

SIMON FRASER UNIVERSITY

MEMORANDUM

To: Alison Watt, Secretary
Senate Committee on Academic Planning

From: K. Mezei, Acting Dean
Graduate Studies

Subject: New Graduate Course, ENSC 854-3 Date: March 9, 1993

The new graduate course, Ensc 854-3 was approved by the Senate Graduate Studies Committee, at its Meeting on March 8, 1993, and is now being forwarded to the Senate Committee on Academic Planning for approval.

K. Mezei
K. Mezei, Acting Dean
Graduate Studies

mm/
encl.

**SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE
MEMORANDUM**

To: Dr. Bruce Clayman
Dean of Graduate Studies

From: Dr. John D. Jones
Graduate Program Chairman

Date: 11 February 1993

Re: New course ENSC 854 - Integrated Microsensors and Actuators

Please find enclosed a positive response from Ralph Stanton (Collections Librarian) for our new course ENSC 854 " Integrated Micro sensors and Actuators, which was approved from the Faculty of Applied Science Graduate Studies Committee on December 1, 1992.

Thank you.



John D. Jones
Graduate Chairman

Enclosures

/br

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: School of Engineering Science

Course Number: ENSC 854

Title: Integrated Microsensors and Actuators

Description: see attached

Credit Hours: 3

Vector: 3-0-1

Prerequisite: ENSC 453, 370, 495 or permission of instructor

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 5

When will the course first be offered: Fall 1993

How often will the course be offered: Once a year or upon sufficient demand

JUSTIFICATION:

There are 5 faculty members in ENSC and 2 faculty members in Physics involved with the micromachining and sensor research. It is essential to have a graduate course to provide the students with the basics of sensors and actuators, their fabrications and applications. Further, this course will provide the students with a hands-on experience of micromachining technology.

RESOURCES:

Which Faculty member will normally teach the course: M. Parameswaran (Ash)

What are the budgetary implications of mounting the course: appended

Are there sufficient Library resources (append details): appended

Appended:

- a) Outline of the Course
- b) An indication of the competence of the Faculty member to give the course.
- c) Library resources

Approved:

Departmental Graduate Studies Committee: John Jones Date: 24/11/92
 Faculty Graduate Studies Committee: John Jones Date: 10/2/93
 Faculty: _____ Date: _____
 Senate Graduate Studies Committee: Wesley Date: 11/3/93
 Senate: _____ Date: _____

INTEGRATED MICROSENSORS AND ACTUATORS

CALENDAR DESCRIPTION:

Microelectronic transducer principles, classification, fabrication and application areas. Silicon micromachining and its application to integrated microelectronic sensors and actuators. CMOS compatible micromachining. Static, dynamic and kinematic microactuator fabrication. Integrated transducer system design and applications. Students will be required to complete a micromachining project in the microfabrication lab at ENSC.

OUTLINE:

This graduate course provides an indepth look into transduction mechanisms with specific emphasis on the fabrication of integrated microsensors and actuators. Starting from the fundamental transduction principles for electrical, thermal, mechanical, magnetic, radiation and chemical signals, the course will lead into the fabrication of microsensors. Semiconductor transducers, specifically Silicon-based devices will be described. On-chip circuit integration, standard IC process compatibility and system realization will follow. Silicon micromachining concepts and the fabrication of static, dynamic and kinematic structures and their applications to sensors, actuators and resonators will be taught.

Laboratory Sessions will be conducted along with the lectures providing the students with experience in simple micromachining experiments. Depending on the process and equipment that would be functional in the clean-room, a group project on fabricating a simple sensor or actuator will be made mandatory.

Main instructor: M. Parameswaran (Ash)
Others: G. Chapman, A. Rawicz

Prerequisites: Ensc 453, 370 / 495 or permission of instructor

OBJECTIVE: This graduate course aims at teaching the students the fundamentals of fabricating transducers, with the emphasis on realizing the integrated systems applicable to areas ranging from measurement and control to bio-medical instrumentation. Along with the classical transducer principles, state of the art technology which is capable of realizing smart sensors and actuators will be taught. The laboratory session will complement the lecture in providing the students with hands-on knowledge on microsensor fabrication.

TEXT

Primary text:

"Silicon Sensors" by Middelhoek and Audet, Academic Press, 1990.

Other related books and journals that are available in SFU library:

"Sensors: A Comprehensive Survey", edited by W. Gopel, J. Hesse and J. N. Zemel, VCH, 1989.

"Chemical Sensing with Solid State Devices", R. Morrison and M. Madou, Academic Press, 1989.

"Microsensors", edited by R.S. Muller, R.T. Howe, S.D. Senturia, R.L. Smith and R.M. White, IEEE Press, 1990.

Sensors and Actuators, Elsevier Sequoia

Sensors and Materials, MYU Publishing, Japan

IEEE Transactions on Electron Devices, IEEE Press.

COURSE SCHEDULE

1. Transducer fundamentals - 1 week
History
Sensor cube effect
Transducer materials
Nomenclature

2. Transduction mechanisms - 4 weeks
Mechanical, Magnetic, Electrical, Thermal
Radiation and Chemical Sensors

Electrostatic, piezoelectric and thermal actuators

3. Transducer technology - 4 weeks
Microelectronic fabrication process*
Silicon sensors
Basic crystallography and
orthographic projection principles
Silicon micromachining
Static, dynamic and kinematic structures

4. Integrated transducers - 2 weeks
Circuit and device integration
Basic conversion circuits
IC process compatibility

5. Systems and applications - 2 weeks
Household
Industrial
Automotive
Calibration standards

* Just the basics of microelectronic fabrication processes.

Budgetary implications: Additional resources required:

| | |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Faculty: | None |
| Staff: | One: One of the research assistants in the micromachining group will assist in lab classes. If the research assistant is not available the we would like to request a T/A. |
| Library: | \$500 for reserve copies of the course and supplementary texts |
| Audio visual: | Whatever available for the standard class teaching |
| Space: | None |
| Supplies: | \$1,500 for wafers, etchants and lab supplies |

5.

SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE
MEMORANDUM

To: Ralph Stanton
Collections Librarian

From: Dr. John D. Jones
Graduate Chairman

Date: February 9, 1993

Subject: ENSC 854 - Integrated Microsensors and Actuators

Thank you for your memo dated December 21, 1992 regarding the above-mentioned course proposal and your positive response. Please find enclosed the information your were missing: number of hours, number of students, and date of offering.

Thank you for your support.

R. Patold
fr Dr. John D. Jones
Graduate Chairman

cc: Sharon Thomas
Head Collections Management

MEMO

TO: Dr. John D. Jones, Graduate Chairman, School of
Engineering Science

FROM: Ralph Stanton (Collections Librarian)

RE: ENSC 854 - Integrated Microsensors and Actuators
(Memo of December 2, 1992)

DATE: 21/12/92

I have examined the Library's holdings in subject areas supporting ENSC 854. The supporting documentation does not indicate: number of hours, number of students, or when offered. There is a short bibliography which includes the text, three monographs and three periodicals. The Library holds all but two items; the latest edition of the text and Microsensors.

The average price of titles in this classification is \$79.00. The Library's holdings in the subjects: Actuators, Transducers, Integrated Circuits, Microprocessors, and Microelectronics are all greater than those of the University of Victoria and close to or better than those of the University of British Columbia. Our holdings are substantially inferior to those of the University of Waterloo.

Our holdings were compared to those of 37 other libraries of a similar size in three classification numbers; QA 76.5, TK 7874, and TK 7895. Our holdings range from equal to or substantially better than our peer group. In the broader classification range QA and TK our holdings are substantially better than our peer group.

The monograph, periodical and index collection is adequate to support this course. The documentation asks for \$500 for "reference" copies of the course and supplementary text. Given that all copies of the text and supplemental readings were on loan from the library on December 21 we agree; if we can change the word reference to reserve. Total cost for library materials is \$500. There is no need to add to the Library base budget since the Collection Profile adequately supports this field of study.

Regards,



RS

c.c. Sharon Thomas, Head Collections Management

7.