Hong Kong Baptist University

Faculty of Science

Department of Mathematics

Title (Units): **MATH 4665 Special Topics in Applied Mathematics I** (3,3,0)

Sub-title: Advanced Numerical Methods & Algorithms

Course Aims: The course aims to provide a general study to all students whose research fields are within the applied and computational mathematics. It covers some fundamental and important topics on linear algebra, optimization and partial differential equations.

Prerequisite: Year 3 standing or above or consent of instructor

Prepared by: Tiejun Tong

Course Intended Learning Outcomes (CILOs):

Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
1	Describe the basic theory and techniques in numerical linear algebra, optimization and partial differential equations
2	Implement basic numerical linear algebra programs
3	Recognize and implement fundamental optimization algorithms
4	Explain fundamental PDE theory and basic analytic/numerical methods
5	Solve computational mathematic problems independently

Teaching & Learning Activities (TLAs)

CILO	TLAs will include the following:
1,2,3,4,5	**Lecture and in-class activity** Instructor will use lectures to introduce the subjects of the course's materials and ample of examples will be given in order to aid the learning of the subjects. Students will consolidate the knowledge through discussion within lectures.

CILO	TLAs will include the following:
1,2,3,4,5	**Tutorial** Instructor will conduct some tutorial sessions for students who have their questions regarding the homework and lectures answered individually. Students will consolidate the knowledge through discussion within tutorials.
1,2,3,4,5	**Programming assignments** Instructor will give programming assignments to allow students to apply the numerical techniques learnt in the lecture and to solidify their understanding of the methods and their limitations.

Assessment:

No.	Assessment Methods	Weighting	CILO Address	Remarks
1	Continuous Assessment (assignments, test, and mini-project)	40%	1,2,3,4,5	Continuous Assessment is designed to measure students' understanding of the theory and techniques in numerical linear algebra, optimization and partial differential equations. This may involve, but not limited to, in class discussions of rigorous technical problems and their solutions.
2	Final Examination (3 Hours)	60%	1,2,3,4,5	Final Examination is designed to see how far students have achieved their intended learning outcomes especially in the knowledge domain. Students should have a thorough understanding of the knowledge and apply them correctly in different context to do well in the exam.

Course Intended Learning Outcomes and Weighting:

Content	CILO No.	Teaching (in hours)
I. Linear Algebra	1,2,5	13
II. Optimization	1,3,5	13
III. Partial Differential Equations	1,4,5	13

References

1. Applied Numerical Linear Algebra by James W. Demmel
2. J. E. Dennis, Jr. and R. B. Schnabel, Numerical Methods for Unconstrained Optimization and Nonlinear Equations, SIAM, 1996.
3. D. G. Luenberger, Linear and Nonlinear Programming, 2nd edition, Addison-Wesley, 1984.
4. Lawrence C. Evans, Partial Differential Equations, American Mathematical Society, 1997.

Software

1. Matlab and other related matrix computation software

Course Contents in Outline:

	Topics	Hours
I	Linear Algebra	13
	A Iterative Methods for Linear Systems	
	B Iterative Methods for Eigenvalue Problems	
II	Optimization	13
	A Multivariable Calculus Background	
	B Optimality Condition	
	C Newton's Method for Unconstrained Optimization	
	D Globally Convergent Modifications of Newton's Method	
	E Quasi-Newton Methods (optional, depends on the time)	
III	Partial Differential Equations	13
	A Overview	
	B Laplace's Equation	
	C Heat Equation	
	D Wave Equation	
	E Numerical Methods (optional, depends on the time)	