City University of Hong Kong

Information on a Course
offered by Department of Mathematics
with effect from Semester B in 2012 / 2013

Part I

Course Title: Enhanced Calculus and Linear Algebra II
Course Code: MA1301
Course Duration: One Semester
No. of Credit Units: 3
Level: B1
Medium of Instruction: English

Prerequisites: (Course Code and Title)
(i) MA1300 Enhanced Calculus and Linear Algebra I, or
(ii) Grade B or above in MA1200 Calculus and Basic Linear Algebra I (approval from MA must be obtained)

Precursors: (Course Code and Title) Nil
Equivalent Courses: (Course Code and Title) Nil
Exclusive Courses: (Course Code and Title) MA1101 Foundation Mathematics II, MA1201 Calculus and Basic Linear Algebra II, MA1001 Higher Mathematics I(A), MA1002 Higher Mathematics I(B), MA1003 Higher Mathematics II(A), MA1004 Higher Mathematics II(B)

Part II

1. Course Aims:

This is the second of two required courses designed for students pursuing studies in mathematics, or engineering/science, students requiring solid background in mathematics. It aims to
• develop fluency in concepts and techniques from integral calculus, linear algebra and complex numbers,
• introduce elementary theory of differential and integral calculus, and
• foster skills in implementing methods of calculus and linear algebra to mathematical and physical applications.
2. **Course Intended Learning Outcomes (CILOs)**

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

<table>
<thead>
<tr>
<th>No.</th>
<th>CILOs</th>
<th>Weighting (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>explain elementary theory of differential and integral calculus.</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>perform techniques of integration to evaluate integrals of functions.</td>
<td>2</td>
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<tr>
<td>3.</td>
<td>explain at high level concepts from vector and matrix algebra.</td>
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</tr>
<tr>
<td>4.</td>
<td>manipulate expressions and solve geometric problems with vector arithmetic.</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>implement techniques of matrix arithmetic and of solving linear systems.</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>perform operations and solve equations involving complex numbers.</td>
<td>2</td>
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<tr>
<td>7.</td>
<td>develop mathematical models through calculus and linear algebra, and appropriately apply to problems in science and engineering.</td>
<td>2</td>
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</tbody>
</table>

3. **Teaching and Learning Activities (TLAs)**

*(designed to facilitate students’ achievement of the CILOs)*

*Indicative of likely activities and tasks students will undertake to learn in this course. Final details will be provided to students in their first week of attendance in this course.*

Students are assigned to lecture sessions (A or B) according to mathematical background and/or results in HKDSE mathematics. Please refer to Section 3 of MA1300 *Form 2B* for details.

<table>
<thead>
<tr>
<th>TLAs</th>
<th>ILO No.</th>
<th>Hours/week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning through <strong>teaching</strong> is primarily based on lectures.</td>
<td>1 – 7</td>
<td>39 hours in total (A); 46 hours in total (B)</td>
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<td>6</td>
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<td>7</td>
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</tbody>
</table>

Learning through **tutorials** is primarily based on interactive problem solving allowing instant feedback.
Learning through **take-home assignments** helps students implement theory of calculus, methods of integral calculus, linear algebra and complex numbers, as well as apply knowledge of which to mathematical and physical problems.

| Learning through **online examples for applications** helps students apply methods of calculus, linear algebra and complex numbers to problems in science and engineering. |
| Learning activities in **Math Help Centre** provides students extra assistance in study. |

<table>
<thead>
<tr>
<th>Assessment Tasks/Activities (designed to assess how well the students achieve the CILOs)</th>
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<table>
<thead>
<tr>
<th>Assessment Tasks/Activities</th>
<th>ILO No.</th>
<th>Weighting (if applicable)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quizzes/Test(s)</td>
<td>1 – 7</td>
<td>15 – 30%</td>
<td>Questions are designed to see how well students have learned theory of calculus, techniques of integral calculus, as well as concepts and methods of linear algebra and complex numbers. These assessment tasks monitor students’ progress and reveal gaps in knowledge.</td>
</tr>
<tr>
<td>Hand-in assignment(s)</td>
<td>1 – 7</td>
<td>0 – 15%</td>
<td>These are skills based assessment to see whether students are familiar with elementary theory of calculus as well as essential methods and applications of integral calculus, linear algebra and complex numbers.</td>
</tr>
<tr>
<td>Examination</td>
<td>1 – 7</td>
<td>70%</td>
<td>Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be skills based to assess the extent to which students have mastered methods of the course and synthesized mathematical knowledge in practical applications.</td>
</tr>
</tbody>
</table>

4. **Assessment Tasks/Activities**

30% Coursework
70% Examination (Duration: 2 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.
5. **Grading of Student Achievement:** Refer to Grading of Courses in the Academic Regulations.

**A−, A, A+**

To achieve a grade of **A**, a student should
- have complete, or close to complete, mastery of all of the core components (**CILOs** 1–6),
- and have demonstrated high levels of fluency in mathematical writing and synthesis of core components, as evidenced by the successful use of mathematical techniques in applications (**CILO** 7).

**B−, B, B+**

To achieve a grade of **B**, a student should
- have good or very good mastery of all of the core components (**CILOs** 1–6),
- and have demonstrated good to very good levels of fluency in mathematical writing and synthesis of core components in applications (**CILO** 7).

**C−, C, C+**

To achieve a grade of **C**, a student should have good working knowledge
- of all of the core components of the course (**CILOs** 1–6);
- or, alternatively, of most of the core components of the course together with some demonstrated ability to synthesise them in applications (**CILO** 7).

**D**

To achieve a grade of **D**, a student should have some working knowledge of
- of most of the core components of the course (**CILOs** 1–6);
- or, alternatively, of some of the core components of the course together with some demonstrated ability to synthesise them in at least an application (**CILO** 7).

**Part III**

**Keyword Syllabus:**

A) Basic theorems of differentiation
B) Applications of differentiation: rate of change, local extrema, optimization problems, power and Taylor series, l’Hôpital rule
C) Definite and indefinite integrals; Techniques of integration, integration by substitution, integration by parts; Improper integrals
D) Physical and geometric applications of integration
E) Vectors in \( \mathbb{R}^2 \) and \( \mathbb{R}^3 \); Scalar products, cross products, triple scalar products; Linear (in)dependence; Applications to equations of lines and planes
F) Matrices; Determinants, cofactor expansion; Systems of linear equations, Gaussian elimination, Cramer’s rule; Matrix inverses, Gauss-Jordan elimination method
G) Arithmetic of complex numbers; Polar and Euler forms; De Moivre’s theorem and its applications

Recommended Reading:

Text(s):

1) *Basic Calculus and Linear Algebra* (Compiled by Department of Mathematics, City University of Hong Kong), Pearson Custom Publishing, 2007