CUHK (SZ)
Course Outline

1. Course Identity

A. Course as listed in CUHK (SZ)

The information in this block should be exactly as approved by CUHK Senate. In case there are any differences, please explain in the table below.

Course code	MAT4001
Course title (English)	Numerical Analysis
Course title (Chinese)	数值分析
Units	3
Description (English)	This introductory course presents students some classical and commonly used numerical methods in various disciplines involving computing and numerical approximation and solution of equations. The course teaches students how to choose an appropriate numerical method for a particular problem and to understand the advantages and limitations of the chosen numerical scheme for a given mathematical problem so that results from the computation can be properly interpreted. The course also highlights important theoretical considerations on convergence and stability for numerical algorithm design.
Description (Chinese)	

B. Corresponding course in CUHK

Please give details of the *closest* corresponding course in CUHK (as approved by CUHK Senate and listed in course list). If the course in SZ maps to more than one course in CUHK, please make multiple copies of the block below.

Course code	MATH3230
Course title (English)	Numerical Analysis
Course title (Chinese)	数值分析
Units	3
Description (English)	Floating-point numbers and roundoff errors, absolute and relative errors, stable and unstable computations, solutions of nonlinear equations, linear systems, interpolation, numerical differentiation, and numerical integration. Students taking this course are expected to have knowledge in advanced calculus and linear algebra.
Description (Chinese)	

2. Prerequisites / Co-requisites

Please state prerequisites and co-requisites, in terms of courses in CUHK (SZ)* or any other requirements (e.g., having taken certain subjects in high school).

(* Because course codes may not yet be stable, please provide both course code and course tile.)

A. Prerequisites

MAT1003 Mathematical Analysis I
MAT1004 Mathematical Analysis II
MAT2040 Linear Algebra

B. Co-requisites

None.

3. Learning Outcomes

Knowledge:

a) Students will understand the iterative methods for solving nonlinear equations.
b) Students will understand the basic principles in data-fitting, numerical integrations and numerical differentiations.
c) Students will learn the elimination and iterative methods for solving linear systems.

Skills

Generic:

d) Students will be able to solve nonlinear algebraic equations.
e) Students will be able to compute integrations and derivatives of a function numerically.
f) Students will be able to solve a linear system numerically.

Valued/Attitude:

g) Students will be equipped with some theoretical and coding knowledge and be able to solve mathematical problem using appropriate numerical methods.
h) Students will understand the importance of theoretical analysis – including the convergent and stability -- for a numerical method.
i) Students will have awareness of the impact of computer methods in applied mathematics.

4. Course syllabus

Computational errors, convergence, and stability; solutions of nonlinear equations; interpolation; numerical differentiation; numerical integration; elimination and iterative methods for linear systems.

5. Assessment Scheme

Component/ method	% weight
Mid-term exam	30
Assignments	20
Final exam	50

6. Descriptor

Grade	Overall course
A	Demonstrates the ability to achieve all the learning outcomes in this course and be able to apply the principles in solving problems in novel situations, in a manner that would surpass the normal expectation at this level, and typical of standards that may be common at higher levels of study or research. Has the ability to express the synthesis of ideas or application in a clear and cogent manner.
A-	Demonstrates the ability to state and apply the principles or subject matter learnt in the course to familiar and standard situations in a manner that is logical and comprehensive. Has the ability to express the knowledge or application with clarity.
B	Demonstrates the ability to state and partially apply the principles or subject matter learnt in the course to most (but not all) familiar and standard situations in a manner that is usually logically persuasive. Has the ability to express the knowledge or application in a satisfactory and unambiguous way.
C	Demonstrates the ability to state and apply the principles or subject matter learnt in the course to most (but not all) familiar and standard situations in a manner that is not incorrect but is somewhat fragmented. Has the ability to express the separate pieces of knowledge in an unambiguous way.
D	Demonstrates the ability to state and sometimes apply the principles or subject matter learnt in the course to some simple and familiar situations in a manner that is broadly correct in its essentials Has the ability to state the knowledge or application in simple terms.
F	Unsatisfactory performance on a number of learning outcomes, OR failure to meet specified assessment requirements.

7. Feedback for evaluation

- CTE
- Feedback from informal conversation over (free) coffee in my office and e-mail correspondence with students after class.

8. Reading

A. Required

None.

B. Recommended

[1] Richard L. Burden, J. Douglas Faires, Annete M. Burden, Numerical Analysis, 10th ed, Cengage Learning, 2015.
[2] C.F. Gerald and P.O.Wheatley, Applied Numerical Analysis, 7th ed., Person Addison Wesley, 2003.

9. Course components

Activity	Hours/week
Lectures	3
Tutorial	1
Readings & Assignments	5

10. Indicative teaching plan

Week	Content/ topic/ activity
1	Introduction, Computer arithmetic, Computational errors; Convergence; Stability
2	Solution of nonlinear equations; Bisection; Fixed-point method
3	Newton's method; Secant method; Convergence analysis
4	Newton's method for system of nonlinear equations;
5	Interpolation of functions; Lagrange interpolation
6	Hermite interpolation
7	Splines
8	Numerical integration; Trapezoidal rule, Simpson's rule
9	Newton-Cotes formula; Composite numerical integration
10	Numerical differentiation; Finite differences
11	System of linear equations; Gaussian elimination, pivoting and scaling
12	Error analysis; Condition Number
13	Jacobi, Gauss-Seidel and SOR iterative methods

11. Implementation plan (2017–18)

The implementation plan may vary from year to year. Please indicate expected enrolment, and number of sections.

Expected enrolment: 70
Number of lecturing sections: 1
Number of tutorial sections: 3

12. Approval

Has the course title been included in the programme submission approved by CUHK Senate? Are there any differences?

Course title was approved by CUHK Senate.

Have the details (as in this document) been approved at School or other level in CUHK (SZ)?

Not yet.

13. Any other information

N.A.

14. Version date

Version number	1
As of (date)	July 27, 2018