COURSE DESCRIPTION FORM

INSTITUTION National University of Computer and Emerging Sciences (NUCES-FAST)

PROGRAM (S) TO BE EVALUATED BS(CS)

A. Course Description

(Fill out the following table for each course in your computer science curriculum. A filled out form should not be more than 2-3 pages.)

Course Code Numerical Computing CS-2008

Course Title	Numerical Computing
Credit Hours	3+0
Prerequisites by Course(s) and Topics	Not Applicable
Assessment Instruments with Weights (homework, quizzes, midterms, final, programming assignments, lab work, etc.)	Mid-I: 15 Mid-II: 15 Assignments: 20 Final: 50

Current Catalog Description	The Numerical computing includes: Error concept and analysis , Roots of nonlinear algebraic equations of one variable ,Direct and iterative method for system of linear equations, Linear interpolation with 2nd and 3rd dimensional , Interpolating polynomials , Differences , Operators and their relation , Numerical differentiation and integration , Numerical solution of differential equation .Iteration for non linear system of equation
Textbook (or **Laboratory Manual** for Laboratory Courses)	Numerical Analysis , 9thEdition , Burden and Faires
Reference Material	1) Numerical Methods using MATLAB , 3rd Edition ,John H.Mathews 2) Applied Numerical Methods with Matlab for Engineers and Scientist, 3rdEdition Steven C,Chapra ,MCcGraw Hill
Course Goals	To introduce the students to the mostly used computing methods in the different fields of engineering and sciences.

The emphasis will be on understanding the algorithm of the various methods for computing and on applying these to obtain the approximate solutions for various mathematical problems.
MATLAB & **Excel** will be used as tool for implementation and application of these computing methods.

A. Course Learning Outcomes (CLOs)

1. Analyze Error, different numerical methods to estimate non-linear and linear system of equations and Hypothesis testing.

2. Apply different numerical methods to perform polynomial interpolation, curve fitting, differentiation, integration, and estimation of algebraic nonlinear equations.

3. Solve ordinary differential equations and compute optimum points in optimization problems using numerical techniques.

B. Program Learning Outcomes

For each attribute below, indicate whether this attribute is covered in this course or not. Leave the cell blank if the enablement is little or non-existent.

1. Academic Education:	To prepare graduates as computing professionals	✔
2. Knowledge for Solving Computing Problems:	Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.	✔
3. Problem Analysis:	Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.	
4. Design/ Development of Solutions:	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	✔
5. Modern Tool Usage:	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.	✔

6. Individual and Team Work:	Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.	✔
7. Communication:	Communicate effectively with the computing community and with society at large about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.	
8. Computing Professionalism and Society:	Understand and assess societal, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.	
9. Ethics:	Understand and commit to professional ethics, responsibilities, and norms of professional computing practice.	
10. Life-long Learning:	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.	

C. Relation between CLOs and PLOs
(CLO: Course Learning Outcome, PLOs: Program Learning Outcomes)

		PLOs									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CLOs	1	✔	✔				✔				
	2	✔	✔				✔				
	3	✔	✔				✔				
	4		✔			✔	✔				
	5		✔		✔		✔				
	6		✔		✔		✔				
	7		✔				✔				
	8		✔			✔	✔				

Topics Covered in the Course, with Number of Lectures on Each Topic (assume 15-week instruction and one-hour lectures)

1. Topics to be covered:

List of Topics	No. of Weeks	Contact Hours	CLO
Chapter 1 **Error analysis:** Introduction of Numerical Computing ,Chopping.Roundoff and truncation error,Absulute ,relative and percentage error Significant figures in approximation, loss of significance **Chapter 2** **Solution(Root) of equations in one variable:** The Bisection or Binary-search method. Fixed Pointiteration. (x=g(x))	**2**	**6**	**1,2**
Chapter 2 Newton's Raphson and Secant Method. Method of False position (Regula falsi).	**2**	**6**	**2,3**
Chapter 3 **Interpolation and Polynomial approximation:** Lagrange interpolation polynomial of degree one,two and three	**1**	**3**	**2,3,**
========== *MID 1* ==========			
Chapter 3 Divided difference table and interpolating polynomial. Newton Forward and Backward difference formula Newton centered difference (stirling) formula.	**2**	**6**	**1,2**
Chapter 4 **Numerical differentiation :** Differentiation using Forward and Backward differences 3-point Endpoint and Midpoint formula	**1.5**	**4.5**	**1,2**

	5-point Endpoint and Midpoint formula			
	Chapter 4 **Numerical Integration:** Trapezoidal and Simpson's rule Closed and open Newton-Cotes formulas. Composite NumericalIntegration: Trapezoidal , Simpson's and Midpoint formula	**1.5**	**4.5**	**2**
	========== *MID 2* ==========			
	Chapter 5 **Differential Equations:** Euler's method , 2-RK method , Mid Point formula Modify Euler and Huen's method , 4-RK method **Chapter 6** **Direct Method for solving linear system:** LU decomposition (Dolittle and Crout method) Symmetric ,Singular ,Diagonally dominant and positive definite matrices LDL^t Factorization , cholesky method	**2.5**	**7.5**	**2,3**
	Chapter 7 **Iterative Techniques:** Iterative methods for solving linear system Gauss-Siedel and Jacobi's methods.	**1**	**3**	**2,3**
	Difference Operator analysis: $\Delta, \nabla, \delta, \mu$,D and E operators and their relations.	**1**	**3**	**1,2**
	Review	**0.5**	**1.5**	
	Total	**15**	**45**	
Laboratory Projects/Experiments Done in the Course				
Programming				

Assignments Done in the Course				
Class Time Spent on (in credit hours)	**Theory**	**Problem Analysis**	**Solution Design**	**Social and Ethical Issues**
	15	20	10	0
Oral and Written Communications	Every student is required to submit at least ____ written report of typically ___ pages and to make __ oral presentations of typically ____ minute's duration. Include only material that is graded for grammar, spelling, style, and so forth, as well as for technical content, completeness, and accuracy.			

Instructor Name **Dr. Khusro Mian**

Instructor Signature _____

Date **February 4, 2022**