Title (Units): **COMP 7150 Numerical Methods for Computer Science Research (3,3,0)**

Course Aims: To introduce the theories and concepts of numerical methods and how they can be implemented for solving computer science research problems.

Prerequisite: Research Postgraduate Student Standing

Course Intended Learning Outcomes (CILOs):
Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
	Knowledge
1	Explain the theories and concepts of numerical methods.
2	Describe how numerical methods can be applied to solve computer science research problems.
	Skill
3	Develop computer programmes to implement numerical methods for problem solving

Calendar Description: To introduce the theories and concepts of numerical methods and how they can be implemented for solving computer science research problems.

Teaching and Learning Activities (TLAs):

CILOs	TLAs will include the following:
1-2	Students will learn the theories and concepts of numerical methods and how they can be applied to solve computer science research problems via lectures, programming assignments, and exams.
2-3	Students will gain the practical skills of implementing numerical methods to solve problems.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Remarks
1	Written Assignments	30%	1-3	Continuous assessments in the form of written assignments will be used to evaluate how well students have learned the theories and concepts of numerical methods.
2	Programming Assignments	30%	1-3	Continuous assessments in the form of programming assignments will be used to evaluate how well they can apply them via programming.
3	Examination	40%	1-2	Examination will be used to evaluate the students' overall understanding and proficiency on the theories and concepts of numerical methods.

Assessment Rubrics:

Excellent (A)	• Achieve all three CILOs, demonstrating a thorough understanding and solid knowledge of numerical methods. • Able to apply a variety of numerical methods for solving problems.
Good (B)	• Achieve most of the three CILOs, demonstrating a good understanding and competent knowledge of numerical methods. • Able to apply some appropriate numerical methods for solving problems.
Satisfactory (C)	• Achieve some of the three CILOs, demonstrating a basic level of understanding and knowledge of numerical methods. • Able to provide numerical methods for solving simple problems.
Fail (F)	• Achieve few of the three CILOs, with little understanding of optimization algorithms. • Unable to provide numerical methods for solving simple problems.

Course Intended Learning Outcomes and Weighting:

Content	CILO No.
I. Numerical Methods and Finite Precision Arithmetic	1
II. Linear Systems of Equations	1-3
III. Least Square Problems	1-3
IV. Other Advanced Topics	1-3

References:

Walter Gander, Martin J. Gander and Felix Kwok. Scientific Computing – An Introduction Using Maple and Matlab, Springer Verlag, 2014

Steven C. Chapra and Raymond P. Canale. Numerical Methods for Engineers, McGraw-Hill Education, 8th edition, 2021

Amos Giat and Vish Subramaniam. Numerical Methods for Engineers and Scientists, Wiley, 3rd edition, 2013

Uri M. Ascher and Grief Chen. A First Course in Numerical Methods (Computer Science and Engineering), Society for Industrial and Applied Mathematics (SIAM), 5th edition, 2011

Course Content in Outline:

Topic

I. Numerical Methods and Finite Precision Arithmetic

II. Linear Systems of Equations
- A. Gaussian Elimination
- B. Cholesky Decomposition
- C. Banded Matrices
- D. Other related topics

III. Least Squares Problems
- A. Linear Least Square (LS) Problems
- B. Singular Value Decomposition
- C. Algorithms Using Orthogonal Matrices
- D. Non-linear LS Problems

IV. Other Advanced Topics