S.88-47

SIMON FRASER UNIVERSITY

MEMORANDUM

To: Senate

From: J.W.G. Ivany
Chair, SCAP

Subject: School of Engineering Science - Curriculum revisions

Date: November 17, 1988

Action undertaken by the Senate Committee on Academic Planning/Senate Committee on Undergraduate Studies gives rise to the following motion:

Motion:

that Senate approve and recommend approval to the Board of Governors curriculum changes in the School of Engineering Science as set forth in S.88-47 including

1) New Courses:

ENSC 385-4 Real Time Systems
ENSC 485-4 Modelling and Measurement

2) Deletion of:

ENSC 380-4 Production Systems

and

3) changes to the degree requirement description and typical schedules including the deletion of the options "Robotics and Control" and "Manufacturing Systems" within the Engineering Science curriculum, and the addition of a new option "Automation Engineering".

COURSE DETAILS

1. Introduction to RT Systems What is a real-time system ? Examples. System characteristics. Costs, problems and solutions.

2. RT System Design Design process overview. Analysis of system requirements and functional specifications. Representation of system control flow, data flow and functions. Functional decomposition and modular designs. Estimates of development costs and system specifications.

3. Hardware Basics A review of the basic elements of a typical microprocessor. The 8086/8088 will be used to illustrate machine architecture, addressing modes, memory organization, various types of interrupts (external, internal, software) etc.

4. Interrupts Interrupts are covered in details ranging from simple single interrupts to multiple interrupts with vectoring and priority encoding. The operations and applications of the 8259A Programmable Interrupt Controller will be discussed. Techniques in writing interrupt handlers will be addressed followed by the implementation of a terminal emulation program capable of handling multiple interrupts.

5. Data Structure Basics and Program Organization A quick review on data structures that would be used later on in the course. Arrays, stacks (LIFO, FIFO), queues, linked lists and trees will be discussed, emphasising the difference between the use of data structures and their implementation. General guidelines on writing programs that are clear, complete and functional are presented.

6. Programming Methodology Reviews standard programming methodology and its purpose. Divide-and-conquer, modularity, top-down design are covered along with additional techniques for concurrent programming.

7. Synchronization Basics Introduces the basic principles of concurrence, buffers, mutual exclusion, semaphores and critical sections.

8. Concurrent Processing Provides a more formal definition of concurrence through the use of multiple independent cooperating tasks. Examines various means of achieving this through intertask communications and synchronization. Also examined are the danger of deadlocks and means of avoiding them.

9. Real-Time Operating System Structure Defines tasks by their component parts and shows how concurrent processing is implemented on a single processor through context switching arbitrated by a task schedular. Included are scheduling algorithms and dynamic task creation and destruction. The

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 385 Credit Hours: 4 Vector: 2.0.4

Title of Course: Real Time Systems

Calendar Description of Course: Project planning, including design- and functional- specifications, as well as cost and time estimation in software design. Interfacing with the external world through ports and interrupt handling from low- and high-level languages. Review of operating system fundamentals as they apply to real-time operating systems. Comparison of real-time, single-tasking, and time-share operating systems. The use of microcontrollers as building blocks to solve real-time problems. Laboratory work is included in this course.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): CMPT 201 and 290

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

2. Scheduling:

How frequently will the course be offered? 1 or 2 times per year

Semester in which the course will first be offered? 90-1

Which of your present faculty would be available to make the proposed offering possible? Lab engineers through sessional appointments.

3. Objectives of the Course: The course will concentrate on the problems encountered when attempting to use computers in real-time and embedded applications, where the computer system must discern the state of the real world and react to it within stringent response time constraints. Both design methodology and practical implementation techniques will be presented.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas: None

Faculty	This course has been offered as a special topics course for several years. No new resources are required.
Staff	
Library	
Audio Visual	
Space	
Equipment	

5. Approvals

Date: 29/8/88 — Department Chairman

29/9/88 — Dean

11/15/88 — Chairman, SCUS

ENSC 385-4 Real Time Systems

PREREQUISITE: CMPT 201 AND 290

OBJECTIVE

The course will concentrate on the problems encountered when attempting to use computers in real-time (RT) and embedded applications, where the computer system must discern the state of the real world and react to it within rather stringent response time constraints. The course will attempt to present both design methodology and practical implementation techniques.

COURSE OUTLINE

This course will cover the following topics. These topics may be modified and others may be added depending on the interest of the class.

Introduction to RT Systems: General overview.

RT System Design: System level design methods and techniques.

Hardware Basics: Microprocessor architecture.

Interrupts: Single and multiple interrupts and example systems.

Data Structure Basics: Arrays, stacks, LIFO, FIFO, lists and trees.

Synchronization: Mutual exclusion, critical regions, semaphores.

Concurrent Processing: Intertask communication and synchronization (semaphores and messages), deadlocking.

RT O/S Structure: Scheduler, task allocation, task table and context switching.

RT Programming Techniques and Related Algorithms: Memory allocation, sorting, searching, order of complexity and time saving techniques.

COURSE POLICY

The grading for the course will be based on about six homeworks (30%), a project (40%) and a final take-home examination (30%). The homework will be based on the materials and extensions of ideas in the lectures. The project forms a substantial part of the course.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information — Department: Engineering Science

Abbreviation Code: ENSC Course Number: 485 Credit Hours: 4 Vector: 2.0.4

Title of Course: Modelling and Measurement

Calendar Description of Course: Modelling and measurement is intended to develop facility in both analytical and experimental study of static and dynamic systems. The approach emphasises learning by example, with general techniques being introduced as the need arises. All examples include an experimental component. The selection of experiments serves both to provide practical experience with generally applicable methods, and to conduct a broad survey of physical effects and instrumentation. Estimation of uncertainty and careful comparison of model with experiment are stressed throughout the course. As the course proceeds the burden of experimental design passes from instructor to student, so that in the latter part of the course the student completes an independent project in modelling and experimental investigation.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 382

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

2. Scheduling:

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

Semester in which the course will first be offered? 89-3

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

3. Objectives of the Course: To develop facility in both analytical and experimental study of static and dynamic systems.

4. Budgetary and Space Requirements (for information only)
What additional resources will be required in the following areas: None

Faculty	Much of the material in this course has been offered elsewhere in the program in the past. Sufficient experimental equipment now exists to operate the laboratory component.
Staff	
Library	
Audio Visual	
Space	
Equipment	

5. Approvals

Date: 29/5/88	29/5/88	11/15/88
Department Chairman	Dean	Chairman, SCUS

ENSC 485-4 Modelling and Measurement

PREREQUISITE: ENSC 382

OUTLINE

MODELLING AND MEASUREMENT is intended to develop facility in both analytical and experimental study of static and dynamic systems. The approach emphasises learning by example, with general techniques being introduced as the need arises. All examples include an experimental component. The selection of experiments serves both to provide practical experience with generally applicable methods, and to conduct a broad survey of physical effects and instrumentation. Estimation of uncertainty and careful comparison of model with experiment are stressed throughout the course. As the course proceeds the burden of experimental design passes from instructor to student, so that in the latter part of the course the student completes an independent project in modelling and experimental investigation.

TYPICAL EXPERIMENTS

1. Inertia measurement by pendulum swinging
   - order-of-magnitude estimation (of drag)
   - systematic and random variables
   - the experimental datum as a random variable; additive noise
   - accuracy and error estimation

2. Wobbling of a slender object
   - linearised 2nd order DE with unstable eigenvalues
   - modelling of support transfer
   - 2 levels of experimental investigation
   - dynamic range and bandwidth
   - parameter extraction by least-squares fit
   - model refinement in light of experimental results
   - use of results to design an "optimised" slope sensor

3. Static beam bending
   - formulation for various loading and boundary conditions
   - sketching (propagation of constraints)
   - deflected shape measurement for low- and high-stiffness beams

4. Dynamic beam bending
   - addition of inertial terms to static analysis: PDE's and modes
   - measuring techniques for frequency and dynamic mode shape
   - statistics of functions of random variables
   - impulsive *vs* resonant forcing

5. Thermal reservoir
   - mechanisms of heat transfer

- approximations for experimental apparatus
- static and dynamic temperature distributions
- measurement techniques

6. Draining standpipe
   - discrimination between important and ancillary effects
   - order-of-magnitude estimates for multiple effects & terms
   - approximations appropriate for different sets of experimental apparatus
   - instrument selection
   - variation of fluid properties
   - planning techniques for experiment and data analysis

7. Fluid reservoir with thermal transients
   - order-of-magnitude estimates for transient times
   - adiabatic and isothermal processes
   - heat transfer mechanisms
   - dimensional analysis: predicting trends with variation of experimental apparatus
   - absolute transducer calibration

8. Damping in a pneumatic actuator
   - identification of candidate dissipation mechanisms
   - order-of-magnitude estimation for various devices
   - experimental design

9. Large-angle pendulum
   - solution of nonlinear DE by perturbation methods
   - order of approximation
   - design of test apparatus
   - error budgeting

10. Passive dynamic walking
    - isolation of phenomena
    - simplified prototype systems
    - measurement of an unstable mode of a coupled pendulum
    - limit cycling
    - linearisation about a trajectory

11. Fatigue failure
    - latin-square experimental protocol
    - experimental controls
    - hypothesis testing

12. Aircraft pitch/heave (example project)
    - development of equations of motion
    - order-of-magnitude parameter estimation
    - experimental design for parameter measurement
    - data reduction

I. CHANGES TO DEGREE REQUIREMENTS DESCRIPTION

| Indicates where the text has changed.

The B.A.Sc. Program in Engineering Science June 13, 1988

Students who study Engineering Science develop skills in systems design along with a high level of scientific knowledge. The program is demanding and is aimed at the superior student. The goal of the program is to produce well educated, innovative engineer/scientists who have entrepreneurial skills and attitudes and who are oriented to the new technologies. Entry to the program is on a competitive basis and once admitted to Engineering Science, students must maintain a cumulative grade point average of 3.0 ('B') to remain in the program.

To obtain the degree, students undertake a basic core program of pure, applied and engineering sciences followed by studies in a specialized option.

The School of Engineering Science began offering courses in September, 1983. The overall plan for the School is to have three major areas of concentration. They are:

Core A - Computing, microelectronics and communications.
Core B - Industrial automation, control and robotics and computer-aided design and manufacturing.
Core C - Chemical and biochemical processing and biotechnology.

At present, Core A and Core B are operational. Core C will be phased in over the next few years.

In all Engineering Science courses, computers receive major emphasis as tools for learning, conceptualization, design and analysis. Built into the program are courses on social impacts of technology, finance, management, design methods and entrepreneurship intended to complement scientific studies. A special, integrated communications course taken throughout the eight academic semesters ensures that all S.F.U. Engineering Science graduates have the communication skills necessary to be effective as engineers.

Industrial Internship

Every student in the Engineering Science program must complete an internship involving at least three work semesters and a thesis project. This results in a combination of work in an appropriate industrial or research setting with study in the chosen option. In the final phase of the program intensive specialized study is coupled with a project under the direction of a practicing engineer or scientist.

Typically, following the sixth academic semester, the student will be given the opportunity for placement in a job appropriate to his/her stated interests to work on a major project. In the seventh semester the student will take courses to help complete work on that project and prepare a formal thesis proposal. The thesis is written in the final semester of the program when the student will be taking classes part-time and working part-time on the thesis project. When appropriate, other patterns of work and study can be adopted.

The School also offers the opportunity to participate in additional work semesters throughout the program to give students further valuable experience and the chance to investigate their career choices. The internships will be administered through the School Internship Co-ordinator whose responsibility is to find and maintain appropriate work placements.

Requirements for the Bachelor of Applied Science Degree

1. A minimum of 160 semester hours credit in basic science, general studies, engineering science, specialized engineering and science, plus project and laboratory work.

2. A Graduation Grade Point Average of at least 3.0 calculated on the required 160 semester hours, or on the 80 semester hours of upper division credit.

3. Completion of an internship. This consists of at least three semesters of practical experience in an appropriate industrial or research setting leading to a project under the technical direction of a practicing engineer or scientist. The internship may take place within the University but in most cases the work site is remote from the university. A member of the external organization and a faculty member from the School jointly supervise the project.

   ENSC 498-3 Engineering Science Thesis Proposal is normally taken during the seventh academic semester. During ENSC 499-9 the student engages in supervised study and practical work in research, development or advanced engineering. A project thesis based on this activity must be submitted.

4. A specialized program of study must be completed in one of five options: Electronics Engineering, Computer Engineering, Engineering Physics, Biomedical Engineering and Automation Engineering. These are listed below on a semester-by-semester basis although there is no strict requirement to follow the sequence of these typical programs. However, any semester's registration less than 15 semester hours must be approved by the Director and students departing from these sequences must be careful about scheduling and prerequisite problems they may face in subsequent semesters.

5. General Studies - This section of the program is made up of non-technical courses intended to broaden the student's education and develop an awareness of general social, economic and managerial factors which affect engineering and scientific work. All units of the engineering communication course must be completed. One course must deal with the interaction of science and technology with society. The other complementary studies courses may also deal with this subject or may be chosen from the areas of administration, arts, humanities or social sciences. Particular course requirements are:

	semester hours
ENSC 101 to ENSC 108 Engineering Communications	6
ENSC 300 Engineering Design & Management	3
ENSC 301 Engineering Economics	3
ECON 200 Principles of Economics (I) Microeconomic Principles	3
A course dealing with the interaction between society and technology and a course sequence in complementary studies	12
	27

II. SUMMARY OF CHANGES TO TYPICAL SCHEDULES

Delete Options: Robotics and Control
Manufacturing Systems

New Option: Automation Engineering

Common Core
- Semester 3: move Math 232 to semester 4
  require Math 310
- Semester 4: move Cmpt 390 to semester 5
  require MACM 316
- Add footnote for Eng'g Physics re: Math 252

All Options
- changes resulting from 280-382-327
- switched 300/301 around
- addition of 485 to ENSC electives
- addition of Special Project Lab as possible ENSC elective

Electronics
- 2nd Math elective defined as MATH 252

Math Con.
- changes resulting from changes in Math Dept. & to common core and electronics option.

Eng. Physics
- Footnote removed - reference was deleted in previous calendar

INSERT: FAS-UCC #88-10 HERE.

ENGINEERING SCIENCE COMMON CORE

June 13, 1988

COURSES AND TYPICAL SCHEDULE

SEMESTER ONE

CHEM 102-3	General Chemistry I for Physical Sciences
CHEM 115-2	General Chemistry Laboratory I
Cmpl I-3	first complementary studies elective
*CMPT 101-4	Introduction to High Level Programming Language
*ENSC 101-0	Engineering Communications I
*MATH 151-3	Calculus I
*PHYS 120-3	Physics I

18 semester hours credit

SEMESTER TWO

CHEM 103-3	General Chemistry II for Physical Sciences
*CMPT 105-3	Fundamental Concepts of Computing
*ENSC 102-1	Engineering Communications II
*ENSC 125-5	Basic Electronics Engineering
*MATH 152-3	Calculus II
*PHYS 121-3	Physics II
*PHYS 131-2	General Physics Laboratory

20 semester hours credit

SEMESTER THREE

Cmpl II-3	second complementary studies elective
*CMPT 290-3	Introduction to Digital Circuit Design
*ENSC 103-1	Engineering Communications III
*ENSC 222-5	Electronic Design I
*MATH 251-3	Calculus III
MATH 310-3	Introduction to Ordinary Differential Equations(1)
*Scie I-3	first science elective(2)

21 semester hours credit

SEMESTER FOUR

*CMPT 201-4	Data and Program Organization
ECON 200-3	Principles of Economics I - Microeconomic Principles
*ENSC 104-1	Engineering Communications IV
*ENSC 280-5	Linear Systems I
MACM 316-3	Numerical Analysis I(1)
*MATH 232-3	Elementary Linear Algebra
*STAT 270-3	Introduction to Probability and Statistics

22 semester hours credit

* course which should be taken at this point in the program (consequences of deviations from this schedule are the responsibility of the student).

(1) Students in Engineering Physics should replace one of these courses with MATH 252-3. All students may apply to the Director for permission to take alternate mathematics courses.

(2) For Electronics Engineering and Engineering Physics, PHYS 221-3 is a required prerequisite and should be taken here. For Automation Engineering, MATH 262-4 should be taken here.

MATHEMATICS CONCENTRATION

The Electronics Engineering program includes a concentration in Mathematics as an optional field of study. It is recommended that students interested in Mathematics utilize their elective courses as follows:

Scie I-3 & Scie II-3 & Scie III-3	three of:	MATH 308-3 Linear Programming MATH 309-3 Continuous Optimizations MATH 322-3 Complex Variables STAT 380-3 Introduction to Stochastic Processes
Cmpt I-3	MATH 243-3 Discrete Mathematics	
Cmpt II-3	open Computing Science elective	
Ensc I-4	as specified for Electronics Engineering	
Ensc II-4	"	
Ensc III-4	"	

ELECTRONICS ENGINEERING

COURSES AND TYPICAL SCHEDULE

SEMESTER FIVE

Cmpl III-3	third complementary studies elective
Cmpt I-3	first Computing Science elective
*CMPT 390-3	Digital Circuits and Systems
*CMPT 391-3	Microcomputer Hardware Workshop
*ENSC 105-1	Engineering Communications V
*ENSC 382-4	Linear Systems II
MATH 252-3	Vector Calculus

20 semester hours credit

SEMESTER SIX

Cmpt II-3	second Computing Science elective
*ENSC 106-1	Engineering Communications VI
ENSC 301-3	Engineering Economics
*ENSC 327-4	Communication Systems
*ENSC 385-4	Real-Time Systems
*PHYS 324-3	Electromagnetics
Scie II-3	second science elective(3)

21 semester hours credit

SEMESTER SEVEN

Ensc I-4	first Engineering Science elective(4)
Ensc II-4	second Engineering Science elective(4)
*ENSC 107-1	Engineering Communications VII
*ENSC 300-3	Engineering Design and Management
*ENSC 321-4	Electronic Design II
ENSC 498-3	Engineering Science Thesis Proposal
Scie III-3	third science elective(3)

22 semester hours credit

SEMESTER EIGHT

Cmpl IV-3	fourth complementary studies elective
Ensc III-4	third Engineering Science elective(4)
ENSC 108-0	Engineering Communications VIII
ENSC 499-9	Engineering Science Undergraduate Thesis

16 semester hours credit

TOTAL 160 semester hours credit

(3) an approved course in a basic, applied or mathematical science

(4) chosen from:

ENSC 423-4	ENSC 429-4	ENSC 439-4	CMPT 495-3
ENSC 425-4	ENSC 435-4	ENSC 480-4	CMPT 496-4
ENSC 426-4	ENSC 436-4	ENSC 485-4	
ENSC 428-4	ENSC 438-4		

With permission, one or more Directed Studies or Special Project Laboratory courses may be chosen in this elective category.

COMPUTER ENGINEERING

COURSES AND TYPICAL SCHEDULE

SEMESTER FIVE

Cmpl III-3	third complementary studies elective
Cmpt I-3	first Computing Science elective[5]
*CMPT 205-3	Introduction to Formal Topics in Computing Science
*CMPT 390-3	Digital Circuits and Systems
*CMPT 391-3	Microcomputer Hardware Workshop
*ENSC 105-1	Engineering Communications V
*ENSC 382-4	Linear Systems II

20 semester hours credit

SEMESTER SIX

Cmpt II-3	second Computing Science elective[5]
*CMPT 400-3	Hardware Architecture
*ENSC 106-1	Engineering Communications VI
ENSC 301-3	Engineering Economics
*ENSC 327-4	Communication Systems
*ENSC 385-4	Real-Time Systems
Scie II-3	second science elective[3]

21 semester hours credit

SEMESTER SEVEN

*CMPT 401-3	Operating Systems
Ensc I-4	first Engineering Science elective[4]
Ensc II-4	second Engineering Science elective[4]
*ENSC 107-1	Engineering Communications VII
*ENSC 300-3	Engineering Design and Management
*ENSC 321-4	Electronic Design II
ENSC 498-3	Engineering Science Thesis Proposal

22 semester hours credit

SEMESTER EIGHT

Cmpl IV-3	fourth complementary studies elective
ENSC 108-0	Engineering Communications VIII
*ENSC 429-4	Discrete Time Systems
ENSC 499-9	Engineering Science Undergraduate Thesis

16 semester hours credit

TOTAL 160 semester hours credit

(3) An approved course in a basic, applied or mathematical science

(4) Chosen from:

ENSC 423-4	ENSC 429-4	ENSC 439-4	CMPT 495-3
ENSC 425-4	ENSC 435-4	ENSC 480-4	CMPT 496-4
ENSC 426-4	ENSC 436-4	ENSC 485-4	
ENSC 428-4	ENSC 438-4		

With permission, one or more Directed Studies or Special Project Laboratory courses may be chosen in this elective category.

(5) In addition to CMPT or MATH courses, as appropriate, students may elect from: MACM 401-3 Switching Theory and Logical Design
MACM 402-3 Automata and Formal Languages

ENGINEERING PHYSICS (ELECTRONICS)

COURSES AND TYPICAL SCHEDULE

SEMESTER FIVE

Cmpl III-3	third complementary studies elective
*CMPT 390-3	Digital Circuits and Systems
*CMPT 391-3	Microcomputer Hardware Workshop
*ENSC 105-1	Engineering Communications V
ENSC 301-3	Engineering Economics
*ENSC 382-4	Linear Systems II
*PHYS 211-3	Intermediate Mechanics

20 semester hours credit

SEMESTER SIX

Cmpl IV-3	fourth complementary studies elective
*ENSC 106-1	Engineering Communications VI
*ENSC 327-4	Communication Systems
*PHYS 324-3	Electromagnetics
*PHYS 344-3	Thermal Physics
*PHYS 355-3	Optics
*PHYS 385-3	Quantum Physics

20 semester hours credit

SEMESTER SEVEN

Ensc I-4	first Engineering Science elective(3)
Ensc II-4	second Engineering Science elective(3)
*ENSC 107-1	Engineering Communications VII
*ENSC 300-3	Engineering Design and Management
*ENSC 321-4	Electronic Design II
*ENSC 495-1	Introduction to Microelectronic Fabrication
ENSC 498-3	Engineering Science Thesis Proposal

20 semester hours credit

SEMESTER EIGHT

ENSC 108-0	Engineering Communications VIII
Ensc III-4	third Engineering Science elective(3)
ENSC 499-9	Engineering Science Undergraduate Thesis
Scie II-3	second science elective(4)
Scie III-3	third science elective(4)

19 semester hours credit

TOTAL 160 semester hours credit

(3) Chosen from:

ENSC 423-4	ENSC 429-4	ENSC 439-4	CMPT 495-3
ENSC 425-4	ENSC 435-4	ENSC 480-4	CMPT 496-4
ENSC 426-4	ENSC 436-4	ENSC 485-4	
ENSC 428-4	ENSC 438-4		

With permission, one or more Directed Studies or Special Project Laboratory courses may be chosen in this elective category.

(4) Chosen from: PHYS 365-3, PHYS 455-3, PHYS 465-3

PROPOSED NEW OPTION

AUTOMATION ENGINEERING

SEMESTER FIVE

Cmpl III-3	third complementary studies elective
CMPT 305-3	Computer Simulation & Modelling
*ENSC 105-1	Engineering Communication V
ENSC 301-3	Engineering Economics
*ENSC 330-4	Engineering Materials
*ENSC 382-4	Linear Systems II
STAT 330-3	Linear Models in Applied Statistics

21 semester hours credit

SEMESTER SIX

*ENSC 106-1	Engineering Communications VI
*ENSC 385-4	Real Time Systems
*ENSC 436-4	Manufacturing Processes
*ENSC 480-4	Industrial Engineering
PHYS 344-3	Thermal Physics
Scie II-3	second science elective(3)

19 semester hours credit

SEMESTER SEVEN

Ensc I-4	first Engineering Science elective(4)
*ENSC 107-1	Engineering Communications VII
*ENSC 300-3	Engineering Design & Management
*ENSC 423-4	Modern Control Theory
*ENSC 439-4	Computer Aided Design & Manufacturing
ENSC 498-3	Engineering Science Thesis Proposal

19 semester hours credit

SEMESTER EIGHT

Cmpl IV-3	fourth complementary studies elective
Ensc II-4	second Engineering Science elective(4)
Ensc III-4	third Engineering Science elective(4)
ENSC 108-0	Engineering Communications VIII
ENSC 499-9	Engineering Science Undergraduate Thesis

20 semester hours credit

TOTAL 160 semester hours credit

(3) An approved course in a basic, applied or mathematical science.

(4) Chosen from:

ENSC 429-4	ENSC 460-4
ENSC 438-4	ENSC 485-4
ENSC 435-4	CMPT 351-3

With permission, one or more Directed Studies or Special Project Laboratory courses may be chosen in this category.

III. SUMMARY OF CHANGES TO CURRENT COURSES

Course		CHANGE			
		Descrip.	Title	Prereq.	Vectors
125	Basic Electronics	X	X		
280	Linear Systems I	X	X	X	
300	Eng'g Design			X	
327	CMNS Systems			X	
330	Eng'g Materials	X			X
382	Linear Systems II	X	X		
423	Modern Control Syst.	X		X	X
428	Data Communications			X	
429	Discrete Time Systems			X	
435	Design'g for Reliability		X	X	
436	Mfg. Processes			X	X
438	Intro to Robotics	X	X		X
439	CAD & Mfg.	X	X		X
480	Industrial Eng'g	X		X	X

COURSE DELETION

380 Production Systems

CHANGES TO: Calendar Description
Title

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
CHANGE
[redacted] COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 125 Credit Hours: 5 Vector: 3,0,4

Title of Course: Basic Electronics and Instrumentation

Calendar Description of Course: Nature and properties of electrical circuits; linearity and superposition; Thevenin and Norton Theorems. DC circuits. AC signals and phasors. AC steady state circuit analysis: impedance, admittance and transfer properties; frequency response; detailed treatment of first order (RL and RC) circuits; properties of LCR circuits. Basic characteristics of diodes and the transistor as a switch, with applications. Introduction to transient response. Fundamentals of simple measurements, units, basic standards, accuracy, precision, uncertainty, measurement errors, sources of errors, different error types; complex measurements, electrical measurements of nonelectrical quantities, transduction theory and physical transducers; instrumentation. Two semester-hours credit in laboratory work is included in this course.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): Corequisite: PHYS 121, 131, MATH 152

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

NO CHANGES

3. Objectives of the Course

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

5. Approvals

Date: June 14/88 — 11/15/88

Department Chairman — Dean — Chairman, SCUS

CHANGES TO: Prerequisites

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

CHANGE COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 300 Credit Hours: 3 Vector: 2,2,0

Title of Course: Engineering Design and Management

Calendar Description of Course: An introduction and overview of modern concepts of engineering design, problem solving and management. Material is presented through lectures, seminars, case studies, and historical review. Studies involve the interrelationship of such factors as problem definition, feasibility studies, specification, constraints, analysis techniques, evaluation, production, project management, conflict resolution, techniques of supervision. Student participation is expected through presentations of independent readings, case analyses and group projects.

Nature of Course: Lecture/Seminar

Prerequisites (or special instructions): ENSC 301

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

NO CHANGES

3. Objectives of the Course

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

5. Approvals

Date: 14 June/88 — 11/15/88

Department Chairman — Dean — Chairman, SCUS

CHANGES TO: Calendar Description
Title
Prerequisites

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
CHANGE
[redacted] COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 280 Credit Hours: 5 Vector: 3,0,4

Title of Course: Linear Systems I

Calendar Description of Course: Properties of linear systems, with examples taken from a variety of physical processes. Linearity and linearization. Time domain analysis: step and impulse responses, the convolution input/output relation; differential equations and finite order systems. Laplace transform analysis for finite order systems; pole-zero diagrams; simulation diagrams, block diagrams. Modelling and approximation of physical systems. Much of the material is presented in a project-oriented lab environment.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 125, 222 Corequisite: ENSC 104

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

3. Objectives of the Course

No Changes

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

5. Approvals

Date: 14 June 88

Department Chairman	Dean	Chairman, SCUS
		11/15/88

CHANGES TO: Prerequisites

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

CHANGE
COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 327 Credit Hours: 4 Vector: 3,0,2

Title of Course: Communication Systems

Calendar Description of Course: Representation of signals; Fourier series and transforms; time and frequency convolution. Amplitude modulation: circuits and systems, single sideband, vestigal sideband. Angle modulation: phase and frequency modulation, circuits and systems. Representation of random signals: correlation, power spectra, processing in linear systems. Effect of noise on different modulation sytems, thresholds in FM, system design and link budgets. Digital modulation techniques and basics of detection. Laboratory work is included in this course.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 382 and STAT 270

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

No Changes

3. Objectives of the Course

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

5. Approvals

Date: 14 June/88		11/15/88
Department Chairman	Dean	Chairman, SCUS

Changes to: Calendar Description
Vector

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
CHANGE
[redacted] COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 330 Credit Hours: 4 Vector: 3,0,2

Title of Course: Engineering Materials

Calendar Description of Course:
An introductory course in materials science which covers materials - their structures, properties, and performance; crystal structures and instruments for structure determination; polymers, ceramics, composites; quality control and reliability.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): CHEM 103, PHYS 121

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

No CHANGES

3. Objectives of the Course

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

5. Approvals

Date: 14 June/88 11/15/88

Department Chairman | Dean | Chairman, SCUS

CHANGES TO: Calendar Description
Title

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
CHANGE
COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 382 Credit Hours: 4 Vector: 3,0,2

Title of Course: Linear Systems II

Calendar Description of Course: Brief review of continuous and discrete time systems and the Laplace transform. Z-transform, properties, transfer function representation, transform of input/output difference equations an applications. Stability of continuous and discrete time systems, Routh stability test and Bode plots. Fourier series and Fourier transforms, properties, signal representations, systems, discretization and design of digital filters. State variable representation of continuous and discrete systems. Examples of introductory control and communication problems are presented throughout. Laboratory work is included in this course.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 280

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

NO CHANGES

3. Objectives of the Course

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

5. Approvals

Date: 14 June/88 — 11/15/88

Department Chairman — Dean — Chairman, SCUS

CHANGES TO: Prerequisites

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

[redacted] CHANGE COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 428 Credit Hours: 4 Vector: 3.0.2

Title of Course: Data Communications

Calendar Description of Course: Channel models and detection techniques for digital signalling, including telephone channels, carrier and bit synch, equalization. Retransmission error control: HDLC as a model, software implementation methods and performance analysis. Forward error correction: Hamming, cyclic and convolutional codes, Viterbi algorithm. Packet network and local area network operation, interfaces, design and performance. Laboratory work is included in this course.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 327 and 385

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

3. Objectives of the Course No Changes

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

5. Approvals

Date: 14 June/88 — 11/15/88

Department Chairman — Dean — Chairman, SCUS

CHANGES TO: Calendar Description
Prerequisites
Vector

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

[redacted] CHANGE COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 423 Credit Hours: 4 Vector: 3,0,2

Title of Course: Modern Control Systems

Calendar Description of Course: Analytical representation of the finite dimensional linear systems, analysis and design of linear feedback control systems based on the state space model, and state/output feedback. Topics include: review of the linear spaces and operators, mathematical modeling, state space representation and canonical forms, controllability, observability, realization of transfer function, and solution of the state equation. Applications include: stability concepts and definitions, Lyapunov's Direct Method, design of the state and output feedback control systems, eigenspectrum assignment, and state estimator design.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 382, MATH 232 and 310

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

No Changes

3. Objectives of the Course

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

5. Approvals

Date: 14 June/88 11/15/88

Department Chairman

Dean

Chairman, SCUS

CHANGES TO: Prerequisites

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

CHANGE COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 429 Credit Hours: 4 Vector: 3,0,2

Title of Course: Discrete Time Systems

Calendar Description of Course: Discrete time signals and systems, sampling and quantization. The Discrete Fourier Transform and fast transforms. Digital filters, IIR and FIR, design procedures and implementations. Quantization noise in digital filters and transforms. Random signals, the response of linear systems to random signals. Introduction to adaptive systems. Introduction to system architectures for digital signal processing. Laboratory work includes familiarization with digital signal processing software packages.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 382

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

No Changes

3. Objectives of the Course

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

5. Approvals

Date: 14 June/88 11/15/88

Department Chairman

Dean

Chairman, SCUS

CHANGES TO: Title
Prerequisites

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
CHANGE
COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 435 Credit Hours: 4 Vector: 2,0,4

Title of Course: Designing for Reliability

Calendar Description of Course:
Aspects of quality control and reliability in manufacturing environments will be discussed, including stress and strain, failure modes, reliability testing, statistical and experimental methods, and destructive/nondestructive testing.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 330

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

NO CHANGES

3. Objectives of the Course

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

5. Approvals

Date: 14 June/88 — 11/15/88

Department Chairman — Dean — Chairman, SCUS

CHANGES TO: Calendar Description
Title
Vector

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

[redacted] CHANGE COURSE PROPOSAL FORM

1. Calendar Information — Department: Engineering Science

Abbreviation Code: ENSC Course Number: 438 Credit Hours: 4 Vector: 3,0,2

Title of Course: Introduction to Robotics

Calendar Description of Course:
Fundamentals of robotics: mathematical representation of kinematics, dynamics and compliance. Planning and execution of robot trajectories. Feedback from the environment: use of sensors and machine vision. A brief introduction to robot languages. Different application domains for manipulator robots, e.g., assembly, manufacturing, etc.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 382

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

3. Objectives of the Course

No Changes

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

5. Approvals

Date: 14 June/88		11/15/88
Department Chairman	Dean	Chairman, SCUS

CHANGES TO: Prerequisites
Vector

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

[redacted] CHANGE COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 436 Credit Hours: 4 Vector: 3,0,2

Title of Course: Manufacturing Processes

Calendar Description of Course:
The principles of manufacturing unit processes including casting, forming, machining, and joining. Interactions between design, materials (metals, polymers, ceramics) and processes. Advantages and limitation, relative costs and production rates of competitive processes.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 330

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

NO CHANGES

3. Objectives of the Course

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

5. Approvals

Date: 14 June/88 — 11/15/88

Department ~~Chairman~~ — Dean — Chairman, SCUS

CHANGES TO: Calendar Description
Title
Vector

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

[redacted] CHANGE COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC **Course Number:** 439 **Credit Hours:** 4 **Vector:** 3,0,2

Title of Course: Computer Aided Design and Manufacturing

Calendar Description of Course: Survey of methods for computer aided design and manufacturing (CAD/CAM), including experience with basic systems in the laboratory component of the course. The student will be introduced to computer integrated manufacturing and flexible manufacturing systems concepts. The use of finite element modelling and analysis will be presented through examples from thermal studies as well as mechanical stress analysis. Issues in constructing and using integrated CAD/CAM in a production environment will be discussed. Emphasis will be on the use of such techniques in light industry, particularly related to electronics manufacturing. The "Quick Chip" facility will be available for student projects, as will a manufacturing cell consisting of several robots and computer control systems.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): ENSC 105 and 382

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

3. Objectives of the Course — No Changes

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

5. Approvals

Date: 14 June/88 — — 14/15/88

Department Chairman — Dean — Chairman, SCUS

CHANGES TO: Calendar Description
Prerequisites
Vector

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

COURSE CHANGE PROPOSAL FORM

1. Calendar Information — Department: Engineering Science

Abbreviation Code: ENSC Course Number: 480 Credit Hours: 4 Vector: 3,0,2

Title of Course: Industrial Engineering

Calendar Description of Course: A basic course dealing with system engineering and decision making processes, and their applications to complex real world engineering problems. Both deterministic, and probabilistic problems are considered. In the deterministic half of the course topics covered include: Linear programming formulation and solution by graphical and simplex methods, network analysis, transportation problems, dynamic programming, and project scheduling. Sequential Markovian decision processes, inventory, and queueing problems are the probabilistic topics covered.

Nature of Course: Lecture/Laboratory

Prerequisites (or special instructions): MATH 232, 310, Stat 270

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

3. Objectives of the Course

No Changes

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

5. Approvals

Date: 14 June/88 — 11/15/88

Department Chairman — Dean — Chairman, SCUS

FAS-UCC #88-10

SCHOOL OF ENGINEERING SCIENCE
SIMON FRASER UNIVERSITY

M E M O

To: FAS Undergraduate Curriculum Committee

From: Donald A. George, Director
School of Engineering Science

Date: September 28, 1988

Subject: ENSC Curriculum Changes

The following changes are for consideration at the 6 October 1988 meeting of the FAS Undergraduate curriculum committee:

Biomedical Engineering Option

MATH II-3 replaced by ENSC 385-4 Real Time Systems

Sci III-3 replaced by ENSC I-4 Engineering Science elective

ENSC 451 Biomedical Engineering Seminar
course weight reduced from 3 credits to 1 credit to offset the above increases.

Common Core

Footnote re: Scie I-3 has been edited to read as follows:

> For Electronics Engineering and Engineering Physics, PHYS 221-3 is a required prerequisite and should be taken here. For Automation Engineering, MATH 262-4 should be taken here. Students in Biomedical Engineering and Computer Engineering must select an approved basic science course.

Donald A. George

Attachments

BIOMEDICAL ENGINEERING (ELECTRONICS)

COURSES AND TYPICAL SCHEDULE

SEMESTER FIVE

BISC 101-4	Introduction to Biology
*CMPT 390-3	Digital Circuits and Systems
*CMPT 391-3	Microcomputer Hardware Workshop
*ENSC 105-1	Engineering Communications V
*ENSC 382-4	Linear Systems II
KIN. 100-3	Introduction to Human Structure and Function

18 semester hours credit

SEMESTER SIX

BISC 102-4	Introduction to Biology
Cmpl III-3	third complementary studies elective
*ENSC 106-1	Engineering Communications VI
ENSC 301-3	Engineering Economics
*ENSC 327-4	Communication Systems
*ENSC 385-4	Real-Time Systems
Scie II-3	second science elective(3)

22 semester hours credit

SEMESTER SEVEN

Ensc I-4	first Engineering Science elective(4)
*ENSC 107-1	Engineering Communications VII
*ENSC 300-3	Engineering Design and Management
*ENSC 321-4	Electronic Design II
*ENSC 451-1	Seminar in Biomedical Engineering(5)
ENSC 498-3	Engineering Science Thesis Proposal
Scie III-3	third science elective(3)

19 semester hours credit

SEMESTER EIGHT

Cmpl IV-3	fourth complementary studies elective
Ensc II-4	second Engineering Science elective(4)
ENSC 108-0	Engineering Communications VIII
ENSC 499-9	Engineering Science Undergraduate Thesis
Ensc III-4	third Engineering elective(3) (4)

20 semester hours credit

TOTAL 160 semester hours credit

(3) an approved course in a basic, applied or mathematical science of which at least two must be from the following:

- KIN. 305-3 Human Physiology I
- KIN. 306-3 Human Physiology II
- KIN. 401-4 Mechanics of Human Movement
- KIN. 402-4 Mechanical Properties of Tissues
- KIN. 407-3 Human Physiology Laboratory
- KIN. 442-3 Biomedical Systems
- KIN. 480-3 Human Factors in Working Environments

(4) Chosen from: Ensc 423-4 429 439 CMPT 495-3
425-4 435 480 496-3

ENGINEERING SCIENCE COMMON CORE

June 13, 1988

COURSES AND TYPICAL SCHEDULE

SEMESTER ONE

CHEM 102-3	General Chemistry I for Physical Sciences
CHEM 115-2	General Chemistry Laboratory I
Cmpl I-3	first complementary studies elective
*CMPT 101-4	Introduction to High Level Programming Language
*ENSC 101-0	Engineering Communications I
*MATH 151-3	Calculus I
*PHYS 120-3	Physics I

18 semester hours credit

SEMESTER TWO

CHEM 103-3	General Chemistry II for Physical Sciences
*CMPT 105-3	Fundamental Concepts of Computing
*ENSC 102-1	Engineering Communications II
*ENSC 125-5	Basic Electronics Engineering
*MATH 152-3	Calculus II
*PHYS 121-3	Physics II
*PHYS 131-2	General Physics Laboratory

20 semester hours credit

SEMESTER THREE

Cmpl II-3	second complementary studies elective
*CMPT 290-3	Introduction to Digital Circuit Design
*ENSC 103-1	Engineering Communications III
*ENSC 222-5	Electronic Design I
*MATH 251-3	Calculus III
MATH 310-3	Introduction to Ordinary Differential Equations(1)
*Scie I-3	first science elective(2)

21 semester hours credit

SEMESTER FOUR

*CMPT 201-4	Data and Program Organization
ECON 200-3	Principles of Economics I - Microeconomic Principles
*ENSC 104-1	Engineering Communications IV
*ENSC 280-5	Linear Systems I
MACM 316-3	Numerical Analysis I(1)
*MATH 232-3	Elementary Linear Algebra
*STAT 270-3	Introduction to Probability and Statistics

22 semester hours credit

* course which should be taken at this point in the program (consequences of deviations from this schedule are the responsibility of the student).

(1) Students in Engineering Physics should replace one of these courses with MATH 252-3. All students may apply to the Director for permission to take alternate mathematics courses.

(2) For Electronics Engineering and Engineering Physics, PHYS 221-3 is a required prerequisite and should be taken here. For Automation Engineering, MATH 262-4 should be taken here. Students in Biomedical Engineering and Computer Engineering must select an approved basic science course.

Students should note that the prerequisites for several of these courses are not provided in the Biomedical Engineering program. Other sections of this Calendar and, if necessary, the School of Kinesiology should be consulted by students interested in KIN. 305, 306 and 407.

(4) Chosen from:

ENSC 423-4	ENSC 429-4	ENSC 439-4	CMPT 495-3
ENSC 425-4	ENSC 435-4	ENSC 480-4	CMPT 496-4
ENSC 426-4	ENSC 436-4	ENSC 485-4	
ENSC 428-4	ENSC 438-4		

With permission, one or more Directed Studies or Special Project Laboratory courses may be chosen in this category.

(5) will not be given every year; students should take at the earliest opportunity.

Course Weight Reduction

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Engineering Science

Abbreviation Code: ENSC Course Number: 451 Credit Hours: 1 Vector: 0.2.0

Title of Course: Seminar in Biomedical Engineering

Calendar Description of Course: A seminar course dealing with examples, principles and particular problems of engineering applications in medicine. Case studies and visiting participants are featured.

Nature of Course: Seminar

Prerequisites (or special instructions): Upper Division Standing

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

2. Scheduling:

How frequently will the course be offered?

Semester in which the course will first be offered?

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

NO CHANGES

3. Objectives of the Course

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

5. Approvals

Date: 6/16/88 6/16/88 11/15/88

6/16/88

Department Chairman

Dean

Chairman, SCUS