THE FACULTY SENATE

October 22, 1996

Dr. Ray M. Bowen
President
Texas A&M University

Dear President Bowen:

At its regular meeting held October 14, 1996, the Faculty Senate considered and approved the following proposals from the University Curriculum Committee:

Nonsubstantive Requests: Change in Name of Degree Program
from: Biochemical and Food Engineering Option
to: B.S. degree in Biological Systems Engineering

Enclosed is the document considered by the Senate. Please inform me of your decision on this recommendation.

Sincerely yours,

Steven M. Oberhelman
Speaker, 1996-97

pc: Dr. Ronald G. Douglas, Executive Vice President & Provost
Dr. R. Bruce Simpson, Chair, Curriculum Committee
Ms. Linda F. Lacey, Director, Academic Services

APPROVED

DATE

Ray M. Bowen

10-31-96
Report of the University Curriculum Committee
September 13, 1996

The University Curriculum Committee recommends approval of the following:

Nonsubstantive Request

Change in Name of Degree Program
from: Biochemical and Food Engineering Option
to: B.S. degree in Biological Systems Engineering
July 9, 1996

MEMORANDUM

To: Karen S. Kubena, Associate Dean
    College of Agriculture & Life Sciences

    W. D. Turner, Associate Dean
    Dwight Look College of Engineering

From: James R. Gilley, H

Subject: Changes in Agricultural Engineering Program for Catalog 120 (1997-98)

1. It is requested to change the existing Biochemical and Food Engineering Option to a B. S. degree in Biological Systems Engineering (BSEN). See attached materials:

   Nonsubstantive Degree Program Request in Biological Systems Engineering
   Biological Systems Engineering Curriculum

2. The following new courses are requested:

   BSEN 354 Engineering Properties of Plant, Animal and Food Materials
   BSEN 366 Transport Processes in Plant, Animal and Food Materials
   BSEN 458 Environmental Control for Plant and Animal Systems

3. It is requested that existing courses AGEN 471 and AGEN 474 be changed to the prefix BSEN.

   BSEN 471: Introduction to Biochemical Engineering
   BSEN 474: Unit Operations in Food Processing

Letters from departments affected by above changes are also included, and placed behind the appropriate course.

These changes are approved.

Karen S. Kubena
Associate Dean
College of Agriculture & Life Sciences

W. D. Turner
Associate Dean
Dwight Look College of Engineering
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II. Curriculum in Biological Systems Engineering
III. Request for new course - BSEN 354 w/ syllabus
IV. Request for new course - BSEN 366 w/ syllabus
V. Request for new course - BSEN 458 w/ syllabus
NAME OF INSTITUTION: Texas A&M University

NAME OF PROPOSED PROGRAM: B.S. degree in Biological Systems Engineering

Display how proposed program(s) would appear on the Coordinating Board program inventory; include Texas CIP code designation(s).

14.0301.0006

How would name(s) of program(s) appear on student diplomas?

Bachelor of Science in Biological Systems Engineering

How would name(s) of program(s) appear on student transcripts?

Bachelor of Science in Biological Systems Engineering

Administrative unit(s) responsible for the program(s):

Agricultural Engineering Department

Proposed date for implementation of program: September 1997

Person to be contacted for further information about proposed program(s):

Name: Dr. Vincent E. Sweat  Title: Associate Head

Phone: (409) 845-3659  FAX: 409-862-3442

Signatures:

Campus Chief Executive Officer

System Chief Executive Officer (As appropriate)

Governing Board approval date:
Texas A&M University  
Department of Agricultural Engineering  

Nonsubstantive Degree Program Request  
Biological Systems Engineering Degree  

July 22, 1996  

The Department of Agricultural Engineering requests to change the name of its Biochemical and Food Engineering Option to Biological Systems Engineering (BSEN) and to change this option to a separate B.S. degree in parallel with the existing B.S. degree in Agricultural Engineering. This revised degree program represents a realignment of existing resources and, therefore, is submitted as a nonsubstantive request. In addition, this proposed request does not require changes in the department's role and mission, will require no new costs, and does not represent duplication with other programs. Moreover, the proposed BSEN degree represents a continuation of the department's success in quality undergraduate engineering education.  

I. Reason for the Request  

A. Rationale - Agricultural Engineering programs traditionally have incorporated some biological science into their curricula, while Food Engineering curricula have included more extensive biological science content. In 1976, the department established a Food Engineering degree option, which included several food science courses in the curriculum. In 1986, the name of the option was changed to Biochemical and Food Engineering and additional biological science courses were added. About the same time, the department saw a need to increase the biological sciences content in the Agricultural Engineering curriculum, and in 1988 an introductory botany course was replaced by introductory biology and a course in biochemistry was added to give students a better background in cell structure and function. These changes were made in recognition of the growing demand for engineers who have a good understanding of biological sciences.  

There has been a consistent demand for graduates of the department's Agricultural Engineering (AGEN) curriculum, and feedback from industry advisors and former students indicates that these graduates are generally well prepared for their initial jobs. At the same time, there is a growing need for engineers with a stronger background in the biological sciences. In response, many traditional agricultural engineering programs throughout the U.S. have adopted biological engineering curricula. Of the 53 departments and programs in the U.S. and Canada, 49% now offer degrees that include the word biological or a similar designation in the title (Cuello, 1995). These revised undergraduate programs house 65% of the students in U.S. and Canadian agricultural/biological engineering degree programs.
(Cuello, 1995). This shift in academic focus resulted from increased student and industry pressure for this change.

Student interest in biological engineering is best documented by enrollment numbers at other institutions where similar programs are in place. In all instances, enrollment and degrees granted have both increased. Comparative enrollment figures for select departments before implementation of a biological engineering curriculum and in 1996 are summarized in Table 1. Beyond overall enrollment increases, many programs have seen an increase in the diversity of the student body following implementation of a biological engineering curriculum.

**Table 1.** Total student enrollment at institutions implementing BSEN degree programs.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Year BSEN Degree Implemented</th>
<th>Year 0 Total Enrollment</th>
<th>Current Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oklahoma State University</td>
<td>1993</td>
<td>14</td>
<td>50</td>
</tr>
<tr>
<td>University of Nebraska</td>
<td>1990</td>
<td>47</td>
<td>105</td>
</tr>
<tr>
<td>Iowa State University</td>
<td>1992</td>
<td>55</td>
<td>115</td>
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<tr>
<td>Louisiana State University</td>
<td>1988</td>
<td>2</td>
<td>78*</td>
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</table>

* includes Biomedical

Students graduating with BSEN degrees are expected to have ample job opportunities. Employers within Texas include the rapidly-expanding confined animal production industry, food manufacturers and processors, greenhouse/nursery industries, and biotechnology companies. Employment of graduates from other U.S. BSEN programs has been stable, with nearly all students seeking industry employment finding jobs. Successful placement of BSEN graduates from other U.S. programs indicates that a market niche for this knowledge is well established.

Currently, there are no similar BSEN degree programs in Texas. In addition, AGEN curricula are only offered at two Texas institutions: Texas A&M University (TAMU) and Prairie View A&M University. The degree program at Prairie View, however, is not accredited by the ABET. Since the AGEN program at TAMU must serve the bulk of interested students from Texas and since student enrollment in this program has increased recently, the existing AGEN program will remain in place should the requested BSEN curriculum be approved.

**B. Historical Documentation** - The proposed program evolved from the existing Biochemical and Food Engineering Option. Consequently, the department already has existing resources supporting BSEN curriculum activities. In addition, three recently-hired replacement faculty will be teaching in the BSEN area.
II. Program Description

The Biological Systems Engineering curriculum will consist of three emphasis areas: a) food engineering, b) bioprocess engineering, and c) bioproduction engineering. A complete description of the curriculum including objectives, degree requirements, and curriculum requirements is provided in Attachment A.

III. Relationship to Existing Authorized Programs

A. Relation to Existing Programs - The proposed BSEN curriculum is unique when compared to other programs at TAMU and at other universities across the state. On the TAMU campus, the most closely related engineering program is AGEN. While these two programs include some similar courses, the overall emphases are different. The proposed BSEN curriculum focuses more on the plant, animal and food sciences, the properties of plant, animal and food materials, and the design of engineered systems for those materials. In contrast, the AGEN program focuses either on feed and fiber production and processing or on environmental and natural resources engineering.

Another related program at TAMU is Bioengineering in the Industrial Engineering Department. This program, however, concentrates on biomedical engineering; the application of engineering to medicine and physiology. The proposed BSEN program excludes biomedical engineering. The proposed BSEN curriculum was developed with input from the Bioengineering faculty to minimize any potential overlap between the two curricula.

Several non-engineering programs at TAMU and at other institutions are tangential to the proposed BSEN curriculum. These programs include Bioenvironmental Sciences, Biochemistry, Animal Science, Food Science and Technology, Horticultural Sciences, and Agricultural Systems Management (AGSM). Faculty from several of these programs have reviewed the proposed BSEN curriculum and have indicated that there are no substantial overlaps in content. Further, since the BSEN degree is an engineering program and these other programs are focused on pure and applied sciences, overlap is minimal.

B. Impacts on Existing Programs - Any effects the BSEN program may have on the existing AGEN program are expected to be slight. Since the existing Biochemical and Food Engineering emphasis will be moved from AGEN to BSEN, those students following that program (roughly 15-20 students) will be encouraged to transfer to the new curriculum. Even with this loss, student
numbers in AGEN are expected to increase. Student enrollment in the AGEN program has increased over the past few years, in part due to development of an Environmental and Natural Resources Engineering emphasis. Total enrollment in 1990 was 118 while it currently is 185. This growth in the AGEN program is expected to overshadow losses caused by moving Food Engineering students to the new BSEN curriculum. Moreover, since both programs will be administered by the department, total student numbers in the department will increase.

Since BSEN students will take many of the same courses as AGEN students, some courses offered within the department may require additional sections; however, anticipated enrollment increase in the department will require additional sections irrespective of the BSEN degree request. Extra sections for all courses, however, are not anticipated since many courses are not currently at full capacity. Increasing student enrollment in these courses will improve the cost-effectiveness of departmental teaching activities.

The proposed BSEN curriculum is not expected to have an impact on the Agricultural Systems Management (AGSM) program which also is administered by the Agricultural Engineering Department. Since AGSM is a non-engineering program, it appeals to different students than would the BSEN curriculum. As a result, no changes in overall enrollment in the AGSM program or enrollment in individual AGSM courses is expected with implementation of the BSEN degree program.

Three new courses are requested to implement the proposed BSEN curriculum. These courses will be taught by replacement faculty who have recently been hired or by existing faculty who will have some of their current responsibilities shifted to new faculty. The recently-hired faculty as well as some of the older faculty have expertise complementary to this new curriculum; therefore, no new faculty will be required to implement this curriculum

IV. Expected Enrollment

A. Enrollment Estimates - Overall enrollment and degrees awarded are both expected to increase when the BSEN curriculum is implemented. An estimate of cumulative headcount and full-time enrollment in BSEN for the first 5 years is presented in Table 2.
Table 2. Anticipated enrollment in the BSEN degree program.

<table>
<thead>
<tr>
<th>Year</th>
<th>New to Institution</th>
<th>New to Program</th>
<th>Full-Time Cumulative Enrollment</th>
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<td>30</td>
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<td>5</td>
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<td>100</td>
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B. Estimate Assumptions - The above estimates were made assuming 25 new students (freshmen and outside transfers) enter the program each year. In addition, it was assumed that approximately 5 students per year will transfer into the program from within TAMU. An attrition rate of 5 students per year from the program is expected, and approximately 25 students should graduate each year starting in year 4. The long-term enrollment is anticipated to stabilize between 100 and 125 students. Total Departmental enrollment including BSEN, AGEN, and AGSM, would reach 400 after year 4 of BSEN implementation. Based on past experience, it was assumed that all students will be full time students.

V. Resources

A. Courses

1. One “new” course (AGEN 474) has been implemented in the last three years that would be included in the BSEN curriculum, but it is very similar to a course developed much earlier. AGEN 451 Unit Operations in Food Engineering was first taught in 1975-76. In 1988-89 AGEN 451 was changed to 2 credit hours to accommodate a departmental plan to change most senior courses to 2 credit hours, and it was renumbered to AGEN 473 Food and Agricultural Process Engineering. The concept of 2 credit hour senior design courses did not work well, so in 1994-95 AGEN 473 was changed back to 3 credit hours and was renumbered to AGEN 474 Unit Operations in Food Processing, which is very similar to the original AGEN 451. Therefore it is requested that AGEN 474 not be counted as a new course for the BSEN degree program.

Catalog descriptions for AGEN 451 and 474 are as follows:

AGEN 451 Unit Operations in Food Engineering. (2-2) Credit 3.
Unit operations in food engineering systems involving basic concepts of rheology and physical properties of foods. Fundamentals of heat and mass transfer and food handling systems.
AGEN 474 Unit Operations in Food Processing. (2-2) Credit 3.
Design of food process engineering systems; basic concepts of rheology and physical properties of foods; fundamentals of heat and mass transfer and process control.

2. New courses not yet implemented:
Three new courses will be needed for the proposed BSEN curriculum:
BSEN 354 Engineering Properties of Plant, Animal and Food Materials;
BSEN 366 Transport Processes in Plant, Animal and Food Systems; and
BSEN 458 Environmental Controls for Plant and Animal Systems. These courses are described in detail in Attachment B.

It is important to note that all three of these courses presently exist in very similar form in several Agricultural/Biological Engineering Departments in the US. Course materials are available so there will be minimal effort required to develop these courses.

3. Two existing courses: AGEN 471 Introduction to Biochemical Engineering and AGEN 474 Unit Operations in Food Processing are required courses in the present Biochemical and Food Engineering option. It is requested that these two courses have the prefixes changed from AGEN to BSEN. No other changes are needed for these courses.

B. Faculty - No additional faculty will be required to implement the BSEN degree program. Three recently-hired faculty, all of whom are currently on staff, or experienced faculty who have expertise relevant to the new courses will be responsible for teaching the three new courses needed.

C. Equipment - The equipment needed for the BSEN program is already in place and has been used for the Biochemical and Food Engineering option courses. No equipment and supplies have been purchased in the last three years specifically for the proposed BSEN program.

D. Facilities - Teaching facilities, including laboratories, are well established within Scoates Hall. No new facilities are required.

E. Library Resources - The proposed new BSEN program presents no unique new requirements for library resources. Existing library resources are adequate to service the BSEN program.
VI. Summary Statement

Changing the Biochemical & Food Engineering option to a Biological Systems Engineering B.S. degree in the Agricultural Engineering Department will help meet the need for engineers with a stronger biological base in the food processing, bioprocessing and bioproduction industries. The request involves no new resources since adequate faculty with appropriate background are available to teach the three new courses; the teaching laboratory can be equipped with existing equipment and no additional support staff or library resources are needed. When approved, the Agricultural Engineering listing of degree programs in the catalog will read as follows (reference page 21 of 1996-97 catalog):

Department of Agricultural Engineering
Agricultural Engineering B.S.
Biological Systems Engineering B.S.
Agricultural Systems Management B.S.

References

Resource 3(3):8-11
ATTACHMENTS -- A

I. Catalog description of Biological Systems Engineering

II. The Biological Systems Engineering Curriculum Listing

III. Electives for Biological Systems Engineering

IV. Approval letters for Curriculum
Curriculum in Biological Systems Engineering

Biological Systems engineers apply their knowledge of physical and biological sciences and engineering principles to biological systems and processes, e.g., processing of food, design of fermentation and enzyme processes, and design of greenhouse and animal housing systems. Because of their broad general engineering background, biological systems engineering graduates are sought by a wide variety of employers including food processing industries, nursery and greenhouse industries, concentrated animal production industries, biotechnology companies, environmental consulting firms, and governmental agencies.

The versatility of biological systems engineers results from their broad fundamental training in biological and physical sciences, mathematics, and engineering science and design. Electives in the curriculum provide an opportunity for students to develop some depth in one of the emphasis areas described below. Students select courses with the assistance of faculty advisors in an individualized advising system. The faculty also assist with professional development and job placement for students.

The following emphasis areas are available to students in biological systems engineering:

**Food Engineering** — Food engineers apply engineering principles and techniques to the production, processing, packaging, storing and distribution of food. The role of the food engineer is to design, develop, build, operate, manage and analyze production and processing systems for food materials. Food engineers are involved in many phases of food processing: process design, plant engineering, distribution and marketing, quality evaluation and control, sanitation and waste disposal, and by-product development and utilization.

**Bioprocess Engineering** — Bioprocess engineers design and develop processes utilizing biological cells or cell components to carry out reactions, e.g., fermentations, tissue culture and enzyme-catalyzed reactions, and devise processes for separation and purification of biological compounds. The bioprocess engineering emphasis gives students a broad background in engineering and biological science which is needed for work in fermentation industries and many of the new biotechnology companies.

**Bioproduction Engineering** — Bioproduction engineers design systems for intensive agricultural production such as greenhouses and concentrated animal feeding operations. Students in this area must develop a good understanding of the interactions between biological systems and the surrounding environment.

The biological systems engineering program is jointly administered by the Colleges of Agriculture and Life Sciences and Dwight Look College of Engineering, and the curriculum has been designed to meet accreditation requirements of the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. The department is one of the largest in North America and is consistently ranked among the top two in the nation.
# Biological Systems Engineering Curriculum

## Department of Agricultural Engineering

## FRESHMAN YEAR

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**T7**

## SOPHOMORE YEAR

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## JUNIOR YEAR

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<td>AGEN 365 Unit Op. for Ag. Engr.</td>
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**T8**

## SENIOR YEAR

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<td>or</td>
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**T16**

## Notes:

1. Entering students will normally be given placement tests in chemistry, mathematics and English. Test results will be used in selecting the appropriate starting course which may be at a higher or lower level.

2. Of the 24 hours of directed electives, 6 must be from humanities, 6 from social science and 12 from citizenship courses as described in "Directed Electives in Engineering."

3. Microbiology and biological science electives are to be selected from an approved list in consultation with the academic advisor to develop a cohesive career emphasis.

4. Mathematics elective is to be selected from AERO 320, CVEN 302, INEN 229, MATH 304 or MATH 417, STAT 221, STAT 225, STAT 211.

5. Engineering electives are to be selected from an approved list in consultation with the academic advisor to enhance the chosen career emphasis.