SIMON FRASER UNIVERSITY

S 85-27

MEMORANDUM

To: SENATE	From: SENATE COMMITTEE ON ACADEMIC PLANNING SENATE GRADUATE STUDIES COMMITTEE
Subject: PROPOSED MASTERS' PROGRAMS IN ENGINEERING	Date: MARCH 12, 1985

Action undertaken by the Senate Committee on Academic Planning at its meeting of March 6, 1985 and by the Senate Graduate Studies Committee at its meeting of February 25, 1985 gives rise to the following motion:

MOTION:

"That Senate approve and recommend approval to the Board of Governors, as set forth in S.85-27 , the proposed Master of Engineering and Master of Applied Science Programs."

SIMON FRASER UNIVERSITY

MEMORANDUM

Walter Wattamaniuk, Secretary Senate Committee on Academic Planning	From. Office of the Dean of Graduate Studies
Subject. Proposed Master's Programmes in Engineering	Date. February 27, 1985

The attached proposed Master's Programmes in Engineering were approved by the Senate Graduate Studies Committee on Monday, February 25, 1985.

Attached:

a) Proposed Master's Programmes

b) Calendar Entry

c) Appendix A - Course Descriptions

d) Appendix B - Library Collection Evaluation

e) Appendix C - Curriculum Vitaes -- (Deleted from Senate package)

i) Albert M. Leung
ii) James Kennedy Cavers
iii) Donald Arthur George
iv) Tad McGeer
v) Muhammad Jamil Ahmed
vi) John S. MacDonald
vii) J. Basil Peters
viii) Kenneth Spencer

f) Dr. Webster's letter to the External Assessors

g) External Assessors Reports

i) J.S. Riordon
ii) H.W. Smith
iii) Dennis Connor
iv) Michael S. Davies

h) Letters of Support

i) P.W. Lancaster
ii) Bruce G. Hartwick
iii) Robert Orth
iv) S. Hussain

John M. Webster
Dean of Graduate Studies.

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SIMON FRASER UNIVERSITY

a)

MEMORANDUM

To: Dr. J. Webster
Associate Vice-President Academic
and Dean of Graduate Studies

From: Dr. D.A. George, Dean
Engineering Science

Subject: Proposed Graduate Program

Date: 18 February 1985

Attached is our proposal for a graduate program for the Faculty of Engineering Science. We very much appreciate the constructive appraisals and valuable recommendations made by your Assessment Committee and by the external reveiwers. We believe that the points made have either been incorporated in the proposal or explained sufficiently in discussion with the Committee. Two issues, however, do require some formal comment.

As proposed, a part-time student proceeding through the program at the quite acceptable rate of one course per semester (except for the Summer when we do not intend to offer graduate courses) would use the whole of the five-year limit for Master's degrees. Any slow-down in this pace, through job requirements or family problems or illness, for example, would result in that limit being exceeded. Yet, that is hardly fair especially since only 10 semesters, rather than the usual 15, would be included in the five-year period. Never-the-less, many students will proceed more rapidly and five years is quite a long time period for a coherent program in this rapidly moving field. We believe that we should stay with the present limit but be ready to give extensions for one or two semesters for cause.

Our second point involves Dr. Davies' recommendation of second priority for the professional M.Eng. program. This we can only reject out-of-hand for it is this program in particular which is so needed in Greater Vancouver. The local letters of support attest to that need. On the other hand, the viability of Engineering Science at SFU rests on the intellectual and research activity which the very name implies. Consequently, not to have a regular research-based M.A.Sc. program would be intolerable and so we assign equal priority to these two complementary graduate programs

Donald A. George, Dean

DAG:mm

26 February 1985

MASTER'S PROGRAM IN ENGINEERING

I GENERAL INFORMATION

1. Title of Program: Master of Engineering, Master of Applied Science

2. Credential to be awarded to graduates: M.Eng., M.A.Sc.

3. Department to offer program: Engineering Science

4. Date of Senate Approval:

5. Schedule for Implementation: September 1, 1985.

II PROGRAM DESCRIPTION

1. Objectives:

M.ENG.:

To provide engineers working in technology intensive areas with an opportunity to pursue graduate studies on a part time basis, without interruption of their careers.

To provide local technology based companies with one way to increase the capabilities of their engineering staff.

M.A.SC.:

To provide a small group of full time graduate students with a research oriented program in more exploratory areas of engineering.

2. Relationship of Program to Role and Mission of the University:

Local engineering companies have for years been requesting a program of part time graduate studies for their engineers, similar to the ones operating successfully in the Ottawa area and in California's Silicon Valley. In responding to this need, we are following in Simon Fraser University's tradition of service to the community through a part-time program based on evening courses.

In the case of the M.Eng. program, all courses will be offered in the evenings or late afternoons, to make them available to working engineers. We will also be exploring alternative formats, such as video delivery, and short intensive courses.

The M.A.Sc. is also a departure from conventional programs, in that it weights thesis research more heavily than course work. This activity will be directed to areas of research interest of Engineering Science faculty and their associates in local electronics, communications and computing industry.

In terms of its area of specialization and emphasis on industrial interaction, this program is a necessary extension of the undergraduate Engineering Science program. Indeed, to sustain the high level of current undergraduate work, the Faculty requires graduate studies, for only with graduate work and research will it be possible to attract appropriate staff and to maintain the level of intellectual activity inherent in the concept of Engineering Science.

3. Other Similar Programs in Engineering:

The M.Eng. component of our proposal is modelled after highly successful programs at Carleton University and Ottawa University, both of which are located in Ottawa. They are frequently cited as significant elements in the Ottawa Valley's explosion of technology intensive companies. The major points of comparison are:

- Graduate courses in Electrical Engineering at the two Ottawa Universities are offered in the evenings, or occasionally at lunch hour, to make them accessible to part-time students. Our proposal is similar.

- Carleton's M.Eng. requirements are 12 one-semester courses, one of which is a project, usually undertaken at the University. We propose 10 one-semester courses, plus a project which must be performed in industry.

Waterloo University, which has an enviable reputation at the graduate, as well as undergraduate levels, also has a part-time Master's program. The requirements for the non-thesis option are 8 one-semester courses, plus a project with weight equal to 2 one-semester courses.

4. Relationship to program at University of British Columbia:

Our proposed program complements the one at UBC. Essentially, the UBC program is geared to full-time students

following the thesis option, and has a strong research orientation. The thrust of our M.Eng. proposal, on the other hand, is toward providing working engineers with an accessible part-time venue for advanced study. The existence of both types of program in the Lower Mainland area will increase the options available to the engineer interested in graduate work.

This is not to suggest that there would be two exclusive domains. UBC, for example, also offers an M.Eng. program, for which the requirements are 15 units of course work (about 10 courses) plus an essay and comprehensive examination. This option is little exercised, although the demand exists. Similarly, we also propose an M.A.Sc. program, which will be based largely on a research project with thesis. Although this component is essential to a healthy graduate program and to faculty research, we do not anticipate a large number of thesis students (see III 2 Enrollment, below).

Another aspect of the complementary nature of the two programs is the fact that UBC addresses a full spectrum of Electrical Engineering disciplines at the graduate level. We do not have an interest in, nor the resources for, such an approach. Instead, we plan to focus on communications, signal processing and electronics, three areas of economic importance to BC's technology base, and which are a primary element of the undergraduate program in Engineering Science.

We will give transfer credit for courses taken at UBC, so that our students can take advantage of the greater diversity of subject material offered there. Similarly, we anticipate that UBC will give their students transfer credit for our courses, which will cover more topics in communications, signal processing and electronics. SFU and UBC have already had preliminary discussions about course exchange over the inter-institutional video link.

5A. Curriculum:

The proposed program will conform to the General Regulations for graduate studies as set out in the SFU calendar. Specific requirements are set out below.

The normal admission requirement to the M.Eng. is a Bachelor's degree in electrical engineering, computer engineering, engineering science or a related area, with a cumulative G.P.A. of at least 3.0 (B) from a

recognized university, or the equivalent. Because of the research oriented nature of the M.A.Sc., however, we will require a CGPA of 3.3. (B+), at least until the program is well established.

Master's candidates are required to complete a minimum of 30 semester hours work in one of the following ways:

M.A.Sc.: a minimum of 12 semester hours course work at the graduate level, plus a thesis.

M.Eng.: a minimum of 30 semester hours course work, at least 20 of which must be at the graduate level, plus a project.

The M.Eng. project work must be performed in industry. An appropriate level of design, documentation and reporting responsibility is required. Details on the project structure are given in II 5B below.

The M.A.Sc. thesis has a weight of 18 semester hours, and is to be an independent research project. The M.A.Sc. thesis, under appropriate conditions, can also be performed in industry.

The M.Eng. requirement of 30 semester hours (10 one semester courses) is to some extent in conflict with SFU's limitation of 5 years for completion of a Master's degree. For this reason, we intend to recommend extensions of 1 or 2 semesters to students in good standing.

The proposed courses are listed below. A more detailed description of each course is contained in Appendix A. All courses have a weight of 3 semester hours. Engineering courses identified as "Topics In ..." will not be offered on a regular basis and will have varying emphasis.

Courses ENSC 8AA to 8EE are required for the M.Eng. degree. ENSC 8AA, in particular, is a prerequisite for all other ENSC graduate courses except ENSC 8EE. Normally, the minimum of four one-semester courses required for the M.A.Sc. will be selected from the list below.

Course	Title	Instructors
ENSC 8AA	Linear System Dynamics	JKC,BTM,AML DAG

ENSC 8BB	Techniques of Digital Communications	JKC,DAG
ENSC 8CC	Digital Signal Processing	JKC,DAG, external
ENSC 8DD	Signal Processing Electronics	AML
ENSC 8EE	Engineering Management for Development Projects	external
ENSC 8FX	Topics in Communications, such as:	
	Network Protocols and Performance	JKC
	RF Communications	external
	Mobiles, Satellite Communications and Local Area Networks	JKC, external
	Optical Processing and Communications	external (Ahmed)
	Telephony and Digital Switching	external
	Error Correcting Codes	external
ENSC 8GX	Topics in System Engineering, such as:	
	System Implementation Methodology	external
	System Performance Analysis	external, JKC
ENSC 8HX	Topics in Signal Processing, such as:	
	Image Processing	external,DAG
	Speech Processing	external,DAG

The initials identify D.A. George, J.K. Cavers, A.M. Leung and B.T. McGeer. An additional faculty member, currently being recruited, will also contribute to our capabilities to offer the above courses. Candidates for this position, to which the University has committed, must have backgrounds in communications and signal processing.

The following is a list of a few of the courses offered by other faculties at SFU which are of particular relevance to the Engineering Science graduate program.

Course	Title
CMPT 840	Advanced Topics in Simulation and Modelling

CMPT 842	Distributed Computing
CMPT 851	Reliable and Fault Tolerant Computing
CMPT 852	VLSI Systems Design
CMPT 860	Algorithms of Optimization
MATH 408	Discrete Optimization
MATH 439	Introduction to Algebraic Systems

5B. The M.Eng. Project

A key component of the M.Eng. program is a significant industrial project which integrates knowledge gained during the course of the student's graduate studies. This project is to be performed in the workplace, typically in industry or government laboratories. As noted earlier, an appropriate level of design, documentation and reporting responsibility is required. The project would be expected to take a minimum of one person-month.

During the project, the student will receive academic supervision, as required, from the student's Senior Supervisor at the University, and day-to-day supervision from the student's manager, or a designated associate, in his or her place of work. These industrial supervisors, who will have appropriate qualifications, will be appointed by the Faculty. In the case of very small companies, alternative arrangements will be made for supervision.

The project will be initiated by the student with a proposal which identifies the scope of the work, anticipated results, resources required and the schedule. It should also provide rationale for the project to be used toward the M.Eng. degree. The proposal will be reviewed by the Faculty Graduate Program Chairman and a three-person Supervisory Committee consisting of the Senior Supervisor, one additional faculty member and the industrial supervisor. Commitment of the company and the University to the project will be formalized by an exchange of letters.
The Supervisory Committee will meet at least once for a project review prior to submission of the student's report.

The Supervisory Committee and the Graduate Program Chairman will assess the student's project on the basis of conduct of the project, quality of the work, and quality of the report. If the report is not at an appropriate level of clarity for technical writing, the committee will reject it and the student will have to resubmit it. In addition to the report, the student will make an oral presentation to at least the Supervisory Committee and one other faculty member.

University regulations require a copy of the report to be placed in the Library. For this reason, the report will normally omit sensitive company information. In those infrequent cases where the company feels that the project and its results should be confidential, the University can withhold the report from circulation for up to one year. This requirement must be accepted by the University at the time of project initiation.

6. Not applicable.

7. Not applicable.

8. Consultation with non-university agencies:

Professors D.A. George and J.K. Cavers have a great deal of contact with industry through personal consulting and industrial research contracts held by universities. Dr. Cavers, in particular, spent the four years prior to his joining SFU in two Vancouver area technology-based companies.

In December 1983, SFU's draft proposal for such a program was reviewed by representatives from four organizations: MacDonald, Dettwiler and Associates, Glenayre Electronics, Microtel Pacific Research, and Vancouver General Hospital. Their requests and comments resulted in a much strengthened plan. During 1984, this revised draft was circulated in the Engineering Departments of a number of B.C. engineering companies. In addition, we made presentations of our plans at three companies: AEL Microtel, Glenayre Electronics, and Microtel Pacific Research. Since many engineers are watching the development of this program with anticipation, we received a large number of suggestions, many of which have been incorporated into this latest proposal.

III NEED FOR PROGRAM

1. Rationale for the Engineering Graduate Program

Most locations with a cluster of high technology companies are characterized by the proximity of universities and by an exchange of ideas and people between industry and university. "Silicon Valley" in California and Route 129 outside Boston are two examples. In Canada, the growth in Kanata, outside of Ottawa, was also supported by the two local universities with part-time graduate programs and evening classes.

Vancouver is not so fortunate. There is at present little university support for part-time graduate work in engineering in Greater Vancouver. This observation motivated one of SFU's objectives for the proposed Engineering Graduate Program:

- ACCESSIBILITY TO PRACTICING ENGINEERS

For a variety of reasons, ranging from shifts in technical emphasis on the job to a fear of technical obsolescence, many engineers look to graduate programs to upgrade their skills. SFU will respond to this need by offering graduate courses at hours and locations, and in formats, such that a Master's degree can be obtained through part-time study.

While the importance of the part-time program cannot be overstated, it must also be recognized that staying current and innovative requires a small group of resident graduate students pursuing thesis work. SFU's second objective reflects this need:

- RESEARCH AND THESIS WORK RELEVANT TO THE DEVELOPMENT OF ADVANCED TECHNOLOGY IN B.C.

2. Enrollment:

(a) Evidence of student interest:

Apart from informal requests for the program from engineers, engineering management and upper management, we have quantitative evidence of demand. We have already offered two graduate courses on a special basis, through the Department of Computing Science. The first was given in the spring of 1984; despite only a two week notice, a dozen working engineers attended the class, two evenings a week. The second course was given in the fall of 1984, also in the evening. We had 35

applications, and had to limit the class size to 20, all of them working engineers.

Companies whose employees have taken our courses include: Microtel Pacific Research, Glenayre Electronics, MacDonald Dettwiler and Associates, Mobile Data International, Spilsbury Communications, Canysco, Kwantlen College, DBA Communications, International Submarine Engineering.

(b,c,d) Enrollment Predictions:

Based on discussions over the past year and a half with local companies, and on the number of students who are taking our ad hoc graduate courses, we believe that the M.Eng. program will attract between 30 and 40 part-time students. Expectations for the M.A.Sc. program are more modest: initially, only 2 or 3 full-time students, and when the program is fully operational, between 5 and 10.

We do not expect to have to set a ceiling on the number of students in the M.Eng. program, though the number in any one course may be restricted. With 3 or 4 courses offered each semester, a typical class would have 10 to 15 students. Minimum enrollment would be about 10 students unless the course is needed for the timely completion of some students' programs. As for the M.A.Sc. program, the number of students is unlikely to exceed 10, simply because of the limited number of faculty members available for thesis supervision.

3. Types of Jobs for Which the Graduates will be Suitable:

Our part-time students will be employed in engineering or other technical work. After completing the M.Eng. program, they will be qualified to undertake research, development and design projects at a more advanced level. Moreover, the course on management, together with the requirement for adequate design and reporting responsibility in the M.Eng. industrial project, will help the graduates to be ready to take on project leader or project manager roles.

The M.A.Sc. graduates will be ready for similar roles at a level influenced by their previous working experience. Many would be expected to undertake doctoral work in preparation for work in research, advanced development or university teaching.

IV PRESENT AND PROJECTED RESOURCES

1. Administrative Personnel:

As the graduate program is introduced, the undergraduate program will be stabilizing. This will free administrative resources sufficient to support the graduate program. No additional personnel will be required.

2. Faculty, Including TA's and RA's:

As there are a limited number of faculty members in SFU Engineering Science, we have structured the program as follows:

- Most of our students will be in the all course (M.Eng.) program, rather than the thesis (M.A.Sc.) program. In addition, the M.Eng. project is required to be performed in industry, rather than at SFU.

- Since most students will take several years to complete the degree requirements on a part-time basis, we can rotate our courses, offering only a subset of them in any year.

- The full-time M.A.Sc. program weights the thesis heavily, so that relatively few courses will be needed in any one year for full-time students.

- The program is focussed, and initially will offer courses only in communications, signal processing and related electronics.

- We will make extensive use of sessional or visiting instructors drawn from the local professional community.

- We will make use of SFU's transfer credit policy to take advantage of appropriate courses offered by other institutions.

The two Master's programs, the M.A.Sc. and M.Eng., have been designed to be operationally complementary so that the number of courses which must be presented in a given semester is small. This is achieved by having a small number of full-time (M.A.Sc.) students pursue a program which emphasizes thesis work while the relatively larger group of part-time (M.Eng.) students take but one, or at most two, courses per semester. Only one course, ENSC 8AA Linear Systems Dyna-

mics, will be given annually, in the Fall semester. Almost all other courses have no prerequisite other than ENSC 8AA. Consequently, a minimum of only two or three courses need be given in any one semester to sustain the program.

The original planning for Engineering Science assumed a graduate program of this nature. In terms of community expectation, as well as the research environment needed to sustain a quality undergraduate program, a graduate program is necessary. An average of one graduate course per faculty member, and an equal number of courses by sessional, visiting or adjunct faculty, yields about eight courses per year. Given the operational structure of the two programs, this is quite sufficient.

Initially however, given current demands on the time and effort of faculty members in Engineering Science, only four graduate courses will be given per year. Two or three of these will be offered by full-time faculty with sessional or part-time staff offering the other one or two.

The use of sessional instructors and part-time visiting faculty drawn from the technical community gives us greater scope in the courses we can offer and leaves us the flexibility to respond quickly in areas of rapidly changing technology. There are in the Vancouver area a number of highly qualified and experienced people who have expressed an interest in teaching a graduate courses. Those who take part in our planning and instructional activities on a continuing basis will be designated as "Adjunct Professors". In order to ensure that the program keeps its intended focus, we will have review meetings of all those involved in graduate teaching at beginning and end of each semester.

One other point which we consider is the supervisory and administrative load of the M.Eng. projects. With an estimated steady-state size of 30 to 40 students in a program which takes up to 5 years to complete, and with an estimated project duration of 6 months, we expect that only 3 or 4 projects will be active at any one time. Since the supervisory part of the load will be spread over several faculty members, we do not expect it to be onerous. The administrative load will be taken by the faculty member acting as Graduate Program Chairman and by the faculty's administrative assistant. Again the load is not excessive, with an estimated 8 project completions per year.

3. Library Resources:

No resources beyond those which will be built up in support of research activities will be needed (see Appendix B).

4. Capital Costs:

No costs beyond those needed for undergraduate and research activities will be required. Our policy calls for integrated laboratories utilized for undergraduate, graduate and research purposes. Graduate use will be time-shared with the other functions. No graduate laboratory work will be undertaken which is not compatible with our research and undergraduate activities.

5. Anticipated External Funds:

Support for research equipment and personnel, including graduate students, is being obtained from the usual sources including NSERC, federal government departments, research contracts from industry, and the B.C. Science Council. Substantial discounts on equipment have been obtained and endowment funds in support of laboratory work are being accumulated.

6. Budget:

Four visiting instructors at a cost of about $14,000 is the major budgetary consequence of this program at full size. With four courses given by regular faculty each year, we would be offering four courses per semester for 30 or 40 part-time students typically taking a single course. Viability requires a minimum of two courses per semester, which could be sustained by full- time faculty, supplemented by one or two visiting instructors per year. Graduate student support is appropriately charged against research and undergraduate instruction.

7. Faculty Research Awards: 1983 - Present

This list includes only the awards since the start of SFU's Engineering Science Program.

Principal	Title/Date	Agency	Amount
J.K. Cavers	Development of a Prototype High Speed Modem for HF Radio/September 1983. (Held by Glenayre Electronics)	BC Science Council	$141,000
	High Speed VHF/UHF Radio Modems/Jan. 1984	Mobile Data International	$ 54,000
	HF and VHF Digital Mobile Radio/March 1984 (Three year operating grant)	NSERC	$ 40,500
	Techniques for Implementing Modem Functions Using DSP Chips	Dept. of Communications	$ 39,000
B.T. McGeer	Robotics in Engineering Science/ September 1984	SFU Programs of Distinction	$ 45,000
	Development of an Ignition Timing System for Spark-Ignited Engines Fueled by Gasoline or Natural Gas/submitted, not yet approved	B.C. Science Council	$ 28,000
A.M. Leung	Infrared Data Communication System	SFU President's Research Grant	$ 2,200
D.A. George (with N.Cercone & W.Richards)	The Automated Academic Advisor	NSERC	$373,000

V EVALUATION

1. Evaluation by Other BC Institutions: attached.

2. Outside Expert Evaluation of the Program: attached.

3. Procedures for Continuing Institutional Evaluation:

The dynamic nature of this area of engineering ensures on-going evaluation within Engineering Science as a matter of course, as does the involvement of adjunct faculty. Enrollments are a more quantitative measure of the quality and appropriateness of the program. Beyond this, no formal processes are presently contemplated.

4. Plans for Future External Evaluation:

As noted in II-8 above, we reviewed our early proposals for the program with representatives of a number of B.C. companies. We plan to hold a similar review on an annual basis, in order to gauge whether the M.Eng. program, in particular, is still covering the areas of interest. Rather than establish a standing committee, we will draw on appropriate community members as they are available in order to bring in fresh viewpoints.

VI LIST OF ATTACHMENTS

Curriculum Vitae of Full-Time Faculty Members

Curriculum Vitae of Adjunct and Visit Professors

Outside Evaluations of the Program Proposal

Additional Letters of Support

School of Engineering Science

Location:	Room 8548, Multi-purpose Complex 291-4371
Director:	Donald A. George, B.Eng. (McG.), M.S. (Stan.), Sc.D (MIT), P.Eng.
Graduate Program Chairman:	James K. Cavers, B.A.Sc., Ph.D. (Br.Col.)

Faculty and Areas of Research

Donald A. George	signal processing applications to communications and ranging systems; man-machine communications; educational application of technology
James K. Cavers	mobile communications, signal processing, network protocols
Albert M. Leung	microelectronics, integrated circuit design, physical sensors
B.T. McGeer	robotics, automatic control, aircraft design

DEGREES OFFERED

Engineering Science offers two distinct programs of study, leading to a Master of Engineering (M.Eng.), or Master of Applied Science (M.A.Sc.). The M.Eng. program is designed for part-time study by practicing engineers and is based on a set of courses, normally offered in the evenings, plus a project performed in industry. The principal areas of study offered in the M.Eng. program are electronics, communications and signal processing. The M.A.Sc., on the other hand, is a full-time program in which primary emphasis is on the thesis, rather than course work. It is more exploratory than the M.Eng., and hence the areas of study cover a greater range.

Admission

The normal admission requirement to the M.Eng. and M.A.Sc. program is a Bachelor's degree in electrical engineering, computer engineering, engineering science or a related area, with a cumulative G.P.A. of at least 3.0 (B) from a recognized university, or the equivalent. Note that the size of the faculty limits the number of M.A.Sc. students.

DEGREE REQUIREMENTS - M.Eng. Program

1. Course Work

M.Eng. candidates are required to complete a minimum of 30 semester hours course work, at least 20 of which must be at the graduate level, plus a project. Of the courses listed below, ENSC 8AA to 8EE are required. ENSC 8AA, in particular, is a prerequisite for all other ENSC graduate courses except ENSC 8EE.

A key component of the M.Eng. program is a significant industrial project which integrates knowledge gained during the course of the student's graduate studies. This project is to be performed in the workplace, typically in industry or government laboratories. An appropriate level of design, documentation and reporting responsibility is required. The project would be expected to take a minimum of one person-month.

During the project, the student will receive academic supervision, as required, from the student's Senior Supervisor at the University, and day-to-day supervision from the student's manager, or a designated associate, in his or her place of work. These industrial supervisors, who will sit on the student's Supervisory Committee, will be appointed by the Faculty. In the case of very small companies, alternative arrangements will be made for supervision.

In addition to submission of a technical report at the completion of the project, the student will make an oral presentation to at least the Supervisory Committee and one other faculty member.

DEGREE REQUIREMENTS - M.A.Sc. Program

M.A.Sc. candidates are required to complete 30 semester hours work, as a minimum of 12 semester hours course work, plus a thesis with a weight of 18 semester hours. The courses will, in consultation with the Senior Supervisor, normally be selected from the list below. Additional courses may be required to correct deficiencies in the student's background. The M.A.Sc. thesis is to be based on an independent project with a significant research component. The student is required to defend the thesis at an examination, in accordance with general university regulations.

ENGINEERING SCIENCE GRADUATE COURSES (ENSC)

ENSC 8AA-3 Linear Systems Dynamics
A unified presentation of systems and signals analysis techniques. Linear algebra up to Cayley-Hamilton. Linear systems: superposition, convolution for differential and difference equations. State variables: canonic forms, modal decomposition. Transforms: Fourier, Laplace, Z. Random processes: discrete time processes, AR and ARMA models, least squares estimation. Communication signals and their representation.
Prerequisite: undergraduate degree in engineering, mathematics or physics.

ENSC 8BB-3 Techniques of Digital Communications
Modulation, detection and synchronization techniques for digital transmission. Decision theory and optimum detectors. Channel impairments: random phase, random gain, restricted bandwidth, nonlinearities. Comparison of signal sets. Carrier and bit synchronization. Precoding for dispersive channels. Adaptive equalization. Sequence decoding by Viterbi algorithm.
Prerequisite: ENSC 8AA

ENSC 8CC-3 Digital Signal Processing

Techniques for digital processing of one and two dimensional signals. Filter design. Finite word length effects. Canonical forms, lattice filters. Estimation of power spectrum. Homomorphic signal processing.
Prerequisite: ENSC 8AA

ENSC 8DD-3 Signal Processing Electronics

Hardware implementation tools and design techniques. CCDs, switched capacitor filters. Noise and dynamic range in sampled analog circuits. Special purpose and general purpose digital signal processors. Signal processing architectures: pipeline, systolic arrays, data flow architectures.
Prerequisite: ENSC 8AA

ENSC 8EE-3 Engineering Management for Development Projects

This course focusses on the management and reporting activities of typical engineering development projects. Through seminars and workshops it builds the student's skills at estimating project cost and schedule, keeping a project on track, and handing over

the completed project to a customer or another team. A writing workshop emphasizes techniques for writing proposals, and writing and controlling documentation.
Prerequisite: Permission of instructor.

ENSC 8FX-3 Topics in Communications

RF Communication

Modulation, detection and propagation considerations in satellite communication, mobile radio, HF radio, and CATV networks. The emphasis is on system design considerations, rather than detailed electronics.
Prerequisite: ENSC 8AA

Mobiles, Satellite Communications and Local Area Networks

Analytical survey of multiple access techniques used in satellite communications, mobile and cellular radio, local area networks and CATV data networks.
Prerequisite: ENSC 8AA, MATH 357 or equivalent

Network Protocols and Performance

Practical techniques of design and performance analysis of data networks up to layer 3 of the Open System Interconnection protocol hierarchy. Point to point data links. Polling networks. Networks of queues, routing strategies, transit time and loading of packet networks.
Prerequisite: ENSC 8AA.

Optical Processing and Communications

This course will give an overview of fibre optics communications and integrated optics, with emphasis on the latter. The discussion will include multimode and single-mode technology, semi-conduconductor sources, photo detectors, communications systems and fibre optic sensors.
Prerequisite: ENSC 8AA

Telephony and Digital Switching

Organization of the voice network, with special reference to digital switching and transmission. Digital conversion. Digital hierarchy, and formats. Multiplexing. Digital switch principles and architecture.
Prerequisite: ENSC 8AA

Error Correcting Codes

Introduction to error detecting and correcting codes and their implementations.

Prerequisite: undergraduate courses in probability and discrete mathematics

ENSC 8GX Topics in System Engineering

System Implementation Methodology

Techniques used in planning, design and implementation of large systems. Functional requirements and high level design. Subsystem specifications. Margin definition and management. The system design and maintenance lifecycle. Team structures and large project management.
Prerequisite: ENSC 8EE

ENSC 8HX Topics in Signal Processing

Image Processing

Analytical and practical treatment of techniques for processing images. Image correction and enhancement, compression for storage and transmission. Hardware structures for image handling and display.
Prerequisite: ENSC 8AA

Appendix A

COURSE DESCRIPTIONS

ENSC 8AA Linear Systems Dynamics

A unified presentation of the systems and signals analysis techniques which are given in a fragmentary fashion in undergraduate and first level graduate courses. Linear algebra up to quadratic form, Jordan form and Cayley-Hamilton. Linear systems: superposition, invariance relations, convolution for differential and difference equations. State variables: canonic forms, modal decomposition, observatility, controllability. Transforms: Fourier, Laplace, Z. Random processes: correlation functions and power spectra, effect of linear operations, discrete time processes, AR and ARMA models. Least squares estimation, Wiener filters. Communication signals and their representation.

Prerequisite: undergraduate degree in engineering, mathematics or physics.

ENSC 8BB Techniques of Digital Communications

Modulation and detection techniques for digital transmission. Complex envelopes. Decision theory and optimum detectors. Channel impairments: random phase, random gain, restricted bandwidth, nonlinearities. Comparison of signal sets, e.g., FSK, PSK, MSK, Manchester. Carrier and bit synchronization. Precoding for dispersive channels: partial response, B6ZS, Miller code. Adaptive equalization. Sequence decoding by Viterbi algorithm.

Prerequisite: ENSC 8AA

ENSC 8CC Digital Signal Processing

Techniques for digital processing of one and two dimensional signals. Review of Fourier, DFT, FFT and chirp-z transforms. Infinite and finite impulse response filter design: impulse invariance and bilinear transform techniques, Chebyshev approximation, Remez exchange algorithm. Canonical forms, lattice filters. Finite word length effects. Estimation of power spectrum, correlation and covariance. Prediction and reflection coefficients, Levinson's recursion, Leroux-Guegin technique. Fast Kalman and lattice recursions. Homomorphic signal processing.
Prerequisite: ENSC 8AA

ENSC 8DD Signal Processing Electronics

CCDs, bucket brigades, transversal and recursive filters, switched capacitor filters. Noise in sampled analog circuits, dynamic range, signal to noise ratio. Special purpose digital processors: bit slice ALUs, MAC chips. General purpose digital signal processors: NEC 7720, TMS 320. Signal processing architectures: pipeline, systolic arrays. Data flow architectures.
Prerequisite: ENSC 8AA

ENSC 8EE Engineering Management for Development Projects

This course focusses on the management and reporting activities of typical engineering development projects. Through seminars and workshops it builds the student's skills at estimating project cost and schedule, keeping a project on track, and handing over the completed project to a customer or another team. Basic prin-

ciples of accounting as applied to engineering are introduced as a language for communicating with a finance department or investor. A writing workshop emphasizes techniques for writing proposals, and writing and controlling documentation.
Prerequisite: Permission of instructor.

ENSC 8FX Topics in Communications

RF Communication

Modulation and propagation considerations in satellite communication, mobile radio, HF radio, and CATV networks. Review of noise figure, intermodulation distortion, and the FM equation. Oscillator instability and phase noise. Satellites: link budgets, effect of carrier frequency and antenna gain, FDM and TDM organization, satellite doppler. Mobile radio: vehicle motion and fading, random FM, diversity, propagation and shadowing, interference and frequency reuse, simulcast. HF radio: propagation mechanism, Clark Watterson model of channel fluctuation, diversity, parallel and serial modulation. CATV networks: coax transmission characteristics, noise and intermod in cascaded amplifiers, feedforward amps, model of upstream transmission. Narrowband and spread spectrum digital transmission over all four media.
Prerequisite: ENSC 8AA

Mobiles, Satellite Communications and Local Area Networks

Analytical survey of multiple access techniques used in satellite communications, mobile and cellular radio, local area networks and CATV data networks. Random access: ALOHA, reservation ALOHA

and CSMA in satellites, cellular radio and CATV, hierarchical organization of CATV networks, Ethernet and token passing performance. Demand assigned multiaccess (DAMA) protocols for single channel per carrier and time division techniques. Intelsat protocols. Spread spectrum multiaccess by direct sequence and frequency hopping in satellite and mobile radio.

Prerequisite: ENSC 8AA, MATH 357 or equivalent

Network Protocols and Performance

Practical techniques of design and analysis of data networks. Open System Interconnection protocol hierarchy. Point to point data link protocols: HDLC, BSC, DDCMP. Pitfalls of protocol design. Effect of noise, bit rate and fading on delay and throughput. Virtual circuits and datagrams. X.25. Routing strategies: fixed alternate, dynamic. Elementary queuing theory. Delay and throughput on a polling network. Networks of queues, independence assumption. Transit time and loading of packet networks.

Prerequisite: ENSC 8AA.

Optical Processing and Communications

This course will give an overview of fibre optics communications and integrated optics, with emphasis on the latter. The discussion will include multimode and single-mode technology, semi-conduconductor sources, photo detectors, communications systems and fibre optic sensors.

Analyses and fabrication techniques of integrated optic wave guides and devices will be presented. Some of the electrooptic and acousto-optic integrated optic devices that will be discussed

are: phase-modulators, directional couplers, switches, filters, spectrum analyzer on-a-chip, gyroscopes, voltage and temperature sensors.

Prerequisite: ENSC 8AA

Telephony and Digital Switching

Organization of the voice network, switching hierarchy. Analog trunk and line interfaces. The PBX. Analog multiplexing, transmission, switching. Digital conversion: companding, channel banks. Digital hierarchy, DS1 and DS3 format. Asychronous multiplexing. Digital switch principles and architecture.

Prerequisite: ENSC 8AA

Error Correcting Codes

Introduction to error detecting and correcting codes and their implementations. Information theory: entropy, information, Huffman codes, random coding bounds. Discrete mathematics: groups, rings, fields, polynomials over finite fields. Group codes, syndromes. Cyclic codes, primitive polynomials, correction algorithms, BCH, Fire, RS codes. Convolutional codes, sequential and Viterbi decoding.

Prerequisite: undergraduate courses in probability and discrete mathematics

NOTE: It is our understanding that the Department of Mathematics is developing a similar course. If it is appropriate, we will drop this course.

ENSC 8GX Topics in System Engineering

System Implementation Methodology

Techniques used in planning, design and implementation of large systems. Functional requirements and high level design. Subsystem requirements and technical specifications. Tradeoff analysis, margin definition and management, hardware versus software implementations, the system design and maintenance lifecycle. Team structures and large project management.

Prerequisite: ENSC 8EE

ENSC 8HX Topics in Signal Processing

Image Processing

Analytical treatment of techniques for processing images. Two dimensional transform and spectral representation. Optical filtering. Product decomposition of image. Non uniform sampling, resampling, image rotation. Geometric correction. Spectral filtering, 2-D recursive filters. Image enhancement and deconvolution. Compression for storage and transmission

Prerequisite: ENSC 8AA

Deadline Date _____

APPENDIX B

SIMON FRASER UNIVERSITY LIBRARY COLLECTION EVALUATION

(To be completed only for new course proposals; not needed for re-numbering)

Course number and name Master's Program in Engineering

1. Evaluation of current library collection (indicate method used, as applicable):

In addition to substantial related holdings in Computer Science, Applied Mathematics, and Physics, the library collection includes 1800 texts and reference books in the specified areas of computer and communications technology, and electronics.
Periodical holdings presently include all such publications of the Institute of Electrical and Electronics Engineers.

2. Recommended additions to collection (monographs, serials, other); attach supplementary lists as necessary:

The collection is presently being enhanced through approval plan coverage of all English language book publications in the specified areas of concentration.
Additional periodical subscriptions will be considered when real demands warrant. Interlibrary loan access to UBC collections will suffice initially.

3. Estimated costs:

A. Initial costs	monographs	_____
	serials	_____
	Total	_____
B. Continuing costs	monographs	_____
	serials	_____
	Total	ø

4. Special budget and scheduling factors (include special processing, equipment, and servicing costs):

None.

5. Other pertinent details:

Computerized literature searching, as presently provided by the Library, should prove of particular value to students in this program.

E. Weinstein
For Library
Date: 84/12/03

For Faculty Department
Date: 84 12 06

December 18, 1984

Dean Spruce Riordou
Faculty of Engineering
Carleton University
Ottawa, Ontario
KlS 5B6

Dear Dean Riordou:

Thank you for agreeing to serve as an assessor of the proposed two Master's Programmes in Engineering.

I enclose a copy of the proposal, a copy of the University Graduate Regulations governing all graduate students at Simon Fraser, the course descriptions (Appendix A), the Simon Fraser University Library Collection Evaluation (Appendix B), a compilation of curricula vitae and background information on the Faculty organization and undergraduate programme.

The Assessment Committee would appreciate your frank comments on the academic merit and suitability of the proposed programmes. Please include in your report answers to the following questions:

1. Is the available academic and professional expertise sufficient to implement the Master's Programmes outlined here?

2. Do you think that graduates of these programmes will be of quality comparable to those produced at the leading institutions in these particular areas of Engineering?

3. How large is the need for the graduates that these programmes would produce and is it a continuing need?

4. Are the particular programmes proposed likely to meet the stated objectives?

You should note that these questions are not meant to limit the range of your comments in any way.

Furthermore, it would be most helpful if you could make, in addition to your other comments, specific recommendations on either the approval, modification, delay or disapproval of the programmes.

...../2

Your report will be made available, upon request, to members of the Committees and other governing bodies both within and without the University that must approve the programmes before they can be implemented.

It would be greatly appreciated if you could see your way to responding within the next couple of weeks.

The honorarium paid by this University for such services is $200. Thank you for your assistance.

Yours sincerely,

John M. Webster, Associate Vice-President, Academic and Dean of Graduate Studies

/dle
Attachments

Carleton University
Ottawa, Canada K1S 5B6

January 28, 1985

Dr. John M. Webster,
Associate Vice President, Academic,
and Dean of Graduate Studies,
Simon Fraser University,
Burnaby, B.C.
V5A 1S6

Dear Dr. Webster:

Attached is my assessment of the proposed Master's program in Engineering at Simon Fraser University. I believe that it is a very worthwhile endeavour, and I look forward to its success.

Yours sincerely,

J. S. Riordon,
Dean of Engineering.

A

Encl.

Office of the Dean □ Faculty of Engineering □ Room 360
C.J. Mackenzie Building □ (613) 231-2616

ASSESSMENT OF

PROPOSED MASTER'S PROGRAM IN ENGINEERING

AT SIMON FRASER UNIVERSITY

1. Academic and professional expertise

The faculty members associated with this program are small in number but of very high quality. In particular, Professors George and Cavers have broad and extensive experience and enjoy deservedly excellent reputations in the electrical engineering community.

The program is ambitious, comprising thirteen one term courses. However, the Faculty of Engineering Science has designed the program in such a way that much of the immediate project supervision for the M.Eng. will be carried out in industry, and that only a limited selection of courses will be offered in any given term.

2. Quality of graduates

Admission requirements to this program are comparable to those of similar ones throughout North America. Course descriptions indicate that courses will be relevant and up-to-date. More important, the academic personnel themselves are leaders in the field. Within the area covered, therefore, I expect that the graduates of this program will be comparable in quality to those of leading institutions in the country.

Arrangements for industry liaison in the operation of M.Eng. projects, and for suitable supervision, have been thought out carefully. They make good use of industrial facilities, and should help to further cement relations between faculty and industry. The small M.A.Sc. program proposed is appropriate and valuable, helping maintain and renew the 'in house' research program.

Four or five faculty members, even with the help of expert sessional lecturers, cannot cover a broad area. In this sense also the program has been well thought out, in that it is focussed upon communications and signal processing. Undoubtedly, though, students will wish to study in cognate areas. Those of real time systems design, performance analysis, and microelectronics come to mind as being of special interest to students in this program. It seems desirable that students be encouraged to take advantage of complementary courses available elsewhere in Simon Fraser University and at the University of British Columbia. Conversely, students in cognate departments will undoubtedly benefit from the expertise made available through this program.

3. Need for graduates

The specialization within this Master's program is closely related to the main thrust of advanced technology industry in the Vancouver region. Most, if not all, of the M.Eng. students will already hold jobs, and the availability of this program will help local industry substantially in maintaining a competitive edge. In a wider context, the rapid worldwide growth of the market sector in computing, communications and electronics indicates a very strong demand for graduates of this nature for the foreseeable future. Indeed, Canada's problem will be that of producing an adequate number of highly qualified people in these fields.

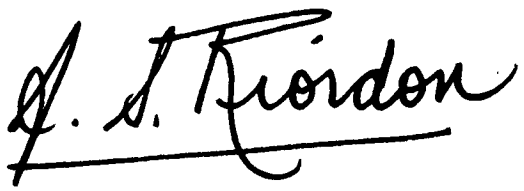
4. Effectiveness

Two principal objectives, acccessibility and the development of relevant thesis research, have been specified. I have every confidence that the program as proposed will meet these objectives.

5. General comments

Dean George and his associates are to be congratulated on meeting the challenge of designing a program which should combine wide accessibility with high quality in the face of very limited resources. In its implementation, I recommend that careful attention be paid to the existence of complementary programs and courses in the Vancouver region in an effort to maintain ease of accessibility which will enrich the base of courses from which students may draw.

In conclusion, I recommend that the program be implemented to begin in the fall of 1985.



UNIVERSITY OF TORONTO
Department of Electrical Engineering
Toronto, Canada M5S 1A4

January 17, 1985

Professor John M. Webster
Associate Vice-President
Academic and Dean of Graduate Studies
Simon Fraser University
Burnaby, B.C. V5A 1S6

Dear Dean Webster:

I have read the material you sent me concerning the proposed two Master's Programmes in Engineering at Simon Fraser. I should make you aware that my experience (with Dean George) as a sessional part-time lecturer at Carleton University (1960-66) in developing similar programmes may be viewed as creating some bias. On the other hand, that experience of developing new programmes gives me some insight into the problems which can arise.

The programmes proposed are essentially conventional in structure. The M.Eng. programme is clearly based in part on Carleton's experience, but it also resembles very closely the industry-oriented M.Eng. stream here. The M.A.Sc. programme differs only slightly from most other programmes in the suggestion that the thesis research may, when appropriate, be done in industry. I will structure my report in the form of extended answers to your four specific questions, followed by the specific recommendation you ask for.

1. Available academic and professional expertise. The c.v.'s of the staff in Engineering Science make it clear that they are capable of offering high quality courses for the technical core of the programme (courses ENSC 8AA-8DD), and of supervising M.A.Sc. students. The courses offered in computer science and mathematics named in the proposal are appropriate and presumably well-established. Transfer credit arrangements with UBC will allow the maintenance of the proposed relatively narrow focus of the SFU programme of courses. The analysis of resources (section IV of the proposal) is clear and convincing. The relatively heavy reliance on external sessional lecturers might be questioned, but this is more a question of quality than anything else, and I discuss this further later on. I conclude that sufficient expertise is available to implement the programmes.

2. Quality of graduates. This must be inferred from the quality of entering students, the quality of courses offered, the quality of the staff, and the quality of project and thesis supervision. The quality of entering students can only be deduced from admission standards. The requirement for a CGPA of at least 3.0, plus letters of reference, seems a reasonable one. I would suggest, however,

.....2

that initially it might be wise to set a somewhat higher CGPA as the programme is in development, say 3.3. I assume this can be effected by administrative action, if it is considered desirable, without changing Graduate School regulations. This somewhat higher level seems to me particularly desirable for M.A.Sc. students. With only about five new M.A.Sc. admissions a year, this policy might prove tenable permanently. I would encourage the Graduate Programme Committee to exercise this initial selectivity to establish firm admission standards at the outset: it is far easier to relax standards found to be too high than to raise standards found to be too lax.

The course outlines describe the material I would expect to find in such courses, organized in a coherent way. So far as one can infer the level of presentation from the descriptions, it appears adequate. I see no reason to question the quality of the courses proposed.

The quality of the regular Engineering Science staff is not in doubt. However, great care must be taken in the selection of adjunct and sessional staff. Quality assurance depends here on people (primarily the Graduate Programme Chairman, who I assume will initially be Dean George) and on the processes used for appointment. This latter issue is not addressed in the proposal, perhaps because SFU already has in place procedures for deciding who may teach graduate students. If such procedures are not in place, I would suggest that appointments be made by the Dean of the Graduate School on the recommendation of the Graduate Programme Chairman, or an equivalent procedure appropriate to SFU 's internal organdization. I believe Dean George's experience will be invaluable in establishing appropriate standards from the beginning. Providing this care is exercised, staff quality should be more than adequate and could be excellent. I would add one suggestion drawn from my own experience as a sometime sessional lecturer. In addition to the review meetings outlined in the proposal, it would be useful if each sessional or adjunct staff member had, as a contact person, a named regular member of staff to turn to for advice during the semester if needed.

Proper supervision of project/thesis work in industry can be difficult. However, SFU already has a system of Supervisory Committees, and section II.5B of the proposal shows awareness of this issue. The Graduate Programme Chairman should, however, take care that Supervisory Committees function properly, particularly in the first years of the programme when standards are being set.

.....3

I conclude that the quality of graduates will be comparable to that of graduates from similar programmes at the University of Toronto, provided that care is taken in student admissions, the selection of sessional staff, and the proper functioning of Supervisory Committees.

3. Need for graduates. I do not wish to engage in manpower needs prediction - a notoriously inexact science. I have no doubt that the Vancouver area can absorb the number of graduates proposed, particularly since M.Eng. graduates will presumably already be employed. At an annual intake level of about 8 M.Eng. and 5 M.A.Sc. students, the need should, in my judgement, be a continuing one. Experience with the part-time M.Eng. programme in this Department has shown that stable enrolment can be maintained over long periods without the lowering of standards.

4. Meeting objectives. I believe the programmes as proposed will meet the stated objectives. In my now rather too long experience of reviewing graduate programme proposals within this University, within the Ontario system, and for the Ontario Council on University Affairs, I have not often seen a more coherent and carefully thought out proposal. Its authors deserve congratulation.

In my comments, I have raised some points where I believe care is necessary in the management of the programmes, particularly in their early years. My remarks are, however, cautionary rather than critical. I have no hesitation in recommending that the proposed programmes be approved. I do recommend, however, that the programmes be evaluated by outside consultants in about seven years' time, when the programmes have produced a number of graduates. A programme in being can be much more accurately evaluated than a proposal can be.

Yours sincerely,

H. W. Smith
Professor and
Chairman

HWS:jdl

MACDONALD
DETTWILER
AND ASSOCIATES LTD.

3751 Shell Road
Richmond, B.C. Canada V6X 2Z9
Telephone (604) 278-3411
Telex 04-355599

January 14, 1985

John M. Webster
Associate Vice-President Academic
Dean of Graduate Studies
Office of the Dean of Graduate Studies
Simon Fraser University
Burnaby, B.C.
V5A 1S6

Dear Sir:

The proposed program of part time graduate studies in Engineering Science with an initial focus on communications, signal processing and electronics has been needed for a long time in Vancouver. MacDonald Dettwiler and Associates has had a number of its employees obtain graduate degrees from UBC while remaining employees, but in each instance it involved special arrangements regarding hours of work so that the student could attend daytime courses, reduced hours so the student could carry the necessary number of courses, time-off for thesis work, etc. In general, the company and the student had to accommodate to the demands of the university. I, personally, always contrasted this situation with that existing in Ottawa when I lived there and had access to part-time graduate degree programs that accommodated themselves to the needs of the working students and the normal 9 to 5 workday.

Such part-time programs are particularly important to companies such as ours that are exploiting rapidly evolving technologies, since being current with the state of the art is essential to remain competitive. The difficulty is that most of our employees are married and thus cannot afford to return to university on a full time basis. A part-time graduate program allows them to become technically current, while remaining fully employed. Thus MacDonald Dettwiler is strongly supportive of the proposed program of graduate studies in Engineering Science, as, I am sure, are companies such as Mobile Data International, Glenayre, Microtel, and Epic Data. Consequently, I strongly recommend approval of both programs in sufficient time for the first students to be enrolled in the fall semester of this year.

I have included in Attachment A some detailed comments on the proposal sent to me. In the following paragraphs I provide a summary of those comments in the process of answering the questions posed in your letter.

The number of faculty is sufficient to implement the programs outlined provided the undergraduate and administrative loads already present are not excessive. The two senior members of the Engineering Science faculty will have to initially bear a larger share of the graduate teaching and project supervision load, since the two remaining faculty have no experience in these activities, and the academic background of one of the junior faculty is not directly related to the areas of concentration. The suggested additional faculty member will help to reduce the effect of any initial load distribution differences. In any event, the discussion in Section IV.2 demonstrates that relatively few courses and projects will be underway at any one time even at the indicated levels of peak enrollment. The academic and professional expertise of the faculty is exceptional in terms of the quality of their degrees, the quality of their publications, and the substantial industrial experience of the two senior faculty. In all cases, except as noted above, all this academic and professional experience is directly relevant to the suggested areas of initial concentration. Thus, it is my opinion that both the quality and quantity of professional and academic expertise is adequate to implement the proposed programs.

The quality of the students who graduate from the proposed programs will be determined by the quality of the teaching and the content of the courses they have taken, and the quality of the projects or theses they complete. The quality of the Engineering Science faculty teaching the courses has been discussed above. Local industry contains many individuals who are working at the forefront of technology in the areas of communications, signal processing, and electronics, as borne out by the success of the products and systems they have designed and sold successfully in the U.S., Europe, Japan, and around the world. If, as I am sure will happen, these individuals give courses in their areas of special expertise, the students will be exposed to world class technology. As a result, the graduates of the proposed programs should definitely be of quality comparable to those produced by the leading institutions in the areas of communications, signal processing and electronics.

Since the majority of the graduates will be fully employed throughout their graduate program, their employment is assured. The need for professionals in local high technology companies to stay current has been discussed and emphatically affirmed above. Given the continuing growth of these companies, there will be a continuing need for such graduate programs.

The proposed program should meet the stated objectives. These are recognized as being interdependent in that the on-going quality of the M.ENG. program will be critically dependent on the on-going research activities of the faculty, and on the ability to attract additional qualified faculty. Both of these needs justify the proposed M.A.Sc. program.

One aspect of the proposed program should be examined, namely the requirement to complete ten courses plus a project for the M.ENG. when the university regulations appear to require seven courses plus a project. The ten courses must be completed in five years which implies continuous attendance at fall and winter courses over this period plus the execution of a substantial project. The probability of being able to sustain continuous attendance over this period while holding down a full time job with its attendant demands is low.

As a final comment I agree with making the engineering management course compulsory since the material covered is essential to developing graduates who will be in a position to contribute to local industry as members of professional staff or as entrepreneurs who start their own companies. The course content should be refined in conjunction with the instructor obtained from local industry. Some possible additions are noted in Attachment A.

I hope the above comments and the attachment are helpful and assist in your obtaining approval for the proposed program which will be a welcome addition to the local high technology scene.

Yours truly,

MACDONALD DETTWILER AND ASSOCIATES LTD.

Denis Connor
Vice President
Corporate Development

Attachment

ATTACHMENT A

Section II.1.para 2.

Increase in capabilities of company staff does not necessarily mean getting a degree, but simply upgrading their technical skills.

Section II.2.para 2

Time suggested for courses is right.

Section II.2.para 3

This heavy weight on thesis research will make this more like a PHD which may not initially be recognized in industry and thus may work to the detriment of students.

Section II.2.para 4

This implies there will be a need for a PHD program soon.

Section II.3.para 3

Ten one semester courses plus a project expected to take 6 months elapsed time implies at least five years to complete if a person takes 1 course in each of the fall and spring semesters, skips the summer semester and then does his project.

Section II.4.para 4

This suggestion of complementarity between the UBC and SFU programs and the transfer of credits should be explored in more depth since this may permit a student to address a broader range of subjects in his course work; also students may need more information on how SFU semester hours translate into UBC units and vice versa.

Section II.5A.para 5

MENG requirements seem more stringent than the regulations in Section 1.7.2 of the General Regulations (Graduate Programs) which require 20 semester hours of graduate courses plus a project, not 30 semester hours, 20 of which must be at the graduate level as stated here. If 20 hours, i.e. 7 courses, were sufficient then students would be able to more easily complete the program within the 5 year restriction of Section 1.12.1 of the General Regulations.

Section II.5A.course list

It appears that JKC will take the lead in most cases where an external lecturer is not involved.

A very useful course for local industry that is not shown would be one entitled " Design of Electronic Products for Manufacturability" which would address how to design electronic products so they can be manufactured at low cost while achieving specified reliability and performance goals. Such a course would have to touch on manufacturing techniques and processes, design for testability, design to meet reliability, availability and maintainability goals, methods for reducing cost in product manufacture, learning curve techniques for predicting cost reductions as a function of number units built, etc.

The list of required courses is excellent and making the engineering management course compulsory is essential to developing graduates who will be in a position to contribute to local industry as members of professional staff or as entrepreneurs starting their own companies.

Section II.5B.para 1

Performance of a project in industry will require an understanding that industry retains proprietary rights to the results of any work. It may also require the university personnel involved to sign non-disclosure agreements

Section II.5B.para 3

I assume it is the intention that the planning and execution of the project will draw on the project management techniques learned in ENSC 8EE, and that the completed project will be judged on how well it was planned and run as well as the quality of the technical work

Section II.8.para 2

It is good to see that a number of industry suggestions have been included.

Section III.1.para 2

Accessibility to practicing engineers is fundamental to the support from industry for this program and industry is very supportive of the program proposed. Although formal graduate studies are the basis for this program, I suspect a number of engineers will want to take an occasional course without intending to get a degree. Will there be anything that will prevent or inhibit this possibility? Also is there any possibility that some of the courses could be given somewhere other than SFU, for example at a Richmond location?

Section III.2(b,c,d).para 1

MDA expects to hire in the coming years a minimum of 20 new graduates a year in engineering, science and computer science. A survey of the other high tech companies in the area would give you an idea of the growth in newly graduated professionals who are working in jobs that will require upgrading of their technical skills

Section III.3.para 1

The courses proposed are in line with the needs of local high tech industry which is heavily oriented to communications, signal processing, image processing, electronics, computer systems engineering and software systems design

Section IV.2.paras 2 to 5

You expect students to take only one course per semester. If they enroll in only two semesters per year it will take them five years to complete the ten courses you indicate are required which barely satisfies Section 1.12.1 as noted above and requires them to fit in a one man month project as well. If only seven courses were required as seems to be indicated in Section 1.7.2 of the general regulations then the 5 year limitation would be less constraining. I think you need to look at these constraints and find a way to provide some relaxation.

These faculty loading discussions indicate there should be no problem handling the program provided the faculty are not already fully loaded with the undergraduate program or administrative duties and provided the load can be equally shared among the faculty. This latter point is of some concern since Dr. Cavers figures so prominently in the list of instructors for the courses on pp.4-5. Also, Dr. McGeer does not appear to have a background that is directly relevant to the indicated areas of concentration, namely, communications, signal processing, and electronics. Consequently, at least in the first few years the load of teaching courses and supervising projects may fall unduly heavily on Dr. Cavers and Dr. George, less heavily on Dr. Leung and fairly lightly on Dr. McGeer. As long as this potential problem is recognized up front and undergraduate loads are adjusted accordingly it should not be a problem, but I feel that some consideration should be given to it at this time and a work-around plan should be developed.

Appendix A ENSC 8EE

This course statement is somewhat loose and could be refined through discussion with industry, in particular with the expected external lecturer. For example, the course could deal with concepts such as work breakdown structures, work packages, statements of work, earned value techniques for measuring progress, project organization, scheduling and resource planning techniques, use of a document table of contents for organizing work, software cost estimation models such as COCOMO, etc.

Department of Electrical Engineering
The University of British Columbia
Vancouver B.C. V6T 1W5

12 December, 1985

Dean John M. Webster
Faculty of Graduate Studies
Simon Fraser University
Burnaby

Dear Dean Webster:

I enclose my assessment of the proposed Master's Program in Engineering. Please excuse this late response.

As you will see, I have misgivings about introducing two Master's Programs while the faculty resources in Engineering Science are so meagre. I would like to stress that my misgivings in no way reflect on the capability of my engineering colleagues at Simon Fraser - I have great respect for them, and would like to see their number increased.

Since I have made this assessment without extensive extra work, I do not feel an honorarium is appropriate, and therefore decline your kind offer.

Please let me know if I can be of further assistance.

Yours sincerely,

M.S. Davies

Michael S. Davies
Associate Professor

Proposed Master's Programs in Engineering
Simon Fraser University

Assessment Prepared by

Michael S. Davies
Department of Electrical Engineering
The University of British Columbia

11 December, 1985

1. Introduction

1.1 It is axiomatic that a healthy undergraduate university program needs to co-exist with a graduate degree program. By insisting that the faculty maintain active research interests, a steady flow of new ideas can enrich the undergraduate program and keep it vital over the long term. Given that Simon Fraser University is committed to the undergraduate Engineering Science Program on a long term basis, it follows that a graduate program in the area should be established as soon as possible.

1.2 The calibre of the Engineering Science faculty is high. Drs. George and Cavers have a great deal of experience in supervising graduate students, and Drs. McGeer and Leung have the necessary credentials for taking on Master's degree students immediately.

2. Degree Requirements

2.1 The proposed M.Eng. degree requirements seem about right. A primarily course work degree should demand two full semesters of courses and the equivalent of one semester spent reading and preparing a comprehensive report. The 30 semester hours of courses implies about 5 courses a term for a full-time student - a typical full load. The industrial project will need careful supervision if the students are not to find themselves ignored by one side or the other. It requires unusual diligence for both the academic and industrial supervisors to keep close contact with such a project.

2.2 The course requirement for the M.A.Sc. is too low. Thesis Master's degrees typically require just under two full semesters of course work, followed by two semesters of research. The degree will therefore usually extend to a total of four semesters. Course work at the graduate level should have some breadth, as well as equipping the student to carry out research in one area. A full first semester of five courses, followed by a lighter load - say three courses - in the second semester, would allow the student to start working on his or her thesis project. I

would favour the equivalent of 24 semester hours minimum.

2.3 Although the emphasis in the Proposal is on the M.Eng. as a part-time degree, many of those taking this degree would wish to do so on a full-time basis. Such students would include currently unemployed engineers, and those released for a year by their employers to enable them to complete a graduate degree. It would be difficult to deny access to such students, although they would place a heavy course work load on the program.

3. Courses

3.1 The weakest aspect of the Proposal is the shortage of faculty to enable a reasonable range of graduate courses to be offered in a given semester. Remembering that this same group must maintain a four year undergraduate program as well, it is to be expected that only two or three graduate level courses can be offered in a semester. Although sessional instructors can relieve some of this pressure, the program should not depend for its viability on outside lecturers.

3.2 The set of courses ENSC 8AA to 8EE form a good core for the narrowly focussed program in digital communications. As the outline indicates, much of the material in ENSC 8AA is actually at the undergraduate level, although such a course is very useful for bringing new students from a range of backgrounds together. ENSC 8EE is also likely to be of value to many students, however, the content is at the undergraduate level. Since graduate students are permitted a certain number of undergraduate credits it should be possible to keep the course in the Program even with an undergraduate number.

3.3 The exchange of graduate courses between Simon Fraser and the University of British Columbia should be encouraged. Both institutions stand to gain from the wider choice made available to students. Such exchange can be through transfer credit, and by use of direct video links.

4. Specific Questions (see Dr. Webster's letter)

4.1 I would recommend that, in view of the limited number of faculty available at present, only one Master's program be implemented at this time. Since the research component is important to the faculty, and since the M.A.Sc. is less course intensive, this would be the logical choice. The designation "Master of Engineering Science" would seem to fit the Faculty and undergraduate program better than M.A.Sc. Under these circumstances, I believe an excellent Master's Program could be

implemented.

4.2 The quality of the graduates would compare well with those in the communications area at other universities.

4.3 The electronics and communications area is one of the few growing sectors of the British Columbia economy. There is a continuing need for engineers in these areas at the graduate level.

4.4 Given the current resources, I feel that a graduate program is just viable. The quality of the resources is excellent; the quantity is not. The long term health of the program will depend on the University being able to substantially increase the number of faculty members in the Engineering Science.

5. Summary

5.1 One degree, preferably the M.Eng.Sc., should initially be offered. The Degree would require a thesis and 24 semester hours of course work.

5.2 A course work Master's should be introduced when an appropriate range of graduate courses can be offered on a regular basis. Organized exchange of graduate courses with UBC would benefit both institutions.

h)

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29 January 1985

Simon Fraser University
Burnaby, B.C.
V5A 1S6

ATTENTION: Dr. John Webster
Dean of Graduate Studies

Dear Sir:

I had reviewed, with interest, the proposed program for part time graduate studies in Engineering leading to Master of Engineering.

The program is relevant to British Columbia's emerging electronics industry and its aim is precise, useful and beneficial to both the engineering companies and their technical staff. I note that the course content currently outlined will be reviewed and aligned with industry needs as they evolve.

I believe this contribution and support by SFU will become an important part of the necessary mosaic of knowledge, skills and attitudes demanded by the communications industry.

Glenayre supports this program whole heartedly.

Yours truly,

GLENAYRE ELECTRONICS LTD.

Paul Lancaster

P. W. Lancaster
Vice-President Engineering

PWL/dd

cc: E.K. Deering, President
P.M. Bradley, V-P & General Manager

MICROTEL
PACIFIC RESEARCH
LIMITED

January 29, 1985

Dr. John Webster
Dean of Graduate Studies
Simon Fraser University
Burnaby, B. C.
V5A 1S6

Dear Dr. Webster:

It is a pleasure for me to have this opportunity to comment upon the proposal for part-time graduate studies in Engineering.

I am relatively new to this community, but I have been an outspoken advocate in other jurisdictions on behalf of increased interaction between universities and industry. Programmes such as that proposed by the Engineering Science Faculty at Simon Fraser University are excellent, practical vehicles for such interaction, providing effective feedback to ensure the contemporary content of the Faculty's curriculum.

I have read the draft proposal which I found to be a very pragmatic, no-nonsense document. I support the notion of dual thrusts in the programme and I agree that they are not only complementary, but essential integral components of a comprehensive, meaningful programme.

The M.A.Sc. is important, but as an employer, it is the M. Eng. which is of particular interest. There is absolutely no question of the need for a programme such as this, if the University is to provide those currently employed, with an opportunity to upgrade their knowledge base, without compromising their existing careers. We employ a large number of engineers at Microtel Pacific Research Limited and as an employer, it is in our best interest to encourage our employees to expand and to update their qualifications. Indeed, in an industry such as ours where technological obsolescence is a major factor in every business plan, we cannot afford to have anything less than the most contemporary levels of technology amongst our technical staff.

8999 Nelson Way, Burnaby, British Columbia, Canada V5A 4B5 604 291-1471

Clearly the necessity of remaining current in our technical skill inventory is such that we are taking initiatives to-day in the absence of the proposed programme. We will continue to do that even with the proposed programme in place, since there are certain areas of technology where it behooves us to remain in advance of the University. This of course is where the real strength of interaction can occur for programmes such as this, with highly leveraged synergy emerging through the contributions of both the Faculty and industry.

In closing, it is essential in order to meet the goal of a viable advanced technology sector in the Provincial economy, that we establish a critical mass of engineering expertise. We have succeeded in doing so at Microtel Pacific Research, but the creation of a part-time graduate programme of distinguished calibre, will do much to assist us in maintaining our momentum. For that reason, I wish to formally indicate my support for this new initiative of the Engineering Science Faculty and to wish it a warm reception before whatever approval bodies it must appear.

Yours sincerely,

Bruce G. Hartwick

Bruce G. Hartwick
President

BGH/ma

MOBILE DATA
INTERNATIONAL INC.

Riverside Industrial Park
Richmond, B.C., Canada V7A 4Z3
Telephone (604) 277-1511
Telex 04-355865

February 5, 1985

Dr. Webster,
Simon Fraser University,
Burnaby, B.C.
V5A 1S6

Dear Dr. Webster:

We have reviewed a proposal for a Master's Program in Engineering forwarded to us by Dr. Jim Cavers. Our industry has had experience with the programs at Carleton and Ottawa University and the results have been an unqualified success. Such training equips the qualified student with systems knowledge rather than dwelling upon circuit or coding details. It is this systems knowledge that plays a very important part in our industry.

Furthermore, we strongly endorse the "M.Eng. Project" and see this as a vehicle for enhancing industry - university co-operation and technology transfer.

Altogether we feel this proposal is timely and support it most strongly.

Yours sincerely,

MDI MOBILE DATA INTERNATIONAL INC.

Dr. Robert Orth,
Director of Engineering.

RO/dt

MICROTEL

March 4, 1985

Dr. John Webster
Dean of Graduate Studies
Simon Fraser University
Burnaby, B.C.
V5A 1S6

Dear Dr. Webster:

I was asked to review the draft proposal on part-time graduate studies in engineering at SFU and provide my comments directly to you.

I am delighted to see that the SFU Faculty of Engineering Sciences is taking the initiative to fulfill a long standing void in the B.C. industrial community by providing a part-time graduate program. I am sure you will concur with me that the only way high-tech industries like Microtel and Microtel Pacific Research can maintain their leadership and competitive edge is by continuously keeping up with innovation and technological changes. Man-power is our most important resource and we try our best to recruit the cream-of-the-crop from all the Universities in Canada. However, due to rapid growth and evolution of technology in industries like ours, there is a constant and critical need for continuous updating and upgrading of the knowledge base of professionals. Although currently a few individuals take a leave of absence to return to Universities for higher degrees, a vast majority of them have to depend on seminars and crash-courses due to a lack of part-time graduate engineering programs in the greater Vancouver area. I know from personal contacts both in Microtel and MPR that a vast number of the professionals will welcome this opportunity to up grade their degree or refurbish their knowledge base by taking a selected number of graduate courses in the proposed part-time graduate program at SFU. I am sure this applies to a growing number of other high-tech industries in the greater Vancouver area. I therefore strongly support the implementation of the proposed part-time graduate engineering program.

While I was working at Bell Northern Research in Ottawa (1973 - 1980), I taught a graduate course for 3 years in the System Engineering Department of Carlton University. A majority of the students in my classes were from the industry and were enrolled to complete graduate degrees on a part-time basis. The industry students were not only committed and extremely motivated, they demanded value for their money (or their companies). Most of all they brought pragmatic and practical perspectives to the class rooms which enriched everyone, particularly the full-time graduate students of the faculty. I can assure you that the reputation of the system engineering programs in Ottawa and Carlton Universities and the success of many of the high-tech companies in Ottawa is largely due to the unique symbotic process created via the part-time graduate programs. The programs not only served to continuously update the valuable manpower resources, but also created an exciting learning environment by bringing together the full-time faculty members, sessional lecturers from industries, full-time students, and the part-time students from the neighboring high-tech communities.

If British Columbia is to maintain and attract high-tech industries, and most of all compete on an equal footing with provinces like Ontario, it is imperative that a program like the one proposed by SFU Faculty of Engineering Sciences is given top priority.

I endorse the courses proposed in the program and I am assuming that other essential courses will be introduced as the program and teaching resources grow both within and outside the University. Transfer of credits to and from UBC and the University of Victoria is, in my view, an essential element for the success of the program. The program does propose and I fully endorse a good mixture of qualified lecturers from industries and a comprehensive program to ensure that these outside sessional lecturers are well integrated with the faculty (aware of departmental objectives, needs, values and performance criteria).

To ensure that a large percentage of the industries in B.C. derive benefit from this program, I recommend that some of the courses be offered at a SFU campus closer to the city. Although Microtel and MPR are fortunate to be physically close to the SFU campus in Burnaby, it is rather far away from many companies in the Vancouver area. I realize the difficulties associated with offering a course in downtown Vancouver. However, I believe that a compromise solution may be available which will encourage greater participation.

In conclusion, let me again emphasize that I fully endorse the program and I hope that your University community will do its utmost to ensure that the program is approved and is a success. If you require any assistance either from me or my company, please do not hesitate to contact me.

Regards,

S. HUSSAIN
Vice President Strategic Product Planning.

SH:lsp