School of Mathematics

Course 4D4 – Computer Aided Design 1998-99
(Optional SS Mathematics, SS Engineering)

Lecturer: Dr. F. Neelamkavil & Dr. M. MacAn Airchinnigh (Comp. Sci.)

Requirements/prerequisites: 3D4

Duration: 18 weeks (First and Second Terms)

Number of lectures per week: 5 hours per week

Assessment:

End-of-year Examination: One 3-hour examination (80%) and course work (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 and 4D4) 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. COMPUTER VISION
    - Computer Vision Applications
    - Illumination and Sensors
    - Image Acquisition and Representation
    - Digital Image Processing
    - Image Segmentation
    - Image Analysis

2. ROBOTICS FUNDAMENTALS

   - Introduction to Robotics
   - Homogeneous Transformations
   - Kinematics and the Inverse Kinematic Solution
   - Integrated Robot Vision Systems

3. ROBOT MOTION CONTROL SCHEMES Path Planning

   - Mathematical notations and mechanisms required to specify a particular path or curve through 3-dimensional space. Introduction to the problem of obstacle avoidance.

   Manufacturing

   - Introduces the concept of surface modelling, required for robot milling in the automated manufacture of items with complex shape characteristics.

4. INDUSTRIAL VISION AND ROBOTICS

   - Lectures, demonstrations, and videos of real-world systems.

5. ENGINEERING VISUALISATION AND HCI

   - The PHIGS graphics library for graphical simulation and visualisation of curves, surfaces, and rotations involved in navigation and manufacturing. Demonstrations using Mathematica. Continual assessment work using IBM's graPHIGS.

6. MODELLING AND SIMULATION

   - Systems, models and simulation
   - Discrete and Continuous Systems
   - Modelling methodology, Verification and Validation of models
   - Discrete system simulation, Simulation languages
   - Collection and analyses of simulation results
   - Introduction to animated graphical simulations
   - Introduction to Expert simulation systems

7. SOLID MODELLING

   - Solids and solid models
   - Solid modelling theory
   - Solid modelling representation schemes (Boundary, CSG,etc)
   - Solid modelling systems
   - Increasing the intelligence of solid modelling systems

8. CAD Applications

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

June 10, 1998