SIMON FRASER UNIVERSITY

MEMORANDUM

SCUS 80-92

To: Mr. H. Evans, Secretary Senate	From: John S. Chase
Subject: Digital Systems Design Honours Program, Computing Science	Date: 7 November 1980

Action taken at the November 5th, 1980 meeting of the Senate Committee on Academic Planning gave rise to the following motion:

> "That the Senate Committee on Academic Planning approve the Digital Systems Design Honours Program in the Department of Computing Science."

Would you please see that this motion and accompanying paper is transmitted to the Senate Committee on Undergraduate Studies for its consideration.

John Chase

JSC:ld
Att.

SIMON FRASER UNIVERSITY

SCAP 80-23

MEMORANDUM

To: John Chase, Secretary to the Senate Committee on Academic Planning	From: Janet Blanchet, Secretary to the Faculty of Interdisciplinary Studies Undergraduate Curriculum Committee
Subject: Digital Systems Design Honors Program, Computing Science	Date: 16 October 1980

I.S.C. 80-15

The above item was approved at a meeting of the Faculty of Interdisciplinary Studies Undergraduate Curriculum Committee held on Tuesday, October 14, 1980. Would you please place it on the next agenda of the Senate Committee on Academic Planning.

Janet Blanchet

JB:jk

Attachment

cc: H. Evans
W.S. Luk

U.C. 80-15

SIMON FRASER UNIVERSITY
M E M O R A N D U M

To: Dr. C. Griffiths, Chairman,
UCC, F.I.D.S.

From: Wo-Shun Luk, Chairman,
UCC, Computing Science

Subject: Digital Systems Design Program Date: Oct. 6, 1980

Attached is the proposal for the Digital Systems Design (DSD) Honours program. We request that the Faculty approve the offering of this program by Computing Science Department in Fall, 1981.

We would like to emphasize the fact that the DSD program is not a truly brand new program but rather part of the planned evolutionary growth of the department. We have been building up strength in this area for several years and we shall continue to do so, with or without the DSD program. This proposal is merely to provide a formal recognition for the students specializing in this area.

We have met the Physics Department twice regrading this proposal. I am pleased to report that they support this proposal enthusiastically. Already progress is being made to reduce the overlap between the courses in digital electronics from the two departments, and Physics is going to modify some of their courses to satisfy the needs of our students in the DSD program.

As you may be aware, the proposed Engineering curriculum has a degree program in Computer Engineering (CMPE), which depends heavily on the Computing Science curriculum. Having read our proposal, the engineering curriculum consultants feel that our proposed program will work hand in hand with theirs. Three of the six proposed new courses in our proposal can be amalgamated with CMPE 311, 312, 411 and 412, so that if our proposal is approved Computer Engineering can be mounted almost without cost, because most of its courses can be drawn from the Electrical Engineering and Computing Science curricula. The major difference between the two proposals lies in accreditation. While the CMPE graduates will be accredited, there are more flexibilities in the DSD proposal. The co-existence of the two programs is in fact very desirable.

We hope that we can successfully convince you that this new proposal will require no major fundings from the University, other than that already committed to us for the planned growth of the department. This understanding would expedite the approval process in the Universities Council of B.C. and make our implementation target date (ie. September 1981) realizable.

DIGITAL SYSTEMS DESIGN - HONOURS PROGRAM

1. RATIONALE:

The design of digital systems, the applications of new physical devices in the design of novel information processing systems, and the construction of special purpose digital systems for a wide variety of applications are among the most exciting (and already persistent) growth areas in applied physics, electrical engineering, and computing science.

Partly because of this, it is not surprising that the number of students enrolling in Computing Science programs across North America has outpaced the faculty growth of Computing Science Departments. At our own University, Computing Science has experienced a 100% growth in the number of FTE students in the last four years. Much of that expansion is due to our "hardware-oriented" reputation in the Lower Mainland. The job potential for recently trained computer-systems designers seems almost unlimited, with little immediate prospect for change.

During the development of the Computing Science program, many courses have been introduced which could be identified as part of a Digital Systems Design program. Some offerings of CMPT 418 (ie. Special Topcis) have also been in that area. Planning for some further such expansion has been a priority of the Department for some years and approval has been given for recruitment of faculty members with specialized interests in the hardware field. This means that majors in Computing Science can already emphasize Digital Systems Design. In order to indicate appropiate courses explicitly to students, and in order to give recognition in transcript form to those students who become sutiably qualified, it is proposed that an Honours program in 'Digital Systems Design' be recognized by the University.

The program outlined below is, it is believed, unique in its scope. A typical computer engineering degree, such as that offered at UC Berkeley, lacks the design aspects of our approach. This is especially true in view of the type of computing mathematics we include. Considerable mathematical maturity is necessary to discern whether an hardware implementation of what traditionally had been done with software or firmware is, in fact, going to be effective and efficient computationally.

2. CURRICULUM:

The present undergraduate Computing Science curriculum already provides a solid base for a Digital Systems Design program. The program is enriched by drawing on courses offered by the Mathematics and Physics Departments.

The proposal is for recognition of an Honours program with 132 credit hours requirement for graduation. While this may initially limit enrollment, we feel it is best to start conservatively with first-

class students to test the program's viability and vitality. Our experience with the new graduate studies program followed a similar track with excellent results so far.

It should be noted that the proposed program satisfies the present degree requirements for a Computing Science major. This should allow some flexibility for students to transfer into or out of it if that proves necessary or is desired.

Lower Division Course Requirements:

Students who plan to undertake a Honours in Digital Systems Design must obtain credit for the following lower division courses:

CMPT 103-3 Introduction to a High Level Programming Language I
CMPT 105-3 Fundamental Concepts of Computing
CMPT 118-3 Computing Projects in the Arts and Sciences
CMPT 201-4 Data and Program Organization
CMPT 205-3 Introduction to Formal Topics in Computing Science
CMPT 260-3 Social Implications of a Computerized Society
CMPT 291-4 Analogue and Digital Circuits
(23 units)

MATH 101-3 Introduction to Statistics
MATH 104-3 Introduction to Computational Methods
MATH 151-3 Calculus I
MATH 152-3 Calculus II
MATH 232-3 Linear Algebra
MATH 251-3 Calculus III
(18 UNITS)

PHYS 120-3 Physics I
PHYS 121-3 Physics II
PHYS 221-3 Intermediate Electricity and Magnetism
(9 UNITS)

Total: 50 lower division units

Degree Requirements:

Attention is drawn to Lower Division Requirements, as prerequisites, as described in the preceding section. In addition to the general requirements of the University for a Honours degree, students must complete the following courses:

+MATH 306-3 Introduction to Automata Theory
CMPT 351-3 Introduction to Computer Graphics or CMPT 410-4 Artificial Intelligence
CMPT 354-3 File and Database Structures
CMPT 390-3 Digital Circuts and Systems
*CMPT 391-3 Microcomputer Hardware Workshop
*CMPT 392-3 Introduction to Digital Signal Processing
CMPT 393-4 Systems Software for Minicomputers and Microcomputers
CMPT 400-3 Hardware-Software Architecture I
CMPT 401-3 Hardware-Software Architecture II
+MATH 401-3 Switching Theory and Logical Design

CMPT 405-3 Design and Analysis of Computing Algorithms
CMPT 483-3 Compiler Construction
**CMPT 491-3 Analogue and Digital Circuits II
*CMPT 492-3 Microprogramming and Emulation
CMPT 493-1 Colloquium I
*CMPT 495-3 Digital Systems Design and Specification Laboratory
*CMPT 496-3 Digital Systems Implementation Laboratory

(50/51 units)

MATH 310-3 Introduction to Ordinary Differential Equations
+MATH 316-3 Numerical Analysis I

(6 units)

PHYS 326-3 Electronics and Instrumentation
PHYS 331-3 Electronics Laboratory

(6 units)

Total: 62/63 upper division units
(Graduation would be subject to overall University requirements and requirements of the Faculty of Interdisciplinary Studies)
* New courses (Note: CMPT 492 has been taught twice by Dr. Hobson as CMPT 418 in the past 2 years; CMPT 391, 490 and 495 are lab courses)
** CMPT 491 would be updated and slightly modified to follow from CMPT 291.
+ Math courses acceptable as Computing Science courses.

3. RESOURCES:

Computing Science has assembled a modest Digital Systems laboratory over the past four years. The laboratory will undergo modest expansion over the next three years to accomodate the three new lab courses.

4. ACADEMIC LOCATION:

It is recommended that the program be mounted within the Computing Science department and run by the same.

5. COST:

Computing Science has planned to offer the Digital Systems Design program for the past four years. During that period of time, faculty acquisitions and laboratory upgrades have been scheduled accordingly. This new Honour's program can be initiated with existing and approved resources.

After students enter the Digital Systems Design Honours program in Fall 1981, they will take minimally two years to mature and reach the proposed digital systems laboratory courses. We expect to amortise the modest cost of equippinging the laboratory over the next three years and further expect that our equipment budget will be sufficient for that purpose.

The only identifiable costs for initiating the Digital Systems Design Honours are:

Faculty - one faculty member needs to be added for the proposed new

lecture courses (CMPT 392 & 492) and the proposed new lab courses (CMPT 391, 490 and 495). This position has been authorised (in addition to three other new positions for this year) and we are already recruiting potential faculty for the area.

Equipment - The cost estimate for upgrading the Digital Systems laboratory is modest.

(1) 600-800 sq. ft. of laboratory space

(2)	10 workstation benches	@ 300	$ 3000
	4 oscilloscopes	@ 6500	$26000
	3 logic analyzers	@ 7000	$21000
	4 stand alone computer systems	@ 12000	$48000
	1 printer	@ 4500	$ 4500
	1 plotter	@ 4500	$ 4500
	10 prototype racks	@ 500	$ 5000
	tools, chips, power supplies, etc		$ 5000
		TOTAL:	$117,000

Note: The equipment budget suggested above is necessary for the emerging graduate program as well as this new honours program. The acquisition of this equipment can be phased in over a 3-year period.

SENATE COMMITTEE ON UNDERGRADUATE STU

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Computing Science

Abbreviation Code: CMPT Course Number: 391 Credit Hours: 3 Vector: 0-0-4

Title of Course: Microcomputer Hardware Workshop

Calendar Description of Course:

Experience with basic microcomputer implementation techniques, including bus design, logic distribution, memory design, programming read only memories, communication interfaces and identification and location of errors. A typical project includes construction of a complete microcomputer system. Students are strongly encouraged to provide their own components so that they can keep the system they design and build.

Nature of Course Laboratory

Prerequisites (or special instructions):

CMPT 291 or appropriate technical experience.

What course (courses), if any, is being dropped from the calendar if this course is approved:

None

2. Scheduling

How frequently will the course be offered? By demand (typically yearly).

Semester in which the course will first be offered? 1981-3

Which of your present faculty would be available to make the proposed offering possible?

Laboratory instructor (Chris Dewhurst or Neil Mackenzie)

3. Objectives of the Course

The course is meant to provide students with marketable practical experience - and their own microcomputer systems.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty	X
Staff	X
Library	X
Audio Visual	X
Space	A new laboratory is required. See DSD proposal.
Equipment	See DSD proposal.

5. Approval

Date: 16 October 1980 16Oct80 DEC 9 '80

Ronald Harry — Department Chairman

J. Wolfart — Dean

D. J. Webster — Chairman, SCUS

SCUS 73-34b: (When completing this form, for instructions see Memorandum SCUS 73-34a. attach course outline).

Course Outline

CMPT 391-3 Microcomputer Hardware Workshop

This laboratory is designed to provide students with experience in the design and implementation of a complete microcomputer system. The student may develop his own design specifications or may produce a design to standard specifications provided by the instructor. The students are encouraged, where possible, to provide the components at their own expense so that at the end of the course they can keep the microcomputer system they have built.

The following features will be emphasized in all designs:

bus design
logic distribution
memory design
programming ROM's, PROM's and EPROM's
communication interfaces
error detection and trouble shooting

Normally it will be necessary to write some systems software although standard packages are available.

SENATE COMMITTEE ON UNDERGRADUATE S

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Computing Science

Abbreviation Code: CMPT Course Number: 392 Credit Hours: 3 Vector: 2-0-2

Title of Course: Introduction to Digital Signal Processing

Calendar Description of Course:

General concepts of Digital Signal Processing; Design of digital filters; Discrete Fourier transforms; General and special purpose digital signal processors; Some additional implementation considerations.

Nature of Course Lecture/Laboratory

Prerequisites (or special instructions): CMPT 291-4 and MATH 251-3

What course (courses), if any, is being dropped from the calendar if this course is approved:

None

2. Scheduling

How frequently will the course be offered? Once a year.

Semester in which the course will first be offered? 82-1

Which of your present faculty would be available to make the proposed offering possible?

R. Hobson, T. Edwards and guest lecturers.

3. Objectives of the Course

The techniques of Digital Signal Processing are now widely used in areas such as biomedical engineering, seismic and geophysical research, image processing, radar and sonar detection, acoustic research and telecommunications. The objective of this course is to provide students with some exposure and skills in this important area.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty
Staff
Library
Audio Visual
Space
Equipment

} See DSD Proposal

5. Approval

Date: 16 October 1980 16 Oct 80 DEC 9 80

Ronald Hamp
Department Chairman

J W Bobot
Dean

Chairman, SCUS

SCUS 73-34b: (When completing this form, for instructions see Memorandum SCUS 73-34a. attach course outline).

CMPT 392-3 Introduction to Digital Signal Processing

1. General Concepts of Digital Signal Processing:

   Continuous-Time and Discrete-Time Signals and Systems. Review of mathematical tools. Sampling theory.

2. Design of Digital Filters:

   Lowpass, highpass, bandpass and bandstop filters, recursive and non-recursive filters, decimation and interpolation.

3. Discrete Fourier-Transform:

   Principles of Fast Fourier Transform (FFT) and FFT algorithms, Fast convolution. Other transforms (Walsh, Haar, etc.)

4. General and Special Purpose Digital Signal Processors:

   The use of general purpose digital computers as digital signal processors, design and implementation of dedicated hardware and firmware as self-contained subsystems to perform specific set tasks in digital signal processing.

5. Two dimensional filters and applications to image processing.

   Special Topics:

   Round-off errors, scaling, limit cycles and overflow oscillations.

Test: A. Peled and B. Liu Digital Signal Processing: Theory, Design and Implementation

TITLE, DESCRIPTION AND CREDIT CHANGE

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Computing Science

Abbreviation Code: CMPT Course Number: 491 Credit Hours: 4 Vector: 3-0-3

Title of Course: Analogue and Digital Circuits II

Calendar Description of Course:

Advanced topics in analogue and digital circuit design including: Bit-slice processors, bus design and bus protocols, interfaces and interface protocols and advanced memory technologies. The principles underlying the fabrication of large scale integrated circuits and the design of advanced mass storage devices and fibre-optic communication channels will be introduced.

Nature of Course Lecture/Laboratory

Prerequisites (or special instructions):

Cmpt 390, Physics 221, Physics 326

What course (courses), if any, is being dropped from the calendar if this course is approved:

None

2. Scheduling

How frequently will the course be offered? Yearly

Semester in which the course will first be offered? 1982-3

Which of your present faculty would be available to make the proposed offering possible?

Ted Edwards

3. Objectives of the Course

To cover more of the physics and engineering associated with solid state digital and analog systems than is possible in CMPT 291 and various existing physics courses.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty	X
Staff	X
Library	X
Audio Visual	See the DSD proposal for space and equipment consideration.
Space	
Equipment	

5. Approval

Date: 16 October 1980 160ct-80 DEC 9 '80

Department Chairman — Dean — Chairman, SCUS

SCUS 73-34b: (When completing this form, for instructions see Memorandum SCUS 73-34a. attach course outline).

CMPT 491-3 Analogue and Digital Circuits II

Course Outline

1. Review of techniques for digital systems analysis and synthesis.
2. Bit-slice processor design.
3. Bus design and bus protocols.
4. Interface design and interface protocols.
5. Communication channels and protocols.
6. Advanced memory technologies including bubble memories.
7. Analog to Digital and Digital to Analog converters.
8. The design of mass storage devices (disk, tape, etc.)

SENATE COMMITTEE ON UNDERGRADUATE [illegible]S

NEW COURSE PROPOSAL FORM

1. Calendar Information — Department: Computing Science

Abbreviation Code: CMPT Course Number: 492 Credit Hours: 3 Vector: 3-0-2

Title of Course: Microprogramming and Emulation

Calendar Description of Course:

A study of our microprogrammable machines. Instruction set emulation techniques are discussed and case studies of emulation are used for examples. The technology which supports microprogrammed machine architecture and its influence on machine design are discussed. A large part of the course is devoted to a team project involving emulation.

Nature of Course Lecture/Laboratory

Prerequisites (or special instructions):

CMPT 393

What course (courses), if any, is being dropped from the calendar if this course is approved:

None

2. Scheduling

How frequently will the course be offered? Yearly

Semester in which the course will first be offered? 1982-1

Which of your present faculty would be available to make the proposed offering possible?

R. Hobson, T. Kameda

3. Objectives of the Course

1. To make participants aware of the nature of microprogrammed (emulated) instruction sets.
2. To gain some experience with emulation.
3. To study bit slice or emulation oriented technology - practicalities, limitations, etc.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty	X
Staff	X
Library	X
Audio Visual	X
Space, Equipment	Existing space and equipment is adequate. But enrollments will be limited. (The course has been taught twice as CMPT 418.)

5. Approval

Date: 16 October 1980 — 16 Oct 80 — DEC 9 '80

Ronald Thorpe — Department Chairman

I.W. Robert — Dean

J.L. Webb — Chairman, SCUS

SCUS 73-34b: (When completing this form, for instructions see Memorandum SCUS 73-34a. attach course outline).

CMPT 492-2 Microprogramming & Emulation

Course Outline

Part I: The Varian, V-75. (3 weeks)

A Varian, V-75 processor is studied in detail. Examples are taken from the V-75 instruction set emulation and from special applications, like string searching. Microprogram assembly and simulation techniques are investigated in class and in the laboratory. (15% of grade)

Part II: An Emulation Example. (1 week)

An emulation of the Intel 8080 microprocessor, by the Varian, is discussed to illustrate some problems and advantages of emulation.

Part III: Team Project. (7 weeks)

We will attempt to create a PASCAL programming environment on the Varian by emulating the UCSD PASCAL P-code instruction set, and simulating the CPM operating system with V-75 instructions and the VORTEX operating system. We will work in groups in class and in the laboratory. Most of the course grade comes from this project (70%), therefore, participation is very important. Each time the course is offered, there will be a new project and the old projects will be used as examples.

Part IV: Bit Slice Logic. (2 weeks)

Current bit slice technology is examined and evaluated for its potential contribution to processor design. Practical experience can be obtained on a designer's evaluation kit for the AMD 2900. (15% of grade.)

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Computing Science

Abbreviation Code: CMPT Course Number: 495 Credit Hours: 3 Vector: 0-1-4

Title of Course: Digital Systems Design and Specification Laboratory I

Calendar Description of Course:

An individual project provides students with practical experience involving the design, specification and implementation of complex digital systems (typically computers).

Nature of Course: Tutorial/Laboratory

Prerequisites (or special instructions):

CMPT 301, 390, 400

What course (courses), if any, is being dropped from the calendar if this course is approved: None.

2. Scheduling

How frequently will the course be offered? By demand

Semester in which the course will first be offered? 1982-3

Which of your present faculty would be available to make the proposed offering possible? Laboratory supervision will be handled by a lab instructor.

3. Objectives of the Course

CMPT 495, 496 play the role of an honors thesis in our DSD program.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty	X
Staff	X
Library	X
Audio Visual	X
Space	See the DSD program description.
Equipment	See the DSD program description.

5. Approval

Date: 16 October 1980 — 16 Oct 1980 — DEC 9 '80

Department Chairman — Dean — Chairman, SCUS

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline).

CMPT 495-3 and 496-3

Digital Systems Design and Specification Laboratory I and II

These two courses fill the role of an honours thesis for the Honours Program in Digital Systems Design.

CMPT 495 and 496 are designed to provide interested students with practical experience involving the design, specification, and implementation stages of complex digital systems (typically computers). Techniques for these laboratories include the use of architecture specification languages, interactive hardware development and testing systems, logic analyzers, microprogramming techniques, and LSI chip slices.

Students are expected to set up a "contract" for a specific digital system including design, specification, and implementation details. Progress must be good in CMPT 495 before CMPT 496 may be attempted. In CMPT 495 a digital design problem is selected by mutual agreement between student and supervisor. The student clearly delineates the scope of the project, and carries on to specify all hardware and firmware details, leaving only the implementation for CMPT 496.

Departmental permission must be obtained to register for these courses and is normally restricted to Honours students.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Computing Science

Abbreviation Code: CMPT Course Number: 496 Credit Hours: 3 Vector: 0-0-6

Title of Course: Digital Systems Implementation Laboratory II

Calendar Description of Course:

A continuation of CMPT 495-3.

Nature of Course Laboratory

Prerequisites (or special instructions):

CMPT 495 and approval of department.

What course (courses), if any, is being dropped from the calendar if this course is approved:

None.

2. Scheduling

How frequently will the course be offered? By demand

Semester in which the course will first be offered? 1983-1

Which of your present faculty would be available to make the proposed offering possible? Laboratory supervision is handled by a lab instructor II.

3. Objectives of the Course

CMPT 495 and 496 play the role of an honors thesis in our DSD program.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty	X
Staff	X
Library	X
Audio Visual	X
Space	See the DSD program description.
Equipment	

5. Approval

Date: 16 October 1980 16 Oct 80

DEC 9 '80

Department Chairman

Dean

Chairman, SCUS

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline).

SIMON FRASER UNIVERSITY

MEMORANDUM

Wo-Shun Luk Chairman, Undergraduate Curriculum, Computing Science	From M. Deutsch Library - Science Division Date 7 October 1980

With regard to the proposal entitled 'Digital Systems Design - Honours Program' (Computing Science Department) the Library's resources can adequately support teaching and research for the program in general and for the six new proposed courses which are listed in the proposal and are tabulated below.

Cmpt 391 Microcomputer Hardware Workshop
Cmpt 392 Introduction to Digital Signal Processing
Cmpt 491 Analogue and Digital Circuits II
Cmpt 492 Microprogramming and Emulation
Cmpt 495 Digital Systems Design and Specification
Cmpt 496 Digital Systems Implementation Laboratory

The Library is currently receiving book material dealing with all aspects of computers, computing science, computer design and engineering, digital electronics, integrated circuits, logic design, switching theory, microelectronics, microprogramming, and related areas. Attached are photocopies of the Library's microcatalog representing material received since September 1977 which would be potentially useful to students in this program.

The Library's journal collection has undergone gradual but continuous expansion in the above areas during the past two years and an important periodical index, Computers and Control Abstracts (part of the INSPEC series) is on order.