 2. Comparing Taylor and Maclaurin Series Approximations 3. Runge-Kutta Method Visualization				**12**	**20%**
	Sr No.	**Evolution Methods**	**SEE**	**CCE**	
	1.	Applied Methodology Open-Book Assessment	20		
	2.	Task:		10	

		Numerical Method Showdown – Euler vs RK4				
		Total:	20	10		
4	**Optimization Methods**: Optimization Techniques: Gradient Descent, Linear Programming: graphical method, simplex method and Nonlinear Programming **Practical:** 1. Visualizing Gradient Descent 2. Solving Linear Programming using Graphical Method 3. Exploring Nonlinear Programming (NLP) Constraints				12	20%
	Sr No.	**Evolution Methods**	**SEE**	**CCE**		
	1.	Practical: Linear Programming	15			
	2.	**Mini Quiz: Optimization Logic Check**	05			
	3.	Project – Real-Life Application of Optimization		10		
		Total:	20	10		
5	**Project and Case Studies:** Application of above topics in engineering cases like quality control, resource allocation, optimization in processes **Practical:** 1. Quality Control using Probability & Statistics 2. Resource Allocation using Linear Programming 3. Process Optimization using Multivariable Calculus				12	20%
	Sr No.	**Evolution Methods**	**SEE**	**CCE**		
	1.	Mini Project Presentation (with Report/Charts)	20			
	2.	Viva		10		
		Total:	20	10		

Suggested Specification table with Marks: 150

Distribution of Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	10%	10%	35%	30%	10%	5%

Course Outcomes (COs):

After learning the course, the students should be able to:	
CO1	Understand and apply statistical techniques to engineering datasets.
CO2	Solve real-world numerical problems through approximation techniques.
CO3	Apply stepwise solution methods for ordinary differential equations.
CO4	Optimize problems using graphical and simplex approaches.
CO5	Work collaboratively on mini-projects using mathematical tools and present findings effectively.

Instructional Method:

The course will be delivered using a mix of traditional and interactive strategies suited for Computer/IT/CE students. In addition to blackboard teaching, the faculty may adopt:

- **Flipped Learning** for at least 10% of topics using NPTEL/SWAYAM/YouTube content with in-class application.
- **Tool-Based Demonstrations** using Excel, GeoGebra, Desmos, and Mathstools to simulate root-finding, optimization, truth tables, and linear programming.
- **Worksheet-Based Simulations** for step-by-step manual execution of numerical methods, matrix operations, and interpolation.
- **Collaborative Group Activities** like method comparison tasks, graph-building with tokens, and optimization challenges.
- **Mini-Projects** using real or simulated data sets for resource planning, quality control, or regression modeling.
- **Gamified Assessments** through MCQs, quizzes, and error-spotting puzzles for concept reinforcement.
- **Use of Virtual Labs and Online Calculators** to reinforce logic without coding dependency.

Internal evaluation includes Active Learning Assignments, mini-projects, and quizzes. Practical/Viva exams will assess applied skills at semester-end.

Reference Books:

1. Advanced Engineering Mathematics By Erwin Kreyszig,Wiley India Pvt. Ltd

2. Numerical Methods and Optimization: An Introduction By Sergiy Butenko & Panos M. Pardalos, CRC Press (Taylor & Francis Group)

3. Numerical And Statistical Methods For Computer Engineering, By Ravish R. Singh, MCGRAW Hill Education Pvt Ltd