# Suggested Schedule for DE1 lectures

The lecture videos are of various length as they are designed to cover a particular topic rather than being a specific length as in traditional lectures. The names of the videos indicate the section in the lecture notes that the video corresponds to.

Below is a proposed schedule for the lectures that you might find useful to plan your term. To help you check that your planned schedule fits with the timing of your tutorials in college, I am also including separately which videos are relevant for which problem sheets.

As the videos are of varying length, the proposed amount of lecture time is not be exactly the same in each week, and you can of course adjust that to fit your plans. Also, the speed of the lecture is relatively slow as it is designed to be so that students who want to take notes should be able to do so without having to pause the videos. If you don't take notes it is likely more suitable to watch the video at a faster speed.

**W1** Picard's Theorem and its proof (via direct iteration argument):
1.1 and 1.2 Introduction and Picard's method of successive approximation (49')
1.3 Picard's Theorem and proof via successive approximation (49')

**W2** Global Existence, continuous dependence and the Proof of Picard via CMT:
1.4 Global existence (31')
1.5 Continuous Dependence (21')
1.6 Proof of Picard's Theorem via CMT (40')
1.7 Picard for systems and higher order ODEs (29')

**W3** First half of chapter 2 on Plane Autonomous Systems:
2.1 Critical Points of Plane Autonomous Systems (30')
2.2 Stability and Linearisation (32')
2.3-1 Classification of critical points (51')

**W4** Second half of chapter 2 on Plane Autonomous Systems:
2.3-2 Examples 1 and 2 (38')
2.3-3 Examples 3 and 4 (38')
2.4 Limit circles, periodic solutions and Bendixson Dulac Theorem (44')

**W5** Main parts of chapter 3 on Method of characteristics:
3.1 Introduction to first order PDEs (21')
3.2 Characteristics (42')
3.3 The Cauchy-Problem (22')
3.4 Examples (23')
First part of video on 3.5 domain of definition and 3.6 Cauchy data (until 16:21)

**W6** Final parts of chapter 3 beginning of chapter 4 on second order PDEs:
Second part of video 3.5 domain of definition and 3.6 Cauchy data (25')
3.7 Discontinuities in the first derivative (31')
4.1 Part 1 Introduction to 2nd order PDEs (36')
4.1 Part 2: Normal form for hyperbolic PDEs (first part until (22'))

**W7** Normal form and characteristics of second order PDEs, wellposedness for wave eq.
4.1 Part 2: Normal form for hyperbolic PDEs (starting from Example 1) (34')
4.1 part 3: Elliptic and parabolic PDE in normal form (39')
4.2 Characteristics for 2nd order PDEs (33')
First part of 4.3 Well-posedness (upto 18', i.e. part on wave equation)

**W8** Well-posedness and maximum principles for both elliptic and parabolic PDEs
Second part of 4.3 Well-posedness (27')
4.4 Maximum principle part 1-elliptic (43')
4.4-2 Maximum principle (parabolic version) (38')

**Problem sheets**

**Problem sheet 1:**
Based on videos of sections 1.1-1.5

**Problem sheet 2:**
Questions 1-3: Based on videos of sections 1.6-1.7
Questions 4,5: Examples of phase planes and plane autonomous systems. The videos that cover the theory for questions are 2.1, 2.2 and 2.3-1. The videos 2.3-2 and 2.3-3 with examples of plane autonomous systems can be useful to watch alongside solving the problem sheet.

**Problem sheet 3:**
Questions 1 and 2 are further examples on plane autonomous systems and in addition to the above videos on sections 2.1-2.3 use also the video on section 2.4.
Questions 3-6 are on the method of characteristics and cover material from chapter 3

**Problem sheet 4:**
Questions 1-4 relate to material covered in videos on sections 4.1-4.3, while questions 5 and 6 concern the maximum principle covered in the videos of section 4.4.

**Lecture notes**
In some places I have used alternative examples or proofs in the videos compared to the typed lecture notes. This is not meant to be so that you need to read/watch more material during the term, but rather to give you some additional examples for the revision or some alternative way of carrying out some proof that you might find useful if you don't like the other variant of the proof. The main differences are pointed out in the corresponding videos and include (no guarantee for completeness) alternative proofs of corollary 1.5 and Proposition 3.1, alternative examples in sections 1.4,3.4, 4.1 and 4.4 as well as additional geometric explanations in various parts of chapter 3.