MA2327 – General information

- **Lecturer:** Paschalis Karageorgis (pete@maths.tcd.ie).
- **Web page:** http://www.maths.tcd.ie/∼pete/ma2327
- **Homework:** Assignments will be posted online every other Thursday. You will be allowed to submit them either 1 or 2 weeks later.
- **Reading:** Some brief lecture notes will be posted online. If you need some additional references, then you may always consult
  - *The qualitative theory of ODEs, an introduction* by Brauer and Nohel,
  - *Elementary differential equations* by Boyce and DiPrima.

  Try to read the former for theory/proofs and the latter for examples.
- **Marking policy:** 80% annual exam and 20% homework. The exam will consist of problems similar to those assigned for homework.
- **Module structure:** There are three main topics to be covered in this module: some general theory, linear systems and stability theory.

MA2327 – Main concepts

The main concepts to be introduced in this module are the following.

1. **General theory:** order of an equation, direction field, initial value problem, existence and uniqueness, blow up, continuous dependence on initial data, separable equation, linear equation, integrating factor, homogeneous equation, Bernoulli equation, Gronwall inequality.
2. **Linear systems:** homogeneous system, superposition principle, linear independence of functions, eigenvector method, matrix exponential, fundamental matrix, variation of parameters, characteristic equation, method of undetermined coefficients, Wronskian, reduction of order.
3. **Stability theory:** autonomous system, equilibrium or critical point, stability, asymptotic stability, Jacobian matrix, Lyapunov function.

MA2327 – Learning outcomes

On successful completion of this module, students will be able to:

- apply various standard methods (separation of variables, integrating factors, reduction of order, substitutions, undetermined coefficients) to solve various types of ordinary differential equations (separable, first-order linear, homogeneous, linear with constant coefficients);
- provide examples of initial value problems to illustrate that such a problem may have infinitely many solutions or no solutions at all;
- use the eigenvector method and/or the matrix exponential to solve systems of linear equations with constant coefficients;
- prove various properties satisfied by fundamental matrices of linear systems and find such a matrix explicitly in a few special cases;
- apply standard methods (Jacobian matrix, Lyapunov theorems) to check the critical points of an autonomous system for stability.