School of Mathematics

Course 376 — Numerical Simulation of Physical Systems, Computer Aided Design
1998-99
(JS & SS Mathematics)

Lecturer: Dr. James Sexton, Prof. F. Neelamkavil

Requirements/prerequisites:
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 — Numerical Simulation of Physical Systems 1997-98
(JS Theoretical Physics
JS Natural Science
M.Sc. Theoretical Physics)

Lecturer: Dr. James Sexton

Requirements/prerequisites:
Some knowledge of Ordinary Differential Equations, and of Newton's Laws.

Duration: 9 Weeks

Number of lectures per week: 3 lectures per week

Assessment: Project counts 20%.

End-of-year Examination: One 3 hour exam, counts 80%

Description:

Mathematical preliminaries, molecular dynamics, symplectic integrators, Monte Carlo techniques in statistical mechanics, applications.

Textbooks: None required. Comprehensive Handouts.

School of Mathematics

Course 3D4 — Computer-aided design 1995-96
(Optional JS & SS Mathematics, JS Engineers)

Lecturer: Dr. F. Neelamkavil & Dr. M. MacAirchinnaigh

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, computer vision and artificial intelligence. 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 curses (Splines, Bezier, NURBS, etc)
   Generation of surfaces (Bezier, B-Spline, etc)

6. INTELLIGENT COMPUTER-AIDED DESIGN (ICAD)
   Review of Principles of Design

   - Form and content
   - Computer geometry and classical computer-aided design
   - Modelling methods and technqiues

   Language as a vehicle of Design

   - Syntax, grammar, semantics
   - Language dimension
   - Shape grammars and generative design

   Artificial Intelligence Paradigms and Tools

   - Concepts, representation, and structures
   - Programming language constructs, their bindings and interpretation

7. CAD APPLICATIONS

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

June 10, 1998