MATH36022 - 2007/2008

General Information

- Title: Numerical Solution of Ordinary Differential Equations
- Unit code: MATH36022
- Credits: 10
- **This course unit may not be taken by any students who have taken the ex-VUM course unit MT2282 *Numerical Analysis 2* in previous years.**
- Prerequisites: MATH10202 or MATH10212, MATH20101 or MATH20111
- Co-requisite units: None
- School responsible: Mathematics
- Members of staff responsible: Dr. Ruth Thomas

Specification

Aims

To introduce some modern numerical methods for solving initial value problems involving ordinary differential equations, together with a rigorous analysis of the methods.

Brief Description of the unit

This course covers the numerical solution of ordinary differential equations. Among the numerical methods introduced are linear multistep methods and Runge-Kutta methods. Important properties of the methods, such as convergence, order of accuracy and stability, are introduced and analysed. Finally, the numerical solution of systems of first order ordinary differential equations is discussed.

Learning Outcomes

On successful completion of this course unit students will be able to

- derive some practical numerical methods for solving initial value problems in ordinary differential equations;
- investigate the stability and convergence properties of the methods;
- identify numerical methods that preserve the qualitative behaviour of the solution of the problem;
- recognise some of the numerical difficulties that can occur when solving problems arising in scientific applications.

Future topics requiring this course unit

None.

Syllabus

1. Introduction to ODEs: Picard's Existence and Uniqueness Theorem. [2 lectures]
2. Introduction to numerical methods: finite Taylor series methods, Runge-Kutta methods and predictor-corrector methods, including the Adams methods. [4]
3. Properties of linear multistep methods: global error, local truncation error, order of accuracy, consistency, convergence, zero- stability, absolute stability. [7]
4. Properties of Runge-Kutta methods. [3]
5. Introduction to first order systems of ODEs. [2]
6. The problem of stiffness: discussion and definition, A-stability and A (alpha)-stability, the BDF methods and implicit Runge-Kutta methods. [4]

Textbooks

- J D Lambert, *Numerical Methods for Ordinary Differential Systems*, Wiley 1991.

Teaching and learning methods

Two lectures and one examples class each week. In addition students should expect to spend at least four hours each week on private study for this course unit.

Assessment

Mid-semester coursework: weighting 20%
End of semester examination: two hours weighting 80%

Arrangements

Coursework

Test in Week 9: Students will be asked to write out their solutions to a small number of problems chosen from a set notified in advance.