**City University of Hong Kong**
**Course Syllabus**

**offered by College/School/Department of Mathematics**
**with effect from Semester A 20 20 / 21**

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**Part I Course Overview**

| | |
|---|---|
| **Course Title:** | **Elementary Numerical Methods** |
| **Course Code**: | **MA3525** |
| **Course Duration:** | **One semester** |
| **Credit Units**: | **3** |
| **Level**: | **B3** |
| **Proposed Area:** *(for GE courses only)* | ☐ **Arts and Humanities**<br>☐ **Study of Societies, Social and Business Organisations**<br>☐ **Science and Technology** |
| **Medium of Instruction:** | **English** |
| **Medium of Assessment:** | **English** |
| **Prerequisites**: *(Course Code and Title)* | **MA2503 Linear Algebra; or MA1503 Linear Algebra with Applications** |
| **Precursors**: *(Course Code and Title)* | **Nil** |
| **Equivalent Courses**: *(Course Code and Title)* | **Nil** |
| **Exclusive Courses**: *(Course Code and Title)* | **Nil** |

## Part II Course Details

### 1. Abstract

*(A 150-word description about the course)*

This course aims to give an introduction of elementary numerical methods. It trains students to apply numerical methods in solving problems in calculus, linear algebra and differential equations, as well as to use software packages in writing computer programs and analyzing solutions of problems. The course also serves to give students practice in clear and concise written and spoken communication of the results of an investigation.

### 2. Course Intended Learning Outcomes (CILOs)

*(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)*

| No. | CILOs[#] | Weighting* (if applicable) | Discovery-enriched curriculum related learning outcomes (please tick where appropriate) | | |
|---|---|---|---|---|---|
| | | | *A1* | *A2* | *A3* |
| 1. | manipulate computing software packages, such as MATLAB, as tools in solving and analyzing solutions of problems. | 0% | | | |
| 2. | design programs of numerical computation with MATLAB. | 0% | | | |
| 3. | explain clearly mathematical concepts of basic numerical methods. | 10% | * | | |
| 4. | apply computational techniques in linear algebra, such as solving a linear system, matrix eigenvalue problem and the least squares problem. | 40% | * | * | * |
| 5. | evaluate integrals and interpolating polynomials numerically. | 20% | * | * | |
| 6. | solve nonlinear equations by using an algorithmic approach technique. | 20% | * | * | * |
| 7. | the combination of CILOs 1-6 | 10% | * | * | * |
| | | 100% | | | |

** If weighting is assigned to CILOs, they should add up to 100%.*

*[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.*

*A1: Attitude*
*Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.*

*A2: Ability*
*Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.*

A3: *Accomplishments*
*Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.*

## 3. Teaching and Learning Activities (TLAs)

*(TLAs designed to facilitate students' achievement of the CILOs.)*

| TLA | Brief Description | CILO No. | | | | | | | Hours/week (if applicable) |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| Lecture | Learning through **teaching** is primarily based on lectures. | Y | Y | Y | Y | Y | Y | Y | 39 hours in total |
| Take-home assignments | Learning through **tutorials** is primarily based on interactive problem solving and hand-on computer exercises allowing instant feedback. | Y | Y | | | | | | 2 hours |
| | | | | Y | | | | | 1 hour |
| | | | | | Y | | | | 4 hours |
| | | | | | | Y | | | 3 hours |
| | | | | | | | Y | | 3 hours |
| Online applications | | | | | | | Y | | after-class |
| Math Help Centre | | Y | Y | Y | Y | | Y | | after-class |

## 4. Assessment Tasks/Activities (ATs)

*(ATs are designed to assess how well the students achieve the CILOs.)*

30% Coursework

70% Examination (Duration: 3 hours, at the end of the semester)

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

| Assessment Tasks/Activities | CILO No. | | | | | | | Weighting* | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| Continuous Assessment: _30___% | | | | | | | | | |
| Test | | | Y | Y | Y | | | 15-30% | Questions are designed for the first part of the course to see how well the students have learned the basic concepts of numerical methods and their applications in solving problems of linear algebra and polynomial interpolation. |
| Hand-in assignments | Y | Y | Y | Y | Y | Y | | 0-15% | These are skills based assessment to enable students to approach mathematical |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | problems via numerical means and to analyze solutions with the aid of computing software packages. |
| Project(s) | Y | | | Y | Y | Y | | 0-15% | Students are assessed on their ability in applying numerical and computational methods to solve mathematical problems, as well as on the presentation of numerical results with analysis. |
| Formative take-home assignments | Y | Y | Y | Y | Y | Y | | 0% | The assignments provide students chances to demonstrate their achievements on numerical methods learned in this course. |
| Examination: _70___% (duration: 3 hrs , if applicable) | | | | | | | | | Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be skills and understanding based to assess the student's versatility in basic numerical methods. |
| * *The weightings should add up to 100%.* | | | | | | | | 100% | |

## 5. Assessment Rubrics

*(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)*

| Assessment Task | Criterion | Excellent (A+, A, A-) | Good (B+, B, B-) | Fair (C+, C, C-) | Marginal (D) | Failure (F) |
|---|---|---|---|---|---|---|
| 1. Test | ABILITY to APPLY and EXPLAIN the basic concepts and methodology of numerical methods | High | Significant | Moderate | Basic | Not even reaching marginal levels |
| 2. Hand-in assignments | CAPACITY for LEARNING to understand the principles of numerical methods | High | Significant | Moderate | Basic | Not even reaching marginal levels |
| 3. Projects | N.A. | | | | | |
| 4. Examination | ABILITY to ANALYZE and DEVELOP numerical methods | High | Significant | Moderate | Basic | Not even reaching marginal levels |
| 5. Formative take-home assignments | CAPACITY for LEARNING to understand the principles of numerical methods | High | Significant | Moderate | Basic | Not even reaching marginal levels |

**Part III Other Information** (more details can be provided separately in the teaching plan)

## 1. Keyword Syllabus

*(An indication of the key topics of the course.)*

MATLAB for numerical computation, Computer Arithmetics. Linear System of Equations. Polynomial Interpolation and Splines. Numerical Integration. Least Squares Problems. Matrix Eigenvalue Problem. Root-finding Methods.

## 2. Reading List

### 2.1 Compulsory Readings

*(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)*

| | |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| … | |

### 2.2 Additional Readings

*(Additional references for students to learn to expand their knowledge about the subject.)*

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|---|---|
| 1. | |
| 2. | |
| 3. | |
| … | |