The Hong Kong University of Science and Technology

UG Course Syllabus

Math 2351-L1 Introduction to Differential Equations

Credits: 3 units

Pre-requisites: MATH 1014; or MATH 1020; or MATH 1024.

Exclusions: MATH 2350, MATH 2352, PHYS 2124.

Name: Xu, Luze

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Office Hours: By email appointment at office Room 3483

Lectures: L1: Wed and Fri, 13:30pm-14:50pm

Venue: CYTG001

Teaching Assistants and Tutorials:

T1A: Mon 18:00-18:50 Room 6602 (Cao, Junzhe jcaobb@connect.ust.hk) (Starting on **Sept 7**)

T1B: Mon 15:00-15:50 LSK 1032 (Guo, Wenzhi wguoal@connect.ust.hk) (Starting on **Sept 7**)

Course Description

This course provides a concise introduction to **differential equations**. Topics include first order ODEs, linear second order ODEs and oscillations, homogeneous system of first order ODEs with constant coefficients, nonlinear ODE, bifurcation theory, and diffusion equation.

Intended Learning Outcomes (ILOs)

Upon successful completion of this course, students should

1. Develop an understanding of the core ideas and concepts of differential equations.

2. Recognize the power of abstraction and generalization, carry out mathematical work with independent judgement.

3. Apply rigorous, analytical and numeric approach to analyze and solve problems using concepts of differential equations.

4. Demonstrate skills in reading, interpreting and communicating mathematical content which are integrated into other disciplines or appear in everyday life.

5. Develop the mathematical maturity to undertake higher level studies in mathematically related fields.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Percentage (%)	Due date	Assessing Course ILOs
Worksheets	10%	After each tutorial sessions	1, 2, 3, 4, 5
Midterm	30%	23/10/2026	1, 2, 3, 4, 5
Final	60%	TBD	1, 2, 3, 4, 5

Grading Rubrics

Tutorial sessions are mandatory. Worksheets will be distributed during the tutorial session and collected after the tutorial session. Each Worksheet is to be graded as 0, 1, or 2. The 0 grade is for unexcused absent students, the 1 grade is for students who only make a minimal effort, and the 2 grade is for students that make a reasonable effort. **Please prepare for tutorials by reviewing the course materials in advance. Full credit is awarded for demonstrating a reasonable effort during the session. However, you should ensure all remaining problems are completed and reviewed afterward if the worksheet is not finished in class.**

The first tutorial session will start on **September 7**.

The midterm exam will be on **October 23** Friday during the class time. The tentative range will be the topics taught in the first five or six weeks.

A 3-hour final exam will be arranged by ARO. It will be cumulative and cover all the topics taught in this course.

The midterm and final exams will be **closed book written tests**. **No calculators** or other electronic aids are allowed.

Percentages are computed for Worksheets, Midterm and Final, and the final scores are computed using the marking scheme without any rescaling. Final scores are normalized to 100.

Policy for Make-up Worksheets:
No make-up worksheet. One lowest grade of worksheets will be dropped to accommodate for potential absence. Students who have an excused absence from submitting multiple Worksheets, please email the instructor as soon as possible.

Policy for Make-up Midterm Exam:
A make-up exam is offered only to students who are unable to make to the exam with justifiable causes which, in particular, exclude self-claimed discomfort or miner illness. And those students can also opt to reallocate the weight for midterm to final exam.

Policy for Make-up Final Exam:
The course will follow the make-up exam policy set by ARO. Approval from the instructor, the dean, and ARO will be needed for applying for a make-up final exam. Students must take the make-up exam before the deadline set by ARO. The problem set of the make-up exam will be different from that of the regular exam with however the level of difficulty.

Tentative Grading Scheme

The letter grade will be based on either an absolute or relative grading scale depending on which is better. The absolute grading scale and the relative scales are given below and are standard. μ is the mean final score, σ is the standard deviation, and G is the student's final score.

90-100	A range (A+, A, A-)
80-89	B range (B+, B, B-)
70-79	C range (C+, C, C-)
65-69	D
<65	F

$G>\mu+\sigma$	A
$\mu<G<\mu+\sigma$	B
$\mu-\sigma<G<\mu$	C
$\mu-2\sigma<G<\mu-\sigma$	D
$G<\mu-2\sigma$	F

Finally, the letter grade F will be treated specially. To pass this course, a student must receive a total score higher than 45. Students who receive a score higher than 45 but are not yet in the C range will receive the grade of D.

Final Grade Descriptors:

Grades	**Short Description**	**Elaboration on subject grading description**
A	Excellent Performance	A solid grasp of all major concepts and techniques, analytical or numerical, of differential equations that are introduced in the course.
B	Good Performance	Comprehensive understanding of all major concepts and techniques, with however some weakness.
C	Satisfactory Performance	Mediocre overall performance in homework, midterm and final exam that shows a student has many weaknesses in understanding of course contents
D	Marginal Pass	A disappointing performance that shows a student has crossed only the very basic hurdle of the course.
F	Fail	A disaster performance that shows a student has learned almost nothing from the course.

Course AI Policy

Students are free to utilize AI in learning, but are barred from accessing AI during exams.

Communication and Feedback

The solution of worksheets will be made available on Canvas later. Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include scores. Students who have further questions about the feedback including marks should consult the instructor within **five working days** after the feedback is received.

Required Texts and Materials

Lecture note by the instructor will be shared via Canvas.

Textbooks (for reference):

Course Lecture Notes by J. R. Chasnov:

https://www.math.hkust.edu.hk/~machas/differential-equations.pdf

Elementary Differential Equations and Boundary Value Problems (12th ed) by W. E. Boyce, R. C. DiPrima and D. B. Meade.

Tentative course schedule

Week 1:

0.13, 1.1, 2.1, 2.2, 2.3 Course introduction; Complex numbers,

Introduction to odes, Euler Method, Separable equations, Linear equations

Week 2:

2.4, 3.1 Applications, Euler Method

Week 3:

3.2, 3.3, 3.4, 3.5 Principle of superposition, Wronskian, Homogeneous odes, Inhomogeneous odes

Week 4:

3.5, 3.7, 3.8, 4.1 Particular solutions, Resonance, Damped resonance, Introduction to Laplace transforms

Week 5:

4.2, 4.3, 4.4, 5.1 The Laplace transform, Initial value problems, Heaviside step functions,

Dirac delta functions, Series solutions

Week 6:

5.1, 5.2, 6.2 Series solutions, Euler equations, Systems of equations

Week 7:

6.2, 6.3 Systems equations, Normal modes

Week 8:

Midterm, make-up classes

Week 9:

7.1 Fixed points and stability, Nonlinear pendulum

Week 10:

7.2, 7.3 Bifurcation theory

Week 11:

8.1, 8.3, 8.4 Derivation of the diffusion equation, Fourier series

Week 12:

8.5 Solution of the diffusion equation, make-up tutorial

Week 13:

8.6, 8.7 Solution of the wave equation and the Laplace equation, Final exam review

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.