THE UNIVERSITY OF NOTTINGHAM

FACULTY OF APPLIED SCIENCE

Applications of Computers

A WEEKS RESIDENTIAL COURSE TO
BE HELD AT HUGH STEWART HALL
UNIVERSITY OF NOTTINGHAM

Monday, 15th September
to
Friday, 19th September,
1958

SYLLABUS

GENERAL INFORMATION

OBJECT OF THE COURSE

The object of this course is to introduce Engineers and Executives to Digital Computers and their applications.

No formal academic qualifications are required for enrolment, but the lectures have been designed for people of Degree or Higher National Certificate standard of education.

ADVANCE COPIES OF LECTURES

Copies of lectures will be circulated in advance to all who register for the course, and lecturers will therefore be enabled to devote lecture periods to the development of the main points of their theses.

FORUM

Though questions and contributions are invited from the audience after lectures Nos. 1-16, the Forum is designed to deal with matters arising from the final three lectures; questions arising from those lectures should therefore be put at the Forum only.

Written questions arising from the course in general, and which students wish to hear discussed at the Forum, should be placed in the box provided in the Entrance Hall.

EXHIBITION

An Exhibition will be arranged in conjunction with the course, and films about Computers will be shown after dinner each evening for those who wish to attend.

ACCOMMODATION

The Course will be held in Hugh Stewart Hall, one of the University Halls of Residence, where residential accommodation will be available for both men and women. Indoor and outdoor recreational facilities are provided. Members of the course will also be temporary members of the University Staff Club which contains billiards and table tennis rooms and a fully licensed bar.

The accommodation fee is fully inclusive, and covers gratuities, overnight accommodation for the Sunday before the course and the Friday following if required.

APPLICATION FOR ENROLMENT

Accommodation is strictly limited and early application is very strongly advised. The enclosed application form should be sent with the appropriate remittance (Course including notes—ten guineas. Accommodation—eight guineas), to :—

The Organising Secretary,
Applications of Computers Course,
Department of Mechanical Engineering,
The University of Nottingham,
University Park,
Nottingham.

PROGRAMME

Monday, 15th September

9.30 a.m. .. Introduction.
10.30 a.m. .. Coffee.
11.0 a.m. .. "Basic Principles—Logical Requirements of a Digital Computer."
1.0 p.m. .. Luncheon.
2.0 p.m. .. "Basic Principles—The Arithmetic Unit."
3.30 p.m. .. Tea.
4.0 p.m. .. "Basic Principles—Storage."
6.30 p.m. .. Dinner.

Tuesday, 16th September

9.0 a.m. .. "Basic Principles—Input and Output."
10.30 a.m. .. Coffee.
11.0 a.m. .. "Basic Principles—Control."
1.0 p.m. .. Luncheon.
2.0 p.m. .. "The Task of the Programmer."
3.30 p.m. .. Tea.
4.0 p.m. .. "Programming Strategy."
6.30 p.m. .. Dinner.

Wednesday, 17th September

9.0 a.m. .. "Economic Implications of Computers."
10.30 a.m. .. Coffee.
11.0 a.m. .. "Error Protection."
1.0 p.m. .. Luncheon.
2.0 p.m. .. "Commercial Applications—(1) Commercial Control."
3.30 p.m. .. Tea.
4.0 p.m. .. "Commercial Applications—(2) Production Control."
6.30 p.m. .. Dinner.

Thursday, 18th September

9.0 a.m. .. "Linear Algebra."
10.30 a.m. .. Coffee.
11.0 a.m. .. "Data Processing."
1.0 p.m. .. Luncheon.
2.0 p.m. .. "Technical Problems—(1) Design and Development."
3.30 p.m. .. Tea.
4.0 p.m. .. "Technical Problems—(2) Auto-Coding."
6.30 p.m. .. Dinner.

Friday, 19th September

9.0 a.m. .. "Some Commercially Available Computing Machines."
10.30 a.m. .. Coffee.
11.0 a.m. .. "The Organisation of a Computer Service in an Aircraft Design Office."
11.45 a.m. .. "The Organisation of a Computing Centre."
1.0 p.m. .. Luncheon.
2.0 p.m. .. Forum.
3.30 p.m. .. Tea.
4.30 p.m. .. Forum.
6.30 p.m. .. Dinner.

HUGH STEWART HALL.

Monday, 15th September.

MORNING SESSION

Chairman: Dr. J. H. MITCHELL

Lecture No. 1 **9.30 a.m.**

INTRODUCTION TO THE COURSE

by A. J. YOUNG, B.A., B.Sc.

Lecture No. 2 **11.0 a.m.**

"BASIC PRINCIPLES—LOGICAL REQUIREMENTS OF A DIGITAL COMPUTER"

by G. E. THOMAS, M.Sc., Ph.D., A.M.I.E.E.

1. **Representation of Numbers**

   The digital representation as distinct from the analogue representation of a numerical quantity. Freedom of choice of radix, though the majority of this lecture will be illustrated in terms of a decimal radix. Accuracy and range requirements and methods of handling exceptional cases.

2. **Apparatus**

   (*a*) Store : Capacity requirements. Means of identification of numbers and the digits in a number.

   (*b*) Arithmetic Unit : A list of the functions and arithmetic operations which will be used frequently and which should be available in the arithmetic unit.

   (*c*) Transport system and control centre : The method of moving numbers into and out of the store and to the arithmetic unit and back. The provision of instructions to the control unit which determines this movement of numbers.

3. **Programming.**

   The breakdown of a numerical problem into an ordered sequence of arithmetic and organisational operations, each operation being defined by a computer instruction. The introduction of instructions which can interrupt the sequential selection of further instructions and so either conserve instructions or provide a facility for decision. An example of a programme to print a table of the series a, a^2, a^3.....a^n will be used to illustrate each type of operation possible in the computer.

AFTERNOON SESSION

Chairman: Professor J. E. PARTON

Lecture No. 3 **2.0 p.m.**

"BASIC PRINCIPLES — THE ARITHMETIC UNIT"

by G. E. THOMAS, M.Sc., Ph.D., A.M.I.E.E.

1. **Extent of the Departure from the Logical Requirements of this Unit.** The facilities usually provided in the arithmetic unit are addition, subtraction, multiplication and division; the remaining functions are provided in the form of subroutines. The dangers of working with a fixed maximum size of number and the precautions that need to be taken. Manual scaling or automatic scaling. The use of an accumulator store.

2. **Addition of Binary Digits**

   Logical operations on binary digits. The laws of binary addition and the way in which they can be simulated from the simpler logical operations.

   The engineering of a single digit binary adder.

3. **Addition of Binary Numbers**

   A serial adder. A parallel adder. A floating point adder. Conversion of an adder to a subtractor. Conversion of an adder to perform the logical operations.

4. **Multiplication and Division**

   Slow, fast, serial and parallel.

Lecture No. 4 **4.0 p.m.**

"BASIC PRINCIPLES — STORAGE"

by A. S. DOUGLAS, B.Sc., M.A., Ph.D., A.Inst.P.

1. **For Arithmetic Control**

   Storage on valve or transistor circuits. Fundamental speed considerations. Speed and storage interchangeable.

2. **'Main' or 'Working' Storage**

   Attached directly to control and arithmetic unit. Use of magnetic cores, delay lines, drums.

3. **Auxiliary 'Backing' Storage**

   Attached to working storage. Use of 'buffering' for simultaneous operation. Drums and magnetic tape as backing stores. Single word and block transfers.

4. **Programming Implications**

   Access considerations : 'random', cyclic, acyclic. 'Optimum' coding. Independent search facilities.

Tuesday, 16th September, 1958.

MORNING SESSION

Chairman: Professor J. W. CUTHBERTSON

Lecture No. 5 **9.0 a.m.**

"BASIC PRINCIPLES — INPUT AND OUTPUT"

by A. S. DOUGLAS, B.Sc., M.A., Ph.D., A.Inst.P.

1. **General Considerations**

   System regarded as a form of backing store as well as input and output. On-line and off-line systems. 'Real-time' problems. Conversion of information for computer use. Binary and Binary-coded-decimal systems.

2. **Input Media**

   Paper tape, cards, magnetic tape, manual and other direct input. Comparison of properties : speed, capacity, strength, storage properties, preparation equipment available, etc.

3. **Output Media**

   Paper tape, cards, magnetic tape, direct printers and other devices. Comparison of properties under similar heads to input.

Lecture No. 6 **11.0 a.m.**

"BASIC PRINCIPLES — CONTROL"

by A. S. DOUGLAS, B.Sc., M.A., Ph.D., A.Inst.P.

1. **Composition of Instructions**

   Basic artithmetic and organisational commands. Formulation in terms of numerical codes. Fundamental gating and timing operations of a computer. Decoding of an instruction in terms of fundamental operations. Degree of complexity in function code of computer.

2. **Sequencing of Instructions**

   Explicit use of address of next instruction. Conventional sequencing with breakpoints. Conditional jumps of control. Looping and counting.

3. **Address Conventions**

   Fixed length words—address codes. Limitations on addresses. Modification systems and use in looping and counting. Variable length words.

4. **Use of Programming Techniques to Supplement Machine Codes**

   Subroutines, interpretive systems and autocodes as devices for extending computer codes. Use of special storage for this. 'Floating point' and other special modes of operation.

AFTERNOON SESSION

Chairman: Professor J. A. POPE

Lecture No. 7 **2.0 p.m.**

"THE TASK OF THE PROGRAMMER"

by S. GILL, M.A., Ph.D.

1. **Programming Techniques**
   Examples using a typical instruction Code : Arithmetic, input and output, cycles.
2. **Preliminary Considerations**
   The definition of the problem. The determination of the method of computation. Avoiding overflow.

Lecture No. 8 **4.0 p.m.**

"PROGRAMMING STRATEGY"

by S. GILL, M.A., Ph.D.

1. **Subroutines**
   The importance of subroutines. The use of a library of subroutines. The place of interpretive routines.
2. **Mistake Diagnosis**
   Methods of obtaining diagnostic information. Manual intervention, post-mortem routines, dynamic checking routines, built-in facilities.
3. **The Language of Programmes**
   The logical development of a programme. Ways of changing the form of a programme ; interpretive routines, conversion routines, etc. Design criteria for a programming scheme.

Wednesday, 17th September 1958.

MORNING SESSION

Chairman: Brigadier S. H. HINDS

Lecture No. 9 **9.0 a.m.**

"ECONOMIC IMPLICATIONS OF COMPUTERS"

by J. H. H. MERRIMAN, M.I.E.E., A.Inst.P.

The economics of size of installation. Centralisation versus decentralisation ; Multi-purpose versus special purpose. Changeover from manual to machine systems. Data conversion, data creation. Overall economic justification and criteria adopted for selection. Amortisation period. Rental versus purchase. Economics of maintenance.

Lecture No. 10 **11.0 a.m.**

"ERROR PROTECTION"

by J. BOOTHROYD, M.A., A.M.I.E.E.

"The location and prevention of faults in Computers"

The use of programmed and automatic checks to detect operational and machine errors. The location of faults and measurement of machine performance by the use of marginal checking techniques and test programmes.

AFTERNOON SESSION

Chairman: Mr. B. B. SWANN

Lecture No. 11 **2.0 p.m.**

"COMMERCIAL APPLICATIONS"

(1) Commercial Control

by C. A. WILKES, F.C.I.S., A.C.W.A.

The commercial application of computers. Routine clerical data processing—payroll, sales analysis, invoicing, etc. Their potential for increasing management efficiency. Production and stock control, costing. Advantages and disadvantages of computers in commercial work. Economics.

Lecture No. 12 **4.0 p.m.**

"COMMERCIAL APPLICATIONS"

(2) Production Control

by K. F. TURNER, B.Com.

"The Application of Electronic Computers to Production Procedures"

Electronic computers can play a very important role as an aide to production management in reflecting policy decisions rapidly and accurately into the manufacturing organisations and by maintaining detailed control over all manufacturing operations—provisioning, machine-loading, scheduling, stores and stock control.

Thursday, 18th September 1958.

MORNING SESSION

Chairman: Dr. J. HOWLETT

Lecture No. 13 **9.0 a.m.**

"LINEAR ALGEBRA"

by M. WOODGER, B.Sc.

General remarks : Programme checks. Simultaneous linear equations; Gaussian elimination. Inversion of matrices. Latent roots and vectors of matrices. General manipulation of matrices, compound problems, need for an interpretive scheme. Example in detail.

Lecture No. 14 **11.0 a.m.**

"DATA PROCESSING"

by S. H. HOLLINGDALE, M.A., Ph.D.

"Processing of Experimental Data"

The automatic computer can be used effectively for processing experimental data only if automatic techniques are also applied to the other stages—the recording and conversion of data and the presentation of results.

The paper describes three automatic or semi-automatic systems which have been developed at the Royal Aircraft Establishment, Farnborough.

AFTERNOON SESSION

Chairman: Dr. D. R. HARDY

Lecture No. 15 **2.0 p.m.**

"TECHNICAL PROBLEMS—DESIGN AND DEVELOPMENT"

by L. GRIFFITHS, B.Sc.

In addition to relieving technicians and engineers of large volumes of repetitive but necessary calculation, digital computers can make a direct contribution to the improvement of the technical quality of the product.

The paper will illustrate this possible contribution in detail by discussing a number of examples which will include digital simulation in :

(i) Aircraft ;
(ii) Aero-Engines ;
(iii) Electrical Engineering,
(iv) Nuclear Engineering.

Lecture No. 16 **4.0 p.m.**

"TECHNICAL PROBLEMS"

(2) Auto-coding

by J. HOWLETT, B.Sc., Ph.D.

"Autocode schemes and other techniques for simplification of programming"

A survey of methods already in use by which a computer can be made to accept programmes written in a form differing as little as possible from ordinary mathematical language.

Friday, 19th September 1958.

MORNING SESSION

Chairman: Mr. W. E. SCOTT

Lecture No. 17 **9.0 a.m.**

"SOME COMMERCIALLY AVAILABLE COMPUTING MACHINES"

by C. STRACHEY, M.A.

A brief description of some of the main types of computers commercially available in this country and an assessment of their characteristics.

Lecture No. 18 **11.0 a.m.**

"THE ORGANISATION OF A COMPUTER SERVICE IN AN AIRCRAFT DESIGN OFFICE"

by J. ARROWSMITH, A.M.I.Mech.E., A.F.R.Ae.S.

Large scale sequence controlled digital computers have become a necessary tool in Aircraft Design Offices. The lecture aims at illustrating how a computer can be fully exploited in the systematic analysis and reconciliation of the many conflicting design factors.

Lecture No. 19 **11.45 a.m.**

"THE ORGANISATION OF A COMPUTING CENTRE"

by T. VICKERS, M.A.

Functions of computing centre at N.P.L. The staffing of a computer group. Producing the correct answers to the right problem. Assessing the costs. Priorities and problems with a "dead-line". The value of specilisation.

FORUM **2.0 p.m.**

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APPLICATIONS OF COMPUTERS COURSE

ENROLMENT FORM

Please complete and return to:—

The Organising Secretary,
Applications of Computers Course,
Department of Mechanical Engineering,
University of Nottingham,
University Park,
Nottingham.

This enrolment form must be accompanied by a remittance of TEN GUINEAS for each person wishing to attend the lectures. An additional fee of EIGHT GUINEAS* is payable for each person needing accommodation. (Cheques should be made payable to the University of Nottingham.)

Name .....
(BLOCK LETTERS)

Address .....

.....

Accommodation required .....
(*Please state YES or NO*)

Luncheon required if not in residence .....
(*Please state YES or NO*)

Authority, Organisation or Firm .....

.....

**Luncheon and light refreshments will be served to members of the course not in residence. The charge will be £2 2s. for the five days of the course and the extra payment should accompany this form if these meals are required.*