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

Numerical Methods

Course Code:	MATH-351	**Semester:**	6th
Credit Hours:	3+0	**Prerequisite Codes:**	MATH-101
Instructor:	Atifa Kanwal	**Class:**	BESE-5AB
Office:	303-A, Faculty Block	**Telephone:**	051-9085-2363
Lecture Days:	Mon,Wed,Thur	**E-mail:**	atifa.kanwal@seecs.edu.pk
Class Room:	CR-18, CR-19	**Consulting Hours:**	Tue, Fri, 11:00-1:00
Knowledge Group:	Computational Mathematics	**Updates on LMS:**	End of Week

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***
1. Explain the consequences of finite precision and estimate the amount of error inherent in different Numerical methods	1	C-2
2. Develop algorithms for different Numerical techniques	1	C-1
3. Apply different computational techniques to solve Mathematical problems arising in engineering and sciences.	3	C-3
4. Compare different Numerical methods on the basis of their limitations, advantages, and disadvantages.	2	C-4
* 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	CLO4	CLO5
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	CLO4	CLO5
Quizzes: 10%					
Assignments: 10%					
OHT-1: 15%					
OHT-2: 15%					
End Semester Exam:50%					

Books:

Text Book:
1. E. Kreyszing: Advanced Engineering mathematics (9th 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. GouglasFaires, Richard Burden: Numerical Methods (3rd Ed)

Topics to be Covered:

Introduction to Numerical Analysis	Numerical Differentiation
Definition of error, different types of error	Use of Series relations, Differentiation by Interpolation techniques
Taylor series and Truncation error	Forward difference, Backward difference and Lagrange's formula and its applications
Solution of Transcendental Equations	Taylor's formulas and error analysis

	Numerical Integration
Linear Iterative, Bisection, Regula-Falsi method	Trapezoidal Rule(TR), Composite TR and error analysis
Newton-Raphson and secant Methods	Simpson's Rule,Comparison of Newton-cotes integration formulas and error analysis
System of Non linear Equations, Newton's Method, Modified Newton's Method	Gauss Quadrature
Interpolation	General Quadrature rules
Basic concept and purpose of curve fitting, Least Square Method for curve fitting	Numerical Solutions of Ordinary Differential Equations
Calculus of Finite Difference, Forward difference, Backward difference, Central difference, Divided difference, Interpolation and extrapolation and their difference	Taylor's Method of different orders
Gregory-Newton Forward and backward difference. Lagrange interpolation Method,	Euler's and Modified Euler's Method, Predictor and corrector method
Newton's Divided Difference Method. Stirling Method	Runge-Kutta(RK) Methods
Error analysis and Comparison of Methods of Curve fitting	Error based analysis of different methods, Applications of Numerical Techniques for ODE's

Lecture Breakdown:

Topics	Sections	Lectures
Introduction		2
Iterative, bisection and Regula-Falsi methods		4
Newton-Raphson and secant Methods, System of Non linear Equations, Modified Newton's Method		6
Least Square Method for curve fitting		2
Calculus of Finite Difference		4
Newton and Lagrange interpolation		4
Numerical differentiation		4
Numerical integration(Newton-cotes formulas)		6
Gauss Quadrature		2
Taylor's Method for solution of first order ODEs		2
Euler's and Modified Euler's Method		4
Predictor and corrector method		2
Runge-Kutta methods		4
Applications of Numerical Techniques for ODE's		2
Week 18: ESE		
	Total Lectures:	48

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.