National University of Sciences & Technology (NUST)
School of Electrical Engineering and Computer Science (SEECS)
Department of Basic Sciences

Numerical Methods

Course Code:	MATH-351	**Semester:**	Spring 2023
Credit Hours:	3+0	**Prerequisite Codes:**	Nil
Instructor:	Dr. Rai Sajjad Saif	**Class:**	BEE-12-2k20-CD
Office:	A-309	**Telephone:**	03009873337
Lecture Days:	Tuesday & Friday	**E-mail:**	Rai.sajjad@seecs.edu.pk
Class Room:	CR-05	**Consulting Hours:**	Thursday 03:00 PM to 05:00 PM
Knowledge Group:	Computational Mathematics	**Updates on LMS:**	After every lecture

Course Description:

The course gives the students sound knowledge to solve non-linear equations numerically. Lengthy and suckle problems of differential, integral calculus and ordinary differential equations are also solved numerically. Curve fitting and interpolation like topics are also included which are very useful for engineers /technologists.

Course Objectives:

The course objective is that its successful completion should develop understanding of solution techniques of various Mathematical problems arising in Engineering and Technology. Emphasis will be placed on understanding the basic concepts behind the various numerical methods studied. This approach is taken since understanding how numerical methods work is essential for choosing the correct method and understanding its limitations.

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**PLO**	**BT Level***
CLO-1: **Explain** the consequences of finite precision and **describe** the amount of error inherent in different Numerical methods	1	C-2
CLO-2: **Define** algorithms for different Numerical techniques	1	C-1
CLO-3: **Apply** different computational techniques to **solve** Mathematical problems arising in engineering and sciences.	3	C-3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain		

Mapping of CLOs to Program Learning Outcomes

PLOs/CLOs	**Level of Emphasis of PLO (1: High, 2: Medium, 3: Low)**	**CLO1**	**CLO2**	**CLO3**
PLO 1 (Engineering Knowledge)	3	√	√	
PLO 2 (Problem Analysis)	3			
PLO 3 (Design/Development of Solutions)	3			√
PLO 4 (Investigation)				
PLO 5 (Modern tool usage)				
PLO 6 (The Engineer and Society)				
PLO 7 (Environment and Sustainability)				
PLO 8 (Ethics)				
PLO 9 (Individual and Team Work)				
PLO 10 (Communication)				
PLO 11 (Project Management)				

PLO 12 (Lifelong Learning)					

Mapping of CLOs to Assessment Modules and Weightages

Assessments/CLOs	CLO1	CLO2	CLO3
Quizzes: 10%			
Assignments: 10%			
OHT-1: 15%			
OHT-2: 15%			
End Semester Exam:50%			

Books:

Text Book:
1. E. Kreyszing: Advanced Engineering mathematics (10th Ed)
2. Steven C. Chapra, Raymond P. Canale: Numerical methods for Engineers (4th Ed)

Reference Books:
- Curtis F. Gerald , Patrick O. Wheatley: Applied Numerical Analysis, Addison –Wesley (6th Ed)
- J. Douglas Faires, Richard Burden: Numerical Methods (9th Ed.)

Sr. No	Main Topics to be covered	Estimated Contact Hours
	Mathematical Preliminaries	1
1	Round off error and Computer arithmetic	
2	Algorithms and Convergence	
	Iterative Methods for the Solutions of Non-Linear Equations (convergence analysis)	
3	Bisection Method	1
4	Fixed point Method	1
5	Newton-Raphson Method	2
6	Secant Method & Regula - Falsi Method	1
	Interpolation	
7	Introduction	1
8	Lagrange Interpolation	2
9	Newton's Divided Difference Interpolation	2
10	Forward Difference and Backward Difference Interpolations.	1
11	Introduction to Cubic Spline Interpolation	1
12	Clamped cubic spline	1
13	Natural spline	1
14	**Numerical Differentiation**	1
	Numerical Integration	
15	Elements of Numerical Integration	1
16	Rectangular , Trapezoidal , Simpson's Rule	3
	Numerical Methods in Linear Algebra	
17	LU Factorization , Doolittle's , Crouts's and Cholesky's Methods	3
18	Iterative Methods for Systems of Equations	1
19	Jacobi's Method, Gauss-Seidel Method	3

20	Evaluation of Eigenvalues by Iteration: Power Method.	3
	Solution of 1st and 2nd Order Ordinary Differential Equations	
21	Introduction	1
22	Euler Method	1
23	Heun's Method	1
24	Runge-Kutta Methods,	3
25	**Solution of Higher Order IVPs**	3
26	**Solution of Elliptic Partial Differential Equations**	3
27	**Solution of Parabolic PDEs: Crank-Nicolson Method**	3

Grading Policy:	
Quiz Policy:	The quizzes will be unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is at the instructor's discretion. Grading for quizzes will be on a fixed scale of 0 to 10. A score of 10 indicates an exceptional attempt towards the answer and a score of 1 indicates your answer is entirely wrong but you made a reasonable effort towards the solution. Scores in between indicate very good (8-9), good (6-7), satisfactory (4-5), and poor (2-3) attempt. Failure to make a reasonable effort to answer a question scores a 0.
Assignment Policy:	In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams.
Plagiarism:	SEECS maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.