BOARD OF THE FACULTY OF MATHEMATICS

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M.Sc. in Computation

COURSE OUTLINE

There are two parts to the course, the formal teaching leading to a written examination, and a project leading to a dissertation and (possibly) an oral examination. Each part takes roughly six months.

FORMAL COURSE

The formal teaching occurs in the first two terms and is examined in a written examination in early May. The syllabus for this examination is defined in the *Examination Decrees*.

Course Content and Lectures.

There are seven examined sections numbered 1, 2, 3, 5, 6, 7, and 8 below, and five practical courses (V1, V2, V3, 4 and 9). Detailed synopses and suggested reading for the examined courses are given in Appendix 1.

Vacation Courses.

V1. Pascal on Microprocessor Workstations. Mr. Harper (27 Sept. - 1 Oct. 10-1).

V2. Elements of Functional Programming. Dr. Henderson (4 Oct. - 8 Oct.)

V3. Microprocessor System Design. Dr. Dexter (10-14 Jan. 1983)

Michaelmas Term.

1. System Specification (paper 1). Mr. Stoy.
   (16 lectures: M.W. 10).

2. Distributed Computing (paper 2) Prof. Hoare
   (16 lectures: M.W. 11).

3. Microprocessor Programming (paper 2) Dr. Henderson
   (16 classes: T.Th. 11).

4. Basic Digital Electronics Dr. Dexter.
   (Fri. 2-5, Weeks 3-8).

Hilary Term.

5. Principle of Programming Languages (paper 1) Dr. Henderson
(16 lectures).

6. Digital Hardware Design (paper 2) Dr. Dexter
(16 lectures).

7. Project Management (paper 2) Mr. Buckle
(16 lectures).

8. Program Correctness (paper 1) Mr. Stoy
(16 lectures)

9. Case Studies. Mr. Sufrin.
(16 lectures).

All lectures will be given in the Seminar Room, 19 Parks Road, EXCEPT for course 4,6 and V3, which will be in the Department of Engineering Science.

Written Examination.

There will be two papers each containing material from the course as indicated above. There will be no questions on either paper from courses V1, V2, V3, 4 and 9. Students will be expected to hand in the results of practical work, which will be made available for scrutiny by the examiners.

During the course students will be given problems relevant to the lecture material, and these will be discussed in weekly classes arranged for the purpose on Tuesdays at 2.00p.m. Some of these problems will involve the use of a computer. There will also be opportunities for practical work at the Computing Teaching Centre, the Programming Research Group or the Department of Engineering Science.

PROJECT AND DISSERTATION.

After the written examination, students will work on a supervised project and prepare a dissertation, which is intended to enable the student to put into practice the principles learnt in the formal course work. The student will decide the topic of the project, preferably during the second term, in consultation with his supervisor and (where appropriate) his employer. If necessary, the greater part of the work may be carried out away from Oxford, though every student must be resident in Oxford during Trinity Term for long enough to satisfy the six-week residence requirements of the University. The dissertation may often take the form of the complete documentation of a programming project. According to University regulations, two typewritten or printed copies must be sent to the examiners (C/O 45 Banbury Road, Oxford) by 19 September, 1983.

Candidates may be required (unless individually dispensed) to attend an oral examination on the dissertation and on any of the topics covered on the course. These orals will probably take place in the first two weeks in October, 1983.

SUPERVISORS.

Each student is assigned to a personal supervisor. It is hoped that supervisors and their students will arrange to see each other regularly (at least fortnightly) during the course, but students should not hesitate to get in touch with their supervisors immediately if they get into any kind of difficulty with the course. It is possible to change supervisor in the third term, if that would be more appropriate for the particular project a student has chosen.

SEMINARS

Students are encouraged to attend the series of seminars on topics in Computation, which are given, usually by visiting speakers, on Thursdays at 4.30 p.m. in the Department of Nuclear Physics.

PREPARATORY WORK.

Texts suitable for preliminary reading.

Lipschulz: Finite Mathematics, Schaum outline series in Mathematics McCraw Hill

Welsh and Elder: Introduction to PASCAL - Prentice Hall.

Henderson: Functional Programming - Prentice Hall.

Hodges: Logic - Penguin Books.

Arbib, Kfoury and Moll: A Basis for Theoretical Computer Science Springer Verlag.

APPENDIX 1

Synopsis

1. System Specification (16 lectures) Mr. Stoy

Propositional Calculus, Predicate Calculus, Equality, Basic Set Theory, Fixed Points, Relations and Functions, Natural Number, Sequences and Trees.

Reading: Lipschultz. Finite Mathematics, Schaum outline series in Mathematics.

2. Distributed Computing (16 lectures) Professor Hoare

Model of a process; alternative, sequential and parallel composition, input, output, pipes; data structures coroutines, iterative arrays, sharing, scheduling, simulation, proof methods, examples and applications.

Text: A Model for Communicating Sequential Processes. PRG Monograph No: 22.

3. Microprocessor Programming (16 classes) Dr. Henderson

Exposure to a wide range of microprocessor systems available in the University, building upon the skills learned in the Pascal and Functional Programming courses.

4. Basic Digital Electronics (6 lectures and Laboratories) Dr. A. Dexter.

An introduction to the electronics of integrated circuits and an opportunity to build some simple systems.

Text: D.P. Leach - Experiments in Digital Principles McGraw Hill 1981.

5. Programming Language Principles (16 lectures) Dr. Henderson

Syntax, semantics, pragmatics, abstract syntax, Data structures, Procedures and Functions, Coroutines, parallel processes, Types, Operational, denotational and axiomatic semantics, Very high level languages including Lisp, Prolog and Lucid. Compilation and interpretation, using state transitions and reduction.

Text: R.D. Tennent - Principles of Programming Languages - Prentice Hall, 1981.

6. Digital Hardware Design (16 lectures) Dr. A. Dexter.

Microprocessor system architecture: bus structures, control of data flow, the three-state bus. Memories and memory interfaces. Peripheral interfaces: LSI interface chips, standard bus systems. Input-output operations; programme-controlled I/O, direct-memory-access. Remote communication: series data transmission, protocols, error detection. Instrument interfaces: the IEEE bus, analogue interfaces. Special-purpose microprocessors, analogue microprocessors, math-processors, I/O processors; single-chip microcomputers, Specification and development of microprocessor-based products.

Text: R. Zaks and A. Lesea: Microprocessor Interfacing Techniques, Sybex, 3rd edition, 1979.

related reading: T.R. Blakeslee: Digital Design with standard MSI and LSI, Wiley Interscience, 2nd edition, 1979.
D.Zissos: System Design with Microprocessors, Academic Press, 1978.
J.F. Wakerly: Microcomputers: Architecture and Programming, Wiley and Sons, 1981.

7. Project Management (16 lectures) Mr. J. Buckle.

Project phases, tools, plans, budgets, reviews, changes, documentation, staffing, interfaces.

Reading: J.K. Buckle - Managing Software Projects - Macdonald, 1977.

8. Program Correctness (16 lectures) Mr. Stoy.

Data Structures, Data Type Invariants, Induction Rules, Program Structures, Program Invariants, Program Proof Rules.

Reading: C.B. Jones: Software Development - A Rigorous Approach Prentice Hall, 1980.

E.W. Dijkstra: A Discipline of Programming - Prentice Hall, 1977.

9. Case Studies (16 lectures) Mr. B. Sufrin.

A detailed study of the application of the methods outlined in the course to the formal specification of the implementation of the following systems:

(1) An interactive text editor.
(2) A Secure filing system.
(3) A medium scale database system.

Reading: B. Sufrin: "Reading Formal Specifications" PRG Monograph (forthcoming).

B. Sufrin: "Formal Specification of a Display Editor" - PRG Monograph No. 21