School of Mathematics

Course 376 — Numerical Simulation of Physical Systems, Computer Aided Design
2001–02
(JS & SS Mathematics)

Lecturer: Dr. Mike Peardon, Prof. F. Neelamkavil

Requirements/prerequisites: 262 is required for 3D4; Some knowledge of Ordinary Differential Equations, and of Newton's Laws.

Duration: 9+11 Weeks

Number of lectures per week:

Assessment:

End-of-year Examination: The 342 and 3D4 sections are assessed separately. The overall result is the average of the results for the two sections.

Description:

Ths course consists of 342 (for Michaelmas Term) plus 3D4 for the second semester.

School of Mathematics

Course 342 — Practical computational simulations. 2000-01
(JS Theoretical Physics, JS Mathematics, JS Computational Science.)

Lecturer: Dr. Mike Peardon

Requirements/prerequisites: Some knowledge of C programming.

Duration: Michaelmas term.

Number of lectures per week: 1 lecture per week, with a 1 hour lab class.

Assessment: Assessment is through lab attendance and assignments and a project.

End-of-year Examination: None.

Description:
The course provides a practical introduction to some numerical techniques for simulating physical systems.

- The C compiler: Using the C compiler, command line arguments, file input/output, structures, linking to libraries.
- Matrix methods: inversion, eigenvalues and eigenvectors.
- Finite difference methods: solving ODEs and PDEs.

Textbooks:

- **UNIX in a Nutshell**, Robbins. O'Reilly Publishing. ISBN: 1-56592-427-4.
- **Practical C Programming, 3rd Edition**, Oualline. O'Reilly Publishing. ISBN: 1-56592-306-5.
- **Numerical Recipes in C**, Press, Teukolsky, Vetterling and Flannery. Cambridge. ISBN: 0-521-43108-5. Online: `http://www.nr.com/`

School of Mathematics

Course 3D4 — Computer-aided design 2000-01
(Optional JS & SS Mathematics, JS Engineers)

Lecturer: Dr. F. Neelamkavil & Mr. J. Dingliana

Requirements/prerequisites: 2E3

Duration: 11 weeks (second semester)

Number of lectures per week: 4 hours per week (3 lectures and 1 tutorial)

Assessment:

End-of-year Examination: One 3-hour examination (80%) and coursework (20%)

Description:
Design is considered to be an interactive process involving specification, synthesis, presentation, analysis, evaluation and modification. Computers are central to engineering and the design of complex machines, structures and processes relies upon modern high speed computers. Computer-Aided Design(CAD) is concerned with the provision and use of a number of carefully chosen computer-based tools and techniques intended to facilitate and possibly automate the work of the designer.

The objective of this course (3D4 followed by 4D4 next year) is to equip the students with the fundamental understanding of the major elements of CAD and related areas including design, computer graphics, geometric modelling, simulation, robotics and computer vision. The course concentrates on the bridge between theory and its practice and is a good preparation for a career that may span several specialisms.

1. INTRODUCTION TO CAD
   Design process and the role of CAD
   Importance of Computer Graphics
   CAD System Architecture
   CAD Application domain

2. CAD/COMPUTER GRAPHICS - Hardware
   Vector and Raster Graphics
   Input and output devices
   New graphics technologies

3. CAD/COMPUTER GRAPHICS - Software
   Device independence
   Input and output functions
   Standards (Graphics, data exchanges, communications)
   Graphics and Graphical User Interfaces (GUI)

4. VISUALISATION-AIDS
   Raster algorithms
   2D transformations (Scaling, translation, rotations), Homogeneous transformations
   Composite transformations, Shearing, Reflection Window to View port transformations
   Line and polygon clipping

   Introduction to 3D viewing operations
   Projections, View volumes and clipping in 3D
   Visual realism (hidden line/surface removal, shading, etc)
   Engineering applications

5. GEOMETRIC MODELLING
   Parametric/non-parametric representations
   Generation of curves (Splines, Bezier, NURBS, etc)
   Generation of surfaces (Bezier, B-Spline, etc)

6. THREE DIMENSIONAL GRAPHICS

   - The 3D pipeline
     Transformations in 3D
     Viewing and Projection

   - Shading and Illumination
     Phong Illumination Model
     Phong and Gouraud Shading

   - Image Synthesis
     Introductory discussion on Global Illumination techniques (e.g. Raytracing, Radiosity)

7. CAD APPLICATIONS

*Some changes in the above syllabi can be expected every year.

April 4, 2002