

# Ordinary Differential Equations

## Autumn 2017

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<http://www.jamescannon.net/teaching/ordinary-differential-equations>  
<http://raw.githubusercontent.com/NanoScaleDesign/OrdinaryDifferentialEquations/master/ode.pdf>

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# Contents

<b>0</b>	<b>Course information</b>	<b>5</b>
0.1	This course . . . . .	6
0.1.1	How this works . . . . .	6
0.1.2	Assessment . . . . .	6
0.1.3	What you need to do . . . . .	7
0.2	Timetable . . . . .	8
0.3	Hash-generation . . . . .	9
0.4	Coursework . . . . .	9
<b>1</b>	<b>Hash practise</b>	<b>11</b>
1.1	Hash practise: Integer . . . . .	12
1.2	Hash practise: Decimal . . . . .	12
1.3	Hash practise: String . . . . .	12
1.4	Hash practise: Scientific form . . . . .	12



## Chapter 0

# Course information

## 0.1 This course

This is the Autumn 2017 Ordinary Differential Equations course studied by 2nd-year undergraduate international students at Kyushu University.

### 0.1.1 How this works

- In contrast to the traditional lecture-homework model, in this course the learning is self-directed and active via publicly-available resources.
- Learning is guided through solving a series of carefully-developed challenges contained in this book, coupled with suggested resources that can be used to solve the challenges with instant feedback about the correctness of your answer.
- There are no lectures. Instead, there is discussion time. Here, you are encouraged to discuss any issues with your peers, teacher and any teaching assistants. Furthermore, you are encouraged to help your peers who are having trouble understanding something that you have understood; by doing so you actually increase your own understanding too.
- Discussion-time is from 14:50 to 16:20 on Fridays at room Centre Zone 1409.
- Peer discussion is encouraged, however, if you have help to solve a challenge, always make sure you do understand the details yourself. You will need to be able to do this in an exam environment. If you need additional challenges to solidify your understanding, then ask the teacher. The questions on the exam will be similar in nature to the challenges. If you can do all of the challenges, you can get 100% on the exam.
- Every challenge in the book typically contains a **Challenge** with suggested **Resources** which you are recommended to utilise in order to solve the challenge. Occasionally the teacher will provide extra **Comments** to help guide your thinking. A **Solution** is also made available for you to check your answer. Sometimes this solution will be given in encrypted form. For more information about encryption, see section 0.3.
- For deep understanding, it is recommended to study the suggested resources beyond the minimum required to complete the challenge.
- The challenge document has many pages and is continuously being developed. Therefore it is advised to view the document on an electronic device rather than print it. The date on the front page denotes the version of the document. You will be notified by email when the document is updated. The content may differ from last-year's document.
- A target challenge will be set each week. This will set the pace of the course and defines the examinable material. It's ok if you can't quite reach the target challenge for a given week, but then you will be expected to make it up the next week.
- You may work ahead, even beyond the target challenge, if you so wish. This can build greater flexibility into your personal schedule, especially as you become busier towards the end of the semester.
- Your contributions to the course are strongly welcomed. If you come across resources that you found useful that were not listed by the teacher or points of friction that made solving a challenge difficult, please let the teacher know about it!

### 0.1.2 Assessment

In order to prove to outside parties that you have learned something from the course, we must perform summative assessments. This will be in the form of a mid-term exam (weighted 30%), coursework (weighted 20%), a satisfactory challenge-log (weighted 10%) and a final exam (weighted 40%).

Your final score is calculated as  $\text{Max}(\text{final exam score}, \text{weighted score})$ , however you must pass the final exam to pass the course.

### 0.1.3 What you need to do

- Prepare a challenge-log in the form of a workbook or folder where you can clearly write the calculations you perform to solve each challenge. This will be a log of your progress during the course and will be occasionally reviewed by the teacher.
- You need to submit a brief report at <https://goo.gl/forms/S69DuM4xCss0WtjH3> by 8am on the day of the class. Here you can let the teacher know about any difficulties you are having and if you would like to discuss anything in particular.
- Please bring a wifi-capable internet device to class, as well as headphones if you need to access online components of the course during class. If you let me know in advance, I can lend computers and provide power extension cables for those who require them (limited number).

## 0.2 Timetable

	Discussion	Target	Note
<b>1</b>	4 Oct	-	Wednesday class
<b>2</b>	13 Oct		
<b>3</b>	20 Oct		
<b>4</b>	27 Oct		
<b>5</b>	10 Nov		
<b>6</b>	17 Nov		
<b>7</b>	24 Nov		
<b>8</b>	1 Dec		Coursework instructions
<b>9</b>	8 Dec	Midterm exam	
<b>10</b>	15 Dec		
<b>11</b>	22 Dec		
<b>12</b>	15 Jan		Monday class
<b>13</b>	19 Jan		Submission of coursework
<b>14</b>	26 Jan		
<b>15</b>	2 Feb		
<b>16</b>	9 Feb	Final exam	

Example: To keep pace with the course, you should aim to complete challenge 2 of chapter 2 by the 14th of October.



## 0.3 Hash-generation

Some solutions to challenges are encrypted using MD5 hashes. In order to check your solution, you need to generate its MD5 hash and compare it to that provided. MD5 hashes can be generated at the following sites:

- Wolfram alpha: (For example: md5 hash of “q1.00”) <http://www.wolframalpha.com/input/?i=md5+hash+of+%22q1.00%22>
- [www.md5hashgenerator.com](http://www.md5hashgenerator.com)

Since MD5 hashes are very sensitive to even single-digit variation, you must enter the solution *exactly*. This means maintaining a sufficient level of accuracy when developing your solution, and then entering the solution according to the format suggested by the question. Some special input methods:

Solution	Input
$5 \times 10^{-476}$	5.00e-476
$5.0009 \times 10^{-476}$	5.00e-476
$-\infty$	-infinity (never “infinite”)
$2\pi$	6.28
i	im(1.00)
2i	im(2.00)
$1 + 2i$	re(1.00)im(2.00)
$-0.0002548 i$	im(-2.55e-4)
$1/i = i/-1 = -i$	im(-1.00)
$e^{i2\pi} [= \cos(2\pi) + i\sin(2\pi) = 1 + i0 = 1]$	1.00
$e^{i\pi/3} [= \cos(\pi/3) + i\sin(\pi/3) = 0.5 + i0.87]$	re(0.50)im(0.87)
Choices in order A, B, C, D	abcd

The first 6 digits of the MD5 sum should match the first 6 digits of the given solution.

## 0.4 Coursework

Coursework information will be placed here at a later date.



## Chapter 1

# Hash practise

## 1.1 Hash practise: Integer

$X = 46.3847$

Form: Integer.

Place the indicated letter in front of the number.

Example: aX where  $X = 46$  is entered as a46

hash of aX = e77fac

## 1.2 Hash practise: Decimal

$X = 49$

Form: Two decimal places.

Place the indicated letter in front of the number.

Example: aX where  $X = 46.00$  is entered as a46.00

hash of bX = 82c9e7

## 1.3 Hash practise: String

$X = abcdef$

Form: String.

Place the indicated letter in front of the number.

Example: aX where  $X = abc$  is entered as aabc

hash of cX = 990ba0

## 1.4 Hash practise: Scientific form

$X = 500,765.99$

Form: Scientific notation with the mantissa in standard form to 2 decimal place and the exponent in integer form.

Place the indicated letter in front of the number.

Example: aX where  $X = 4 \times 10^{-3}$  is entered as a4.00e-3

hash of dX = be8a0d