Document Submission Portal
Texas Higher Education Coordinating Board

Institution: **The University of Texas System**
Chief Academic Officer/Other Contact - **Dr. Kevin Lemoine / Ms. Renee Collins**
Report ID: **4595** Status: **Received**

Request Information

1. **Which institution is this for?**

   The University of Texas at Austin

2. **What type of request is this?**

   New degree program

3. **Short summary of request.**

   U.T. Austin's full proposal for the Bachelor of Science in Computational Engineering. Included with the proposal is an addendum providing additional information.

4. **Program director's name, title, phone, and e-mail (*if applicable*).**

   None

5. **Upload up to three PDF-formatted files with pertinent information - up to 15MB each.**

   1. Uploaded pdf file - 4/8/16-02:44:05 *10.29MB*
   2. No pdf file
   3. No pdf file

6. **Comments Made:**
   None

THE UNIVERSITY *of* TEXAS SYSTEM
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Office of Academic Affairs
601 Colorado Street
Austin, Texas 78701-2982
512-499-4233
WWW.UTSYSTEM.EDU

April 7, 2016

Dr. Rex Peebles
Assistant Commissioner
Academic Quality and Workforce
Texas Higher Education Coordinating Board
1200 East Anderson Lane
Interagency Mail

Dear Dr. Peebles:

The University of Texas at Austin has prepared the full proposal for the Bachelor of Science (B.S.) in Computational Engineering (CIP Code 30.3001). Included with the proposal is an addendum providing additional information that parallels responses to questions recently posed for the B.S. in Environmental Engineering.

Please let us know if you have any questions.

Sincerely,

Steven W. Leslie, Ph.D.
Executive Vice Chancellor for Academic Affairs
The University of Texas System Administration

SWL/rdc

cc: President Gregory Fenves
Dr. Judith Langlois
General Counsel to the Board of Regents Francie Frederick

New Program Request Form for Bachelor's and Master's Degrees

Directions: An institution shall use this form to propose a new bachelor's or master's degree program that is in the field of engineering or has costs exceeding $2 million for the first five years of operation. In completing the form, the institution should refer to the document *Standards for Bachelor's and Master's Programs,* which prescribes specific requirements for new degree programs. Note: This form requires signatures of (1) the Chief Executive Officer or Chief Academic Officer, certifying adequacy of funding for the new program and the notification of other institutions; (2) a member of the Board of Regents (or designee), certifying Board approval. NOTE: Preliminary notification is required for all engineering programs. Prior to submission of an engineering program proposal, the institution should notify the Division of Workforce, Academic Affairs and Research of its intent to request such a program.

For more information: Contact the Division of Workforce, Academic Affairs and Research at 512/427-6200.

Administrative Information

1. Institution:
The University of Texas at Austin

2. Program Name – Show how the program would appear on the Coordinating Board's program inventory (*e.g., Bachelor of Business Administration degree with a major in Accounting*):
Bachelor of Science in Computational Engineering

3. Proposed CIP Code: 30.3001

4. Number of Required Semester Credit Hours (SCHs) (*If the number of SCHs exceeds 120 for a Bachelor's program, the institution must request a waiver documenting the compelling academic reason for requiring more SCHs*): **122**

5. Brief Program Description – Describe the program and the educational objectives:
Engineering applications are becoming increasingly complex and interdisciplinary, and solutions often rely on the efficient use of computer software and hardware. There is a need for a degree program which combines fundamental engineering principles with more advanced knowledge of mathematics, computational methods and programming techniques, beyond what is currently offered in most engineering disciplines. The computational engineering program is designed in response to this need.

6. Administrative Unit – Identify where the program would fit within the organizational structure of the university (*e.g., The Department of Electrical Engineering within the College of Engineering*):
The Department of Aerospace Engineering and Engineering Mechanics within the Cockrell School of Engineering

7. Proposed Implementation Date – Report the date that students would enter the program (MM/DD/YY): **08/24/16**

8. Contact Person – Provide contact information for the person who can answer specific questions about the program:

   Name: **Dr. Clint N. Dawson**
   Title: **Professor**

E-mail: **clint@ices.utexas.edu**
Phone: **(512) 475-8627**

Program Information

I. Need

A. Job Market Need – Provide short- and long-term evidence of the need for graduates in the job market.

Companies that indicated an interest in hiring Computational Engineering graduates include: Emergent, NASA, Northrup/Grumman, Southwest Research, JPL, Chevron, Bell Helicopter, Shell, Micron Research, and Lockheed Martin among others. Additional documentation of conversations with representatives from these companies may be provided if necessary.

B. Student Demand – Provide short- and long-term evidence of demand for the program.

Over the past five years, we have collected input from graduating seniors in senior exit interviews. Every year, the students indicate a greater need for more computational engineering as they are frequently asked for these skills in job interviews. We receive this same information from our External Advisory Committee which consists of industry and government professionals, all of whom hold responsible engineering positions in industry or government laboratories. In addition, many of our students have chosen to pursue joint degrees in engineering and mathematics, or to obtain undergraduate certificates in scientific computing, currently offered through the math department or through the Institute for Computational Engineering and Sciences.

C. Enrollment Projections – Use this table to show the estimated cumulative headcount and full-time student equivalent (FTSE) enrollment for the first five years of the program. (*Include majors only and consider attrition and graduation.*)

YEAR	1	2	3	4	5
Headcount	10	30	50	75	100
FTSE	10	30	50	75	100

II. Quality

A. Degree Requirements – Use this table to show the degree requirements of the program. *(Modify the table as needed; if necessary, replicate the table for more than one option.)*

Category	Semester Credit Hours	Clock Hours
General Education Core Curriculum *(bachelor's degree only)*	43	
Required Courses	73	
Prescribed Electives	6	
Free Electives	0	
Other *(Specify, e.g., internships, clinical work)*	(if not included above)	0
TOTAL	122	

B. Curriculum – Use these tables to identify the required courses and prescribed electives of the program. Note with an asterisk (*) courses that would be added if the program is approved. *(Add and delete rows as needed. If applicable, replicate the tables for different tracks/options.)*

Prefix and Number	Required Courses	SCH
M 408D	Sequences, Series and Multivariable Calculus	4
COE 301	Introduction to Computer Programming	3
M E 320	Applied Thermodynamics	3
M 427J	Differential Equations with Linear Algebra	4
E M 306	Statics	3
M E 210	Engineering Design Graphics	2
M 427L	Advanced Calculus for Applications II	4
COE 211K	Engineering Computation	2
*COE 111L	Engineering Computation Lab*	1
E M 311M	Dynamics	3
E M 319	Mechanics of Solids	3
ASE 320	Low-Speed Aerodynamics	3
ASE 330M	Linear System Analysis	3
SDS 329C	Practical Linear Algebra I	3
M 362K	Probability I	3
ASE 347	Introduction to Computational Fluid Dynamics	3
ASE 321K	Computational Methods for Structural Analysis	3
SDS 322	Introduction to Scientific Programming	3
*COE 371	Applied Mathematics I*	3
*COE 352	Advanced Scientific Computation*	3
*COE 373	Senior Design I*	3
ASE 375	Electromechanical Systems	3
*COE 372	Applied Mathematics II*	3
*COE 374	Senior Design II*	3
PHY 103M	Laboratory for Physics 303K	1
PHY 103N	Laboratory for Physics 303L	1

Prefix and Number	Prescribed Elective Courses	SCH
SDS 335	Scientific and Technical Computing	3
SDS 339	Applied Computational Science	3
M 378K/SDS 378	Introduction to Math Statistics	3
SDS 374C	Parallel Computing for Science & Engineering	3
SDS 374D	Grid and Distributed Computing	3
SDS 374D	Visualization and Data Analysis	3
E M 360	Finite Element Methods	3

C. Faculty – Use these tables to provide information about Core and Support faculty. Add an asterisk (*) before the name of the individual who will have direct administrative responsibilities for the program. *(Add and delete rows as needed.)*

Name of *Core* Faculty and Faculty Rank	Highest Degree and Awarding Institution	Courses Assigned in Program	% Time Assigned To Program
Bui-Thanh, Tan Asst. Professor	PhD. in Computational Fluid Dynamics Massachusetts Institute of Technology	COE 211K	50
*Dawson, Clint Professor	PhD. in Mathematical Sciences Rice University	COE 371, 372, 373, 374	50
Demkowicz, Leszek Professor	PhD. in Engineering Mechanics Cracow Univ. of Technology	COE 371, 372, 373, 374	50
Hughes, Thomas Professor	PhD. in Engineering Science University of California-Berkeley		33
Oden, J. Tinsley Professor	PhD. in Engineering Mechanics Oklahoma State University		33
Rodin, Gregory Professor	PhD. in Mechanical Engineering Massachusetts Institute of Technology	E M 306	33
Wheeler, Mary Professor	PhD. in Mathematics Rice University		33

Name of *Support* Faculty and Faculty Rank	Highest Degree and Awarding Institution	Courses Assigned in Program	% Time Assigned To Program
Acikmese, Behcet Asst. Professor	PhD. in Aeronautics and Astronautics Purdue University	ASE 330M	16
Landis, Chad Professor	PhD. in Mechanical and Environmental Engineering U of California-Santa Barbara	ASE 321K, E M 306, E M 319	25
Huang, Rui Professor	PhD. in Civil and Environmental Engineering Princeton University	E M 306, E M 319	25
Mear, Mark Professor	PhD. in Engineering Science Harvard University	ASE 321K, E M 319	25
Goldstein, David Professor	PhD. in Aeronautics California Institute of Technology	ASE 320	16
Akella, Maruthi Professor (effective 9/1/15)	PhD. in Aerospace Engineering Texas A&M University	ASE 330M	16
Russell, Ryan Assoc. Professor (effective 9/1/15)	PhD. in Aerospace Engineering The University of Texas at Austin	COE 353	16
Bisetti, Fabrizio (start date 9/1/16)	Computational Fluids Area	ASE 347	16

D. Students – Describe general recruitment efforts and admission requirements. In accordance with the institution's Uniform Recruitment and Retention Strategy, describe plans to recruit, retain, and graduate students from underrepresented groups for the program.

In the first year, admission will likely be done internally with students entering their third year to go straight into the program. There will be a minimum GPA requirement (likely 3.0) among the first two years of coursework in order to be admitted to the major. We plan to thoroughly describe and outline the program on our website and begin admitting FTIC students in Fall 2017. In an effort to be in accordance with the institution's strategy, we will work on incorporating this program into current efforts made with the Equal Opportunity in Engineering office and Women in Engineering Program.

E. Library – Provide the library director's assessment of library resources necessary for the program. Describe plans to build the library holdings to support the program.

There will be no new relevant material; existing material is sufficient.

F. Facilities and Equipment – Describe the availability and adequacy of facilities and equipment to support the program. Describe plans for facility and equipment improvements/additions.

The program will fit in the current environments for the ASE/E M department.

G. Accreditation – If the discipline has a national accrediting body, describe plans to obtain accreditation or provide a rationale for not pursuing accreditation.

Per Wallace Fowler (ASE Professor and ABET evaluator), we will be working with ABET in a process that occurs for new programs. We will need to start the program and run it for up to four years or until a student graduates from the program and then the program can be retroactively accredited.

H. Evaluation – Describe the evaluation process that will be used to assess the quality and effectiveness of the new degree program.

We will use the established ABET evaluation process per ABET standards. We will also follow the procedures for SACS.

III. Costs and Funding[1]

Five-Year Costs and Funding Sources - Use this table to show five-year costs and sources of funding for the program.

No new funding is needed as the overall enrollment in ASE-EM will not increase. The program will be funded by reallocation of current ASE-EM instructional resources.

Five-Year Costs		**Five-Year Funding**	
Personnel[1]	$0	Reallocated Funds	$4200
Facilities and Equipment	$0	Anticipated New Formula Funding[3]	$0
Library, Supplies, and Materials	$0	Special Item Funding	$0
Other[2] (accreditation)	$4200	Other[4]	$0
Total Costs	**$4200**	**Total Funding**	**$4200**

1. Report costs for new faculty hires, graduate assistants, and technical support personnel. For new faculty, prorate individual salaries as a percentage of the time assigned to the program. If existing faculty will contribute to program, include costs necessary to maintain existing programs (e.g., cost of adjunct to cover courses previously taught by faculty who would teach in new program).
2. Specify other costs here (e.g., administrative costs, travel).
3. Indicate formula funding for students new to the institution because of the program; formula funding should be included only for years three through five of the program and should reflect enrollment projections for years three through five.
4. Report other sources of funding here. In-hand grants, "likely" future grants, and designated tuition and fees can be included.

[1] Please use the "Program Funding Estimation Tool" found on the CB website to correctly estimate state funding.

Signature Page

1. Adequacy of Funding and Notification of Other Institutions – The chief executive or chief academic officer shall sign the following statements:

   I certify that the institution has adequate funds to cover the costs of the new program. Furthermore, the new program will not reduce the effectiveness or quality of existing programs at the institution.

   I certify that my institution has notified all public institutions within 50 miles of the teaching site of our intention to offer the program at least 30 days prior to submitting this request. I also certify that if any objections were received, those objections were resolved prior to the submission of this request.

   [signature] 12.3.2015

   Chief Executive Officer/Chief Academic Officer — Date

2. Board of Regents or Designee Approval – A member of the Board of Regents or designee shall sign the following statement:

   On behalf of the Board of Regents, I approve the program.

   [signature] 4/8/16

   Board of Regents (Designee) — Date of Approval

Additional Information for the Texas Higher Education Coordinating Board's Review of the Proposal from UT-Austin for a B.S. degree in Computational Engineering

I. Job Market Need

1. Please provide examples of specific industries where graduates of the proposed program are likely to find relevant work.

Response: Computational engineering is a new field that recognizes the increasing demand for advanced computational methods in engineering practice. This interdisciplinary engineering degree offers the opportunity to work on complex 21st Century engineering problems within a wide range of real-world applications. Computational engineers will have extensive education in fundamental engineering and science, and advanced knowledge of mathematics, algorithms and computer languages. Because of the breadth and depth covered in the curriculum, graduating computational engineers will be capable of pursuing careers in a variety of fields, including energy, manufacturing, aerospace, health care, microelectronics and more. Computational engineers have the skills to work in cross-disciplinary teams. Whether graduates of this program choose to pursue employment in industry, government or consulting, they will have the tools they need to succeed. Those interested in graduate work in computational engineering and science should be well prepared. As a computational engineer, one might develop computer models for locating oil and gas reserves, use computer codes to predict loads on buildings during earthquakes, design turbine blades in jet engines, or develop methods for simulating blood flow inside the cardiovascular system. Other applications might include smart energy design, software design, data mining and visualization. Since this will be the first undergraduate program of its kind, we do not have specific statistics on hiring, but companies that have indicated an interest in hiring Computational Engineering graduates include: Emergent Space Technologies, NASA Johnson Space Center, Northrup/Grumman, Southwest Research Institute, NASA Jet Propulsion Laboratory, Chevron, Bell Helicopter, Shell, Micron Research, and Lockheed Martin among others. Additional documentation of conversations with representatives from these companies may be provided if necessary. A few comments from our Aerospace Engineering External Advisory Council industry contacts are listed below:

> NASA: This degree appears to provide the skill set that we look for in potential candidates. With many other degree programs, the efficient use of computer technology is not really engrained in the program. It is expected that students will acquire the skill through work experience or through necessity in having to complete projects for their education. What is usually acquired is a lack of understanding of how to code and use computer hardware efficiently which leads to bad habits. Also, I would like to mention that I shy away from hiring computer science majors because of a lack of mathematics and engineering skills. So, at least at first glance, this program looks like something that would benefit my program and my company.
>
> Southwest Research: Undergraduates with strong fundamentals in using numerical methods to approximate the solution of physics-based problems is certainly of interest/value to us
>
> Lockheed Martin: This would seem to be a useful degree for Lockheed Martin.

2. Where possible, distinguish between available jobs for computational engineers where the entry level degree is the BS, not the MS or PhD.

Response: See previous response. These industries and government agencies are likely to hire at both the BS and MS levels. As graduates of the BS in Computational Engineering are produced, many industry partners that once looked only for MS level graduates to start employment will likely consider graduates with BS degrees because this degree has at least as much coursework directly related to computational engineering as the MS currently has.

3. Indicate if the proposed program is preparing graduates directly for the job market or for continued graduate study.

Response: Some students will go directly into the job market following completion of the B.S. degree. Some will attend graduate school to pursue an M.S. or Ph.D. degree. We expect, as with most B.S. degrees in engineering, the majority will go directly into the work force. The BS program in Aerospace Engineering, (also within the Department presenting this request for a BS in Computational Engineering) sends approximately 16% to graduate school; we expect a similar percentage for this degree program.

4. Give job or graduate school placement information, if available, for BS graduates of Aerospace Engineering and other undergraduate Engineering fields at your institution.

Response: For the 2014-15 academic year graduates with a BS in Aerospace Engineering, 62% were in jobs, 13% were in graduate school, and the other 25% (11% no job/school reported; 14% did not use ECAC) did not report to our Engineering Career Assistance Center (ECAC). In the Cockrell School of Engineering, per statistics presented by ECAC on their website, 78% are employed, 15% attend graduate school, 6% have no job reported, and 1% return to their home country for employment or graduate school. These numbers fluctuate somewhat from year to year, but these data from the most recent graduating class are typical.

II. Student Demand

1. Give evidence, if available, of specific student demand at your institution.

Response: Over the past five years, we have collected input from graduating seniors in senior exit interviews. Every year, the students indicate a greater need for more computational engineering as they are frequently asked for these skills in job interviews. A small sample of student comments for the survey questions 'What areas of the curriculum may need improvement?' and 'Are there topics which you would like to see included in the curriculum?' are listed below:

- More computation like classes. This was achieved with the Computational [Structural Analysis] class (which I took before the emphasis on computation).
- Coding in languages other than MATLAB.
- I think more exposure to coding is necessary.
- I think a better emphasis on programming would be nice, learning Matlab is great, but most employers that want programming experience want C or even Fortran.
- Coding
- Programming and Computation
- Programming classes (need more than Matlab)
- Programming, engineering statistics, linear algebra

- Computer Science
- Scientific Computing
- Most students are never trained in any way in the use of common tools such as [Computational Fluid Dynamics], unless they take graduate level classes or sign up for research. Implement more curriculum around using the tools of the engineering trade, including using relevant programs.
- We need to learn more computer techniques. Programming (C++) and other software skills (CFD, Structural Analysis) are very valuable in industry and could make our students more marketable.

We receive this same information from our External Advisory Committee, which consists of industry and government professionals, all of whom hold responsible engineering positions in industry or government laboratories.

In addition, many of our students have chosen to pursue joint degrees in engineering and mathematics, or to obtain undergraduate certificates in scientific computation (SC) and/or Computational Science and Engineering (CSE), currently offered through the College of Natural Sciences and the Institute for Computational Engineering and Sciences, respectively. The office coordinating the SC certificate reported 204 total students enrolled in the program since 2009—of those 204, 54 (26.5%) were Engineering students. The SC certificate is not widely advertised, but the students who have been enrolled have actively sought out the information for this certificate option themselves.

The office coordinating the CSE certificate reported 74 total students enrolled (officially signed up with the department) in the program since 2010—of those 74, 47 (63.5%) were engineering students. Typically students do not officially enroll in the program until they are ready to take the final class required for the certificate or when they have completed all of the requirements, thus we estimate a much higher number who are pursuing the CSE certificate and are not yet officially 'enrolled'.

In 2014, we polled our undergraduate students in the aerospace engineering (ASE) major to determine interest in a potential new major. Of the 149 responses, 54 (36%) were students who could potentially graduate with this degree if it were approved by Fall 2016—these 54 self-identified as the Class of 2018, we will call them C18. The other 64% were students who will (or have already) graduate with a BS in ASE—,we will call them C16. Of the C18 students who responded, 56% were interested in more information (27%), likely (19%) or very likely (10%) to consider applying to transfer to Computational Engineering in Fall 2016. Of the C16 students, 59% identified that they would have been interested in more information (16%), likely (29%) or very likely (14%) to apply to Computational Engineering if the chance had been offered to them. This survey was done only for aerospace engineering—we strongly believe that had it been opened up to non-ASE majors, we would have received similar responses from both engineering and closely-related disciplines (Math, Physics, Computer Science).

2. How has the institution arrived at the enrollment projections?

Response: The progression of the original enrollment projections we submitted last year have been slightly modified, but have the same ultimate/long-term numbers as the original proposal. The more appropriate estimation is indicated in Table 1 below; the table shows the expected number of total students (from all classes) pursuing the Computational Engineering degree at any time. In the first year of the program, we expect to allow some second and third year students to transfer into this program from other engineering programs (primarily Aerospace Engineering). In the second year of the program, we expect to begin admitting a freshman class of 20 students to gauge interest and determine the applicant pool until we are able to better advertise the major since it will be the first of its kind among our peer institutions in the United States. We will gradually raise numbers of allowed internal transfer students each year as more become aware of the major option. In the third year and beyond, we expect to admit freshman classes of 25 each year and gradually move to an intended number of 25 students per class at any one time.

Although there is expected attrition like any other major, we also expect to equal out the number lost with new students gained through internal transfer, thus allowing our numbers to remain as consistent as possible. The University of Texas at Austin and, within that, the Cockrell School of Engineering, have instituted several policy reforms and new retention-based programs that are designed to reduce the attrition rate and decrease the time to degree; the success of these programs in coming years would lead to a greater number of degrees awarded per year and approximately the same total enrollment (given a shorter time to obtain the degree).

Table 1. Projected Enrollments for the First Several Years of the Program

	Years Measured from the Start of the Program				
Student Classification	1	2	3	4	5
First year		20	25	25	25
Second year	15	20	25	25	25
Third year	15	15	20	25	25
Fourth year		15	20	25	25
Total enrollment	30	70	90	100	100
# of Graduates		15	20	25	25

3. Please provide enrollment projections broken down by ethnicity (White, Black, Hispanic, Other) and origin (Domestic, International).

Response: It is expected that the ethnicity of the new Computational Engineering program will be similar to the current Aerospace Engineering program. At the current time (spring semester 2016), the aerospace engineering program has 521 students. The ethnicity of 4 (0.8%) is unknown, but there are 95 (18.2%) Asian, 14 (2.7%) Black, 112 (21.5%) Hispanic or Latino, 2 (0.4%) multiracial (one being black), 17 (3.3%) multiracial (excluding black/Latino), 18 (3.5%) Foreign, and 259 (49.7%) White.

With respect to origin and citizenship, 473 (90.8%) are US citizens, 30 (5.8%) are permanent resident aliens, and 18 (3.5%) are non-US citizens.

4. Indicate if the projections are based upon enrollment trends in existing undergraduate Engineering programs.

Response: The values listed above are based on the current Aerospace Engineering program at the University of Texas at Austin. We have no way of identifying a trend of enrollment in this field overall since this will be the first undergraduate degree of its kind in the United States.

5. In order to accurately calculate formula funding, provide the number of projected graduates and anticipated attrition per year.

Response: The answer to this question is contained in Table 1. Due to the high caliber of internally admitted students (anticipated average GPA of 3.9) and the high level of competition expected for FTIC admission, we do not anticipate more than 10% attrition each year. Also as indicated in number 2 above, we expect our numbers to balance out from those who leave with those who are internally admitted, thus eventually leveling out our number of graduates per year to 25 after our first two years of 15 and 20 respectively.

6. Is the program planning on expansion after five years?

Response: No.

7. What are the restraints on the enrollments for the proposed program: (student interest, teacher-student ratio, physical resources, etc.?)

Response: Limitations are based on physical resources (especially teaching labs), personnel resources (number of faculty), and necessary caliber of student qualification for admission (advanced coursework included in the degree).

III. Degree Requirements

1. Please provide a quotation or summary from the relevant section of ABET requirements that explains why the curriculum must be over 120 SCH.

Response: The Bachelor of Science in Computational Engineering degree requires 122 SCH. The ABET requirements pushed the degree requirements over 120 SCH based on documentation from the ABET accreditation guidelines, as explained below.

In the curriculum section of the ABET criteria (quoted in its entirety below), they explain the requirements in terms of a year (or half-year) of coursework in various groupings of subjects. The last line of this section defines one year as 32 hours or ¼ of the total required hours; this statement implies that ABET-accredited programs generally require 128 SCH. The ABET documentation can be found at the following URL:
www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2016-2017/#curriculum

A critical aspect of this criterion is the second sentence: "The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution." More than most other engineering fields, computational engineering relies heavily on additional training in mathematics and advanced scientific computing, hence the proposed curriculum has a slightly greater mathematics and programming component than the minimum ABET requirements in the basic sciences and mathematics.

The ABET criteria also note the requirements of the institution, and in the case of UT-Austin, those requirements include the THECB-approved core curriculum. The faculty determined that the proposed curriculum with its 122 SCH was the minimum curriculum that could satisfy the core curriculum and ensure that this degree program would eventually procure ABET accreditation (which cannot be sought until at least one student has graduated from the program).

GENERAL CRITERION 5. CURRICULUM

The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:

(a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences.

(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.

(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.

One year is the lesser of 32 semester hours (or equivalent) or one-fourth of the total credits required for graduation.

2. Please provide the approved lists of Computational Engineering technical electives.

Response: The courses that are to be computational engineering electives are shown below. This list has been expanded since the original list was submitted in the proposal. Each student will be required to take two technical electives (6 SCH). As in our existing Aerospace Engineering degree plans, additional courses can be added with the approval of the ASE/EM faculty. All electives are upper-division courses.

Computational Engineering Technical Electives
Aerospace Engineering 357, Mechanics of Composite Materials
Aerospace Engineering 365, Structural Dynamics
Aerospace Engineering 366K, Spacecraft Dynamics
Aerospace Engineering 370L, Flight Control Systems
Aerospace Engineering 372N, Satellite-Based Navigation
Computational Engineering 379K, Undergraduate Research
Computational Engineering 679HB, Undergraduate Honors Thesis
Engineering Mechanics 360, Finite Element Methods

Mathematics 348, Scientific Computation in Numerical Analysis
Mathematics 368K, Numerical Methods for Applications
Mathematics 374M, Mathematical Modeling in Science and Engineering
Mathematics 378K, Introduction to Mathematical Statistics
Statistics and Data Sciences 321, Introduction to Probability and Statistics
Statistics and Data Sciences 335, Scientific and Technical Computing
Statistics and Data Sciences 339, Applied Computational Science
Statistics and Data Sciences 374C, Parallel Computing for Science and Engineering
Statistics and Data Sciences 374D, Distributed and Grid Computing for Science and Engineering
Statistics and Data Sciences 374E, Visualization and Data Analysis for Science and Engineering
Mechanical Engineering 343, Thermal-Fluid Systems
Mechanical Engineering 344, Dynamic Systems and Controls
Mechanical Engineering 354M, Biomechanics of Human Movement
Mechanical Engineering 355K, Engineering Vibrations
Mechanical Engineering 360, Vehicle System Dynamics/Controls
Mechanical Engineering 379M, Computational Methods in Thermal/Fluid Systems

3. Formula funding calculations depend upon which courses are taken at what level, so please indicate which required and elective courses are at the lower-division level and which are at the upper-division level.

Response: The list below shows the breakdown between lower division courses and upper division courses. Some of the non-technical requirements (e.g., social science elective) are chosen from a list in which some courses are lower division and others are upper division; we have chosen the more conservative option in this listing and noted all as lower division. The course numbering system at UT-Austin indicates the number of credits with the first digit and the level of the course with the second and third digits. For these latter digits, lower division courses are 01-19 and upper division courses are 20-79.

Lower Division (66 SCH):

- Math and Science Courses (19 SCH): M 408C, M 408D, CH 301, PHY 303K, PHY 103M, PHY 303L, PHY 103N
- Non-Technical Courses (27 SCH): RHE 306, UGS 302 (or 303), GOV (6 hours), HIS (6 hours), Humanities Elective (3 hours), Visual and Performing Arts Elective (3 hours), Social Science Elective (3 hours)
- Engineering Courses (20 SCH): EM 306, EM 311M, EM 319, COE 301, COE 211K, COE 111L, ME 210, ME 310T

Upper Division (56 SCH):

- Specifically required courses (53 SCH): M 427J, M 427L, M 362K, ASE 333T, ASE 320, ASE 330M, ASE 347, ASE 375, COE 321K, COE 352, COE 371, COE 372, COE 373, COE 374, SDS 322, SDS 329C (or M 340L)
- Technical Electives in various categories (6 SCH)

4. Please indicate if there any provisions to promote accelerated degree completion: competency-based learning, credit for prior learning, transfer credits, placing out of courses by exam, etc.

Response: The UT-Austin rules for all of these items are detailed in the Undergraduate Catalog, and these rules apply to all programs within the University, including the proposed Computational Engineering degree program. Students in Aerospace Engineering regularly bring in transfer credits and advanced placement credits that help to promote accelerated degree completion and this will be expected for Computational Engineering students as well.

5. Please also indicate if there are any plans for distance education or alternative content delivery.

Response: At this time, there are no plans for distance education or alternative content delivery for any part of the proposed curriculum.

6. Will there be any relationship between the proposed program and the existing MS and PhD programs?

Response: There is not a graduate program in Computational Engineering. The closest comparison is the Computational Science, Engineering and Mathematics (CSEM) MS and PhD degrees, but those are not housed in the Department of Aerospace Engineering and Engineering Mechanics—they are part of an interdisciplinary program run through the Institute for Computational Engineering and Sciences. COE 371 (Applied Math I) and COE 372 (Applied Math II) are derived from classes that graduate students take in CSEM, Aerospace Engineering and Engineering Mechanics graduate programs. Other than this course relation, there is not currently a relationship to be proposed.

7. Will graduate students be teaching or running lab sections?

Response: Doctoral students will serve as teaching assistants and help to organize and execute laboratories for some courses.

IV. Faculty

Please note that some courses assigned to faculty were labeled differently than is ultimately anticipated—ASE 321K will be changed to 'COE 321K' in Spring 2017, but will still be the same content and same assigned support faculty. COE 353 has since been renumbered as COE 352, but retains the same assigned support faculty. COE 111L was not listed in assignments, but will be developed and run by Dr. Clint Dawson and Dr. Tan Bui-Thanh. All Math (M) and Statistics and Data Sciences (SDS) courses have been approved to allow for additional enrollment by their respective department Chairs.

V. Students

1. Please provide admission requirements. Is entry to the program competitive? What are the minimum test scores, minimum GPA, or other requirements?

Response: FTIC (First Time in College) admission to all programs at UT-Austin is handled by the Admissions Office. Entry to all engineering programs is quite competitive. A document explaining the admissions process is attached as Appendix A. Internal transfer (from other majors at UT-Austin) admission requires a minimum GPA of 3.25 overall and technical GPA, however minimum GPAs will vary year to year based on the applicant pool for internal transfer. Internal transfer into any Engineering major requires completion of M 408C, M 408D, PHY 303K, PHY 103M and several residency requirements that are outlined on the Cockrell School's website here:
http://www.engr.utexas.edu/undergraduate/admissions/changeofmajor

VI. Evaluation

Please provide a description of the relevant ABET, SACSCOC, and internal evaluation standards.

Response: The relevant ABET evaluation standards are shown in Appendix B; this appendix includes the ABET criteria that is relevant to all undergraduate engineering programs. There is presently not criteria for Computational Engineering specifically since this is the first undergraduate degree of its kind in the United States. Dr. Wallace Fowler, long-time ABET evaluator (http://www.abet.org/blog/news/wallace-fowler-23-visits-and-counting/) and faculty in the Department of Aerospace Engineering and Engineering Mechanics for over 50 years has assured us that there will not be a problem with earning accreditation after we graduate our first student. It is a process we will be prepared to undertake and have already started gathering information that is needed to begin the process. We will contact ABET representatives once we gain approval from THECB.

The SACSCOC standards are explained in detail in a document entitled "Principles of Accreditation" which is available in its entirety at the following URL:
www.sacscoc.org/pdf/2012PrinciplesOfAcreditation.pdf
The following excerpt from that document encapsulates the critical criteria for evaluation of programs.

The Commission on Colleges adheres to the following fundamental characteristics of accreditation (p. 3, Principles of Accreditation):

- Participation in the accreditation process is voluntary and is an earned and renewable status.
- Member institutions develop, amend, and approve accreditation requirements.
- The process of accreditation is representative, responsive, and appropriate to the types of institutions accredited.
- Accreditation is a form of self-regulation.
- Accreditation requires institutional commitment and engagement.
- Accreditation is based upon a peer review process.
- Accreditation requires an institutional commitment to student learning and achievement.
- Accreditation acknowledges an institution's prerogative to articulate its mission, including a religious mission, within the recognized context of higher education and its responsibility to show that it is accomplishing its mission.
- Accreditation requires institutional commitment to the concept of quality enhancement through continuous assessment and improvement.
- Accreditation expects an institution to develop a balanced governing structure designed to promote institutional integrity, autonomy, and flexibility of operation.
- Accreditation expects an institution to ensure that its programs are complemented by support structures and resources that allow for the total growth and development of its students.

Internal evaluation of the program will be extensive throughout the first five years of the program to ensure that the students are well prepared for either professional practice or graduate studies in computational engineering. A sub-committee of faculty will utilize the ABET evaluation system developed by Dr. Fowler (see Appendix C) to continuously monitor the progress of students and assess whether they are successfully meeting ABET criteria and if they will be able to apply knowledge gained in early courses to the subjects that come later. An integral part of the ABET accreditation process is to have an extensive internal evaluation system, including feedback from students, graduates, and employers. We will conduct surveys and in-person interviews with students at the end of each semester for the first two years and with graduating seniors in their final semester to gain input and suggestions for future changes as they might be needed. If any part of this multi-level evaluation process leads us to believe that the curriculum needs to be changed, we will undertake such changes.

VII. Costs

Please confirm that there are no costs for personnel.

Response: There will be no new personnel costs for this program as the BS Aerospace Engineering program will be reduced in enrollment to correspond with the increase in BS Computational Engineering enrollment. Therefore, the total undergraduate enrollment in the Department of Aerospace Engineering and Engineering Mechanics will not change with the introduction of the new degree program. Fewer BS Aerospace Engineering students and overlap of courses required for Computational Engineering which are also required for Aerospace Engineering will allow the shuffling of teaching assignments such that the proposed program will be cost neutral.

VIII. Funding

Please complete the Program Funding Estimation Tool for the projected enrollments if not all students for the first five years will be transfers from existing programs. If the full enrollment in the proposed program is expected to draw from existing undergraduate programs, then please provide details on what programs will be losing up to 100 students per year by the fifth year, and how the College will be impacted by the shifts created by the proposed program.

Response: As noted above, the number of students in the Aerospace Engineering program will be reduced by the same numbers as added to the Computational Engineering program. This change is expected to have no significant impacts. As we allow internal transfers from other majors, the total number allowed for internal transfer admission will be one total number in consideration for the entire department (both ASE and COE major numbers combined). The Program Funding Estimation Tool is attached as Appendix D.

Please confirm that there will be no costs for labs or equipment for the proposed program.

Response: There is only one lab added (COE 111L) that is not already part of the Aerospace Engineering degree requirements. The COE 111L lab is computer-based and will be taught using the facilities that are already available for Aerospace Engineering students. The reduced enrollment in labs required for aerospace students only (Aerospace Materials Lab, Low-Speed Aerodynamics Lab and High-Speed Aerodynamics Lab) will more than make up for any cost that might have been associated with the addition of COE 111L.

Please confirm that the program has no designated tuition or fees, including lab fees, above the general tuition for all undergraduates at your institution.

Response: All undergraduate students in the Cockrell School pay tuition on the same flat-rate scale, as will the students in the proposed new program.

Appendix A
Admission to the Cockrell School of Engineering at The University of Texas at Austin

CRITERION 1. STUDENTS

A. Student Admissions

FRESHMAN ADMISSION

Eligibility to Apply

To be eligible to apply for freshman admission, an applicant must:

- Have graduated or be on track to graduate from high school or receive a GED and
- Not have enrolled in another college or university after graduating from high school or earning a GED.
- In addition, Texas applicants who believe they may be eligible for automatic admission must meet or be on track to meet the high school coursework requirements defined in the state's Uniform Admission Policy or coursework that is equal in content and rigor. Public high school applicants must graduate under the state's Foundation High School Program with a distinguished level of achievement, or the Recommended or Advanced High School Program; the Distinguished Program is also an option. The Uniform Admission Policy is defined in sections 51.801 through 51.809 of the Texas Education Code.

High school coursework exemptions are available for Texas applicants who attend private high schools or Department of Defense high schools who may be eligible for automatic admission. An applicant claiming an exemption must (1) achieve certain benchmarks on either the SAT or the ACT and (2) meet UT Austin's minimum high school coursework requirements. Submitting a certification/exemption form completed by a high school counselor may also serve as an exemption.

No student is exempt from the University's minimum coursework requirements: four units of language arts, two units of a single foreign language, three units of mathematics at the level of Algebra I or higher, two units of science, three units of social studies, one and one-half units of electives, and one-half unit of fine arts.

Meeting the minimum requirements makes a student eligible to apply for admission, but exceeding the minimum is often necessary for applicants to be competitive for admission to many of the University's academic programs.

Under Texas law, graduates of unaccredited high schools may seek admission to the University.

Admission Deficiencies

Some applicants may be required to complete the University's deficiency process in order to meet UT Austin's minimum coursework requirements. Applicants who appear to be deficient after applying for admission are notified by the Office of Admissions that they must submit additional information through an online process. Notified students who fail to complete the deficiency process will not be considered for admission.

Admitted students must complete the coursework required to remove a deficiency before they enroll at the University. A deficiency in foreign language must be removed by achieving first-year college-level credit in a foreign or classical language or by earning a passing score on the appropriate placement examination given by the University. A deficiency in mathematics must be removed by earning credit for Mathematics 301, College Algebra, or Mathematics 303D, Applicable Mathematics, or an equivalent transfer course. For all other subjects, one semester of college credit is required to remove a deficiency of one year or less of high school credit.

Freshman Application Procedures

To be considered for admission as a freshman, an applicant must submit the following items by the deadline:

- Application and essays. A completed US Freshman Apply Texas Application, including at least two required essays.
- Transcript and rank. An official high school transcript showing coursework information through the end of the junior year along with information about the applicant's class rank and high school class size (usually noted on the transcript).
- Student Information form: A completed Student Information Form submitted online, providing responses to all required items.
- High school coursework or exemption information. Documentation showing that the applicant is on track to meet high school coursework requirements or is requesting an exemption; applicants who claim an exemption based on equivalent coursework must submit a certification/exemption form as described above.
- Test score. An official test score report for the SAT Reasoning Test, including the student-written essay, or for both the ACT Assessment and the ACT Writing Test. Scores must be sent directly from the testing agency to be considered official.
- Fee or waiver request. The application processing fee or a request for a fee waiver.
- Additional information about applying for freshman admission, including details about reporting rank, high school coursework requirements, and testing requirements, is available on the Freshman Admissions Web site.
- International applicants interested in applying for freshman admission should review the International Admission information in this catalog.
- Reporting dual credit. A freshman applicant may not disregard any part of his or her academic record, including college credit earned as dual credit. Such coursework must be reported on the Apply Texas application, and the applicant must submit official transcripts of the coursework.

Freshman Application Review Process

The Office of Admissions uses an individualized, holistic review process to consider each completed freshman application. Applications from students who qualify for automatic admission are reviewed to determine majors. Applications from students who are not eligible for automatic admission are reviewed to determine admissibility and to make decisions about majors.

The following items are considered during holistic review:

- Class rank
- Strength of academic background
- SAT Reasoning Test or ACT scores
- Record of achievements, honors, and awards
- Special accomplishments, work, and service both in and out of school
- Essays
- Special circumstances that put the applicant's academic achievements into context, including his or her socioeconomic status, experience in a single parent home, family responsibilities, experience overcoming adversity, cultural background, race and ethnicity, the language spoken in the applicant's home, and other information in the applicant's file
- Recommendations (although not required)
- Competitiveness of the major to which the student applies
- No specific class rank, test score, or other qualification by itself—other than automatic admission based on section 51.803 of the Texas Education Code—ensures admission.

Admission decisions are made on the basis of the information submitted as part of the student's application. Applicants who believe that supplemental items will help convey information about their qualifications are encouraged to submit such items with their applications. Supplemental items often included with applications are expanded résumés of accomplishments and extracurricular activities, letters of recommendation, and letters addressing an applicant's special circumstances.

Admission Decisions

The Office of Admissions reviews complete freshman applications to determine which students will be offered admission, either through automatic admission based on Texas law or through holistic review, and to make decisions about majors for all admitted students.

Texas applicants eligible for automatic admission. Section 51.803 of the Texas Education Code defines the rules that govern automatic admission to Texas universities. Under these rules, the University is required to use automatic admission to fill at least 75 percent of the spaces available to Texas residents in each entering freshman class.

Each September, the University informs school districts of the rank that will be required to earn automatic admission to the University in the next application cycle. On September 15, 2014, the University notified school districts that it will automatically admit students in the top 8 percent of their high school classes to summer/fall 2016 and to spring 2017. In order for a student to qualify for automatic admission, the high school must report the student's rank as prescribed by section 51.803 of the Texas Education Code.

To be considered for admission to the Cockrell School of Engineering, the Jackson School of Geosciences, and the Environmental Science major in the College of Liberal Arts and the College of Natural Sciences, applicants who are otherwise eligible for automatic admission to the University must meet the calculus-readiness requirement. To be considered for admission to other math-intensive majors (mathematics, business, physics, or computer science), an applicant who is otherwise eligible for automatic admission to the University but does not meet the calculus-readiness requirement is offered admission to another major at the University.

Automatic admission for military/veteran applicants. Students who qualify for automatic admission to UT Austin at the time they graduate from high school and who join the military after graduation maintain eligibility for automatic admission for the period of time they serve in the military. Military or veteran applicants interested in enrolling at UT Austin following military service who have not enrolled in college-level coursework since high school graduation should apply for freshman admission. Such applicants are reviewed holistically with the freshman applicant pool to determine the major to which they will be offered admission. Qualified applicants who have enrolled in college-level coursework since high school graduation should apply for transfer admission.

Applicants not eligible for automatic admission. To be considered for freshman admission, applicants who are not eligible for consideration under the provisions of section 51.803 of the Texas Education Code must normally have graduated from or be on track to graduate from high school and have met the high school preparation requirements.

As a state-assisted institution, the University reserves 90 percent of its spaces for Texas residents per Texas law; 10 percent of the spaces are reserved for out-of-state and international students.

Alternative Paths to Admission

As part of the freshman admission decision process, the Office of Admissions may invite a limited number of fall applicants to join the freshman wait list. The University also works to identify and develop alternative admission programs that offer prospective students a clear path to completion of an undergraduate degree at the University. In 2015, two such programs are in place.

Path to Admission through Co-Enrollment (PACE). PACE, the University's co-enrollment program with Austin Community College (ACC), offers selected freshman applicants who are not offered full-time admission to UT Austin an opportunity to co-enroll for one year at UT Austin and ACC.

PACE students spend the fall and spring semesters of their freshman year completing required transferable coursework at ACC and one course per semester in residence at UT Austin. Students who successfully complete the coursework requirements and attain the required grade point average are guaranteed admission into UT Austin's College of Liberal Arts when they transition to full-time status. PACE participants may request to compete for admission to majors in other colleges and schools when transitioning.

The Coordinated Admission Program. The University of Texas System established the Coordinated Admission Program (CAP) as an opportunity for eligible applicants who are not admitted as freshmen to complete their undergraduate studies at UT Austin. CAP is offered to Texas residents who meet the University's high school preparation requirements, complete a freshman application for admission to UT Austin by the required deadline, and meet the enrollment requirements of at least one of the UT System universities participating in CAP for the designated academic year.

CAP students spend their freshman year in residence at a participating UT System component institution other than UT Austin. Students who are offered participation choose from a list of institutions open to them when they complete the CAP agreement. The agreement also provides details about the requirements students must meet to successfully complete the program and obtain admission to UT Austin as regular students in the fall semester following their year in CAP. Students are guaranteed admission into the College of Liberal Arts at UT Austin. CAP participants may request to compete for admission to majors in other colleges and schools. Information about CAP requirements for the 2015-2016 academic year is available on the CAP Web site.

Whenever admission through CAP exceeds 60 percent of total external undergraduate transfer admission, a review of the CAP requirements for entry into UT Austin will be conducted and new requirements will be established as appropriate.

APPENDIX B

ABET Criteria for Undergraduate Degree programs (Excerpted from a longer ABET document)

CRITERIA FOR ACCREDITING ENGINEERING PROGRAMS

Effective for Reviews During the 2016-2017 Accreditation Cycle

Incorporates all changes
approved by the
ABET
Board of Delegates
Engineering Area Delegation
as of
October 16, 2015

ABET

Engineering Accreditation Commission

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E001 10/20/2015

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Requests for further information about ABET, its accreditation process, or other activities may be addressed to the Director, Accreditation Operations, ABET, 415 N. Charles Street, Baltimore, MD 21201 or to accreditation@abet.org.

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Criteria for Accrediting Engineering Programs
Effective for Reviews during the 2016-2017 Accreditation Cycle

Definitions

While ABET recognizes and supports the prerogative of institutions to adopt and use the terminology of their choice, it is necessary for ABET volunteers and staff to have a consistent understanding of terminology. With that purpose in mind, the Commissions will use the following basic definitions:

<u>Program Educational Objectives</u> – Program educational objectives are broad statements that describe what graduates are expected to attain within a few years of graduation. Program educational objectives are based on the needs of the program's constituencies.

<u>Student Outcomes</u> – Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program.

<u>Assessment</u> – Assessment is one or more processes that identify, collect, and prepare data to evaluate the attainment of student outcomes. Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the outcome being measured. Appropriate sampling methods may be used as part of an assessment process.

<u>Evaluation</u> – Evaluation is one or more processes for interpreting the data and evidence accumulated through assessment processes. Evaluation determines the extent to which student outcomes are being attained. Evaluation results in decisions and actions regarding program improvement.

This document contains three sections:

The first section includes important definitions used by all ABET commissions.

The second section contains the General Criteria for Baccalaureate Level Programs that must be satisfied by all programs accredited by the Engineering Accreditation Commission of ABET and the General Criteria for Masters Level Programs that must be satisfied by those programs seeking advanced level accreditation.

The third section contains the Program Criteria that must be satisfied by certain programs. The applicable Program Criteria are determined by the technical specialties indicated by the title of the program. Overlapping requirements need to be satisfied only once.

These criteria are intended to assure quality and to foster the systematic pursuit of improvement in the quality of engineering education that satisfies the needs of constituencies in a dynamic and competitive environment. It is the responsibility of the institution seeking accreditation of an engineering program to demonstrate clearly that the program meets the following criteria.

I. GENERAL CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS

All programs seeking accreditation from the Engineering Accreditation Commission of ABET must demonstrate that they satisfy all of the following General Criteria for Baccalaureate Level Programs.

Criterion 1. Students

Student performance must be evaluated. Student progress must be monitored to foster success in attaining student outcomes, thereby enabling graduates to attain program educational objectives. Students must be advised regarding curriculum and career matters.

The program must have and enforce policies for accepting both new and transfer students, awarding appropriate academic credit for courses taken at other institutions, and awarding appropriate academic credit for work in lieu of courses taken at the institution. The program must have and enforce procedures to ensure and document that students who graduate meet all graduation requirements.

Criterion 2. Program Educational Objectives

The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented, systematically utilized, and effective process, involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria.

Criterion 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Criterion 4. Continuous Improvement

The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.

Criterion 5. Curriculum

The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:

(a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences.

(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.

(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.

One year is the lesser of 32 semester hours (or equivalent) or one-fourth of the total credits required for graduation.

Criterion 6. Faculty

The program must demonstrate that the faculty members are of sufficient number and they have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students.

The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching effectiveness and experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and licensure as Professional Engineers.

Criterion 7. Facilities

Classrooms, offices, laboratories, and associated equipment must be adequate to support attainment of the student outcomes and to provide an atmosphere conducive to learning. Modern tools, equipment, computing resources, and laboratories appropriate to the program must be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and to support program needs. Students must be provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories available to the program.

The library services and the computing and information infrastructure must be adequate to support the scholarly and professional activities of the students and faculty.

Criterion 8. Institutional Support

Institutional support and leadership must be adequate to ensure the quality and continuity of the program.

Resources including institutional services, financial support, and staff (both administrative and technical) provided to the program must be adequate to meet program needs. The resources available to the program must be sufficient to attract, retain, and provide for the continued professional development of a qualified faculty. The resources available to the program must be sufficient to acquire, maintain, and operate infrastructures, facilities, and equipment appropriate for the program, and to provide an environment in which student outcomes can be attained.

II. <u>GENERAL CRITERIA FOR MASTER'S LEVEL AND INTEGRATED BACCALAUREATE-MASTER'S LEVEL ENGINEERING PROGRAMS</u>

Programs seeking accreditation at the master's level from the Engineering Accreditation Commission of ABET must demonstrate that they satisfy the following criteria, including all of the aspects relevant to integrated baccalaureate-master's programs or stand-alone master's programs, as appropriate.

Appendix C
Department of Aerospace Engineering and Engineering Mechanics
ABET Evaluation Procedure

CRITERION 4 -- CONTINUOUS IMPROVEMENT

ABET Criterion 4 states:
The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.

A. Student Outcomes

This section describes the design of the assessment and continuous improvement processes used to gather data upon which the evaluation of student data has been based. The design of our assessment process has evolved over its period of development. Our basic design goal was to produce an effective, relatively simple, sustainable process. In order to do this, we developed formal design requirements based on Criterion 4. The following terms are used in the discussion of our student outcomes assessment and continuous improvement processes.

Definitions:

ABET Cycle – This is a six year cycle based on the general review ABET accreditation process. The ABET general review occurs in the fall semester of year 1 of the general review cycle.

Aerospace Program Criteria – the Aerospace Program Criteria published by ABET.

Assessment Semester – This is a semester in which Student Work data are collected. For the current ABET cycle, we ran a test semester in fall 2012 and collected student work to provide evidence of attainment of Student Outcomes (SOs) in Spring 2013 and Fall 2014.

Student Outcome (SO) – any of ABET's student outcomes (a-k)

Student Outcomes Assignment Review (SOAR) – This is the review of an assignment designed to target one or more SOs. This review is of the assignment and solution only, and not student work. As any given course involves multiple outcomes, usually, multiple assignments are required to demonstrate assignments associated with each outcome associated with that course.

Student Work Outcomes Review (SWOR) – This is the review process that assesses the work of all students in a class on an assignment that targets a particular SO. In this review, the work of every student in the course on that assignment is reviewed by multiple faculty members to determine the level of attainment of that outcome.

Targeted Student Outcome – This is a student outcome (SO) that has been chosen for data collection, either for the SWOR process or the SOAR process. For most courses, the full set of student outcomes associated with a course will not be targeted for collection of student work during a given Assessment Semester. Exceptions to this are the writing course, specific laboratories, and the capstone design sequences where student work is used to demonstrate attainment of multiple SOs.

A.1 Student Outcomes Assessment Process

The current student outcomes assessment and continuous improvement systems evolved from the processes used for the 2010 ABET Accreditation. In the 2010 student outcomes assessment process, massive amounts of data were periodically collected and selectively analyzed to show the degree to which each of the eleven student outcomes (a)-(k) were being achieved. An assessment of the 2010 process after the ABET visit revealed that most of the student work data were redundant and only cursorily used in the student outcomes assessment process. Upon closer examination, it was found that much smaller data samples from selected courses were sufficient to determine the degree to which students were attaining the SOs. Subsequently, we developed a prototype for the new procedure. As a test, we collected data for a few selected courses in fall 2012. From the 2012 data, we decided to use two processes: (1) collection and evaluation of student work in selected courses to assess attainment SOs and to provide information for curriculum improvement, and (2) the evaluation of assignments targeting SOs in all courses separately to provide additional information for continuous curriculum improvement.

In the spring 2013, we collected SWOR student work (SWOR process) from courses selected from required aerospace engineering courses in the program. We also collected assignments targeting student outcomes for a larger set of courses (SOAR process). The submissions were non-uniform and the information obtained was not as good as expected. A majority of our faculty members did not understand what was expected of them. This led us to rework our system requirements and faculty instructions for a fall 2014 assessment.

In fall 2014, using feedback from the partially successful spring 2013 evaluations, we decided to develop our student outcomes assessment and continuous improvement systems using engineering design methodology.

A.1.1 Student Work Outcomes Review (SWOR) Process Description

For the **SWOR** assessment, the instructor is required to submit copies of the work of all of the students in the class on a single assignment that targets the SO selected for the review. After the assignment is graded, the instructor assesses the degree to which, in his/her opinion, demonstrate that the targeted SO is being attained by the students in the class. The assignment, the student work, and the instructor's assessment are then reviewed by other members of the faculty who assess the degree to which each SO is being attained. The assessment is made on a five point scale. A sixth score (zero) is included in the scale for the situation in which no student work is provided to be assessed. The scale is shown below:

5 ~ excellent attainment of the SO by almost all of the students

4 ~ satisfactory attainment of the SO by at least 75% of students

3 ~ above marginal attainment of the SO by at least 60% of students

2 ~ poor attainment of the SO by a majority of students

1 ~ little or no attainment of the SO by most of the students

0 ~ no student work is provided

The acceptable score for student attainment of each SO is a 4 or better.

The assessments are reviewed and summarized. If a score lower than 4 results from an assessment, the faculty members making the assessment provide recommendations for improvement. Recommendations for improvement in the course are fed back to the instructor while recommendations for course / curriculum changes are forwarded to the aerospace engineering curriculum committee.

A.1.2 Redesign/Improvement of the SWOR Process

Assessment of the fall 2013 SWOR process itself revealed that we needed better written and oral instructions to faculty members. Some faculty members produced assignments and three examples of student work on an assignment (the pre-2010 assessment model) while others completely forgot to collect data. However, we assessed attainment of SOs based on the data provided and used the problems with the data process itself to tune the assessment process. In particular, these problems inspired the development of formal goals and design requirements for the Student Outcomes Assessment and Continuous Improvement Processes. These goals and requirements for the SWOR process are described below.

Student Outcomes Assessment System Design Goals

The goals for our system to assess the degree to which our students are attaining ABET student outcomes (a) – (k) and the aerospace engineering program outcomes are:

(1) to identify, efficiently collect, and analyze appropriate data that allows us to assess the degree to which students attain each student outcome,
(2) to use the results of the analysis, plus other data, to improve the curriculum,
(3) to standardize the data analysis and feedback mechanisms, and
(4) to allow the system to evolve in order to make it more efficient, simpler, more responsive, and sustainable.

The following design requirements were used to redesign the SWOR processes for the fall 2014 assessment.

Requirements for
Assessment of the Degree of Attainment
of Student Outcomes (SWOR Process)

The first sentence of Criterion 4 states: ***"The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained."*** This statement is used as the basis for the following requirements.

1. "*The program ~~must~~ shall ~~regularly~~ use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained.*" (ABET Criterion 4)
   Rationale: This is a modified statement from the ABET's Engineering Program Accreditation Document. The word "must" was replaced by the word "shall" to conform to

systems engineering standards. The term "regularly" was removed here as it is used to generate the second requirement below.

2. There shall be two occurrences, called ***Assessment Semesters***, during which student outcomes data are collected during each 6 year ABET cycle.
   Rationale: This is done to meet the requirement for regular assessment and evaluation and to provide regular feedback for curriculum improvement.
3. Where feasible, the system shall assess attainment of Student Outcomes (SOs) in courses near the culmination of the curriculum.
   Rationale: The requirement is to assess the degree to which students are attaining the specified student outcomes. The curriculum is a building block process designed for each student to become more proficient in each SOs as he/she progresses through the curriculum. Hence, it is most appropriate to evaluate the degree of SO attainment as close to graduation as is feasible. This can be done efficiently by selecting, assessing, and evaluating detailed student data from selected courses near the end of the curriculum. This process is called the ***Student Work Outcomes Review (SWOR)***.
4. The detailed student work selected for assessment of each targeted SO shall be evaluated and assessed by the course instructor at the end of the Assessment Semester prior to a second assessment by other program faculty.
   Rationale: Assessment and evaluation of student work by the instructor is a key part of the SWOR process. The instructor has the most information about the assignment, class, and student work.
5. At least two faculty members other than the instructor shall evaluate student work targeting each SO to determine the degree to which each student outcome is being attained by the students and provide feedback to course instructors when appropriate.
   Rationale: This evaluation is heart of the assessment of student attainment of the SOs and aerospace program criteria. These faculty members provide an independent assessment and evaluation of the degree of attainment of each SO and provide feedback for course improvement and curriculum change. This assessment and the resulting feedback to the faculty are essential for curriculum improvement.

A.2 Frequency of SWOR Assessment

During the ABET Cycle under review, there were two assessment semesters, spring 2013 and fall 2014. The spring 2013 data collection served as the prototype for the system and was critiqued strongly, resulting in a streamlined process in fall 2014.

In the future, student work will be collected twice during each six year ABET cycle, in the spring of the second year of the cycle and in the fall of the fourth year of the cycle. The student work assessment by the faculty assessment team will then occur during the fall of the second year of the cycle and the spring of the fifth year of the cycle. These data will then be used in the self-assessment document that will be written in the spring and summer of the fifth year of the cycle and the fall of the sixth year of the cycle. The document will be edited during the spring of the sixth year of the cycle and will be submitted to ABET during the summer of the sixth year of the cycle, leading to the accreditation visit of ABET experts in the fall of the first year of the next ABET cycle.

Appendix D
Program Funding Estimation Tool

Texas Higher Education Coordinating Board - General Academic Institution - Program Funding Estimation Tool

Instructions

Insert the credit hours projected to be taken for all students per semester into the appropriate field. Select the discipline and level from the drop-down menus. The spreadsheet will estimate the total amounts.

Assumptions

1. Calculations are based on hours taken, not Full-Time Student Equivalent (FTSE) or headcount. This model accounts for credit hours taken at different academic levels, across various disciplines, and at different loads during the fall, spring, and summer semesters.
2. Hours used to calculate formula funding are based on the summer and fall of even numbered years and the spring of odd numbered years. For example, summer and fall 2010 and spring 2011 (Base Year 2011) are used to allocated funds for both fiscal years 2012 and
3. The program's formula funding forecast will include hours from the various disciplines that a student must take to complete the degree, not just hours from the named discipline of the program.
4. The level of the hours funded is the level of the course or the student's enrollment classification, whichever is lowest.
5. The program's new cost to the state is the funding rate reduced by the institution's estimated statutory tuition.
6. Funding is not generated for the first two years the program generates semester credit hours.
7. The funding rate is held constant into future years.
8. This model's information and assumptions are subject to change, and the estimates are not a guarantee of funding.

Designated Tuition Rate	$	5,260.00
Statutory Tuition Rate	$	50.00
(FY 10-11)		$55.39

Five-Year Total			FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
Total Student-Based Funding	$	47,609,730	$ -	$ 4,938,300	$ 11,443,050	$ 14,857,515	$ 16,370,865
Student Fees (TEC, Chapters 51, 54, and 55)	$	-	$ -	$ -	$ -	$ -	$ -
Board Authorized Tuition	$	-	$ -	$ -	$ -	$ -	$ -
Designated Tuition	$	46,814,000	$ -	$ 4,891,800	$ 11,335,300	$ 14,543,900	$ 16,043,000
General Revenue Estimate (State's Portion)	$	350,730	$ -	$ -	$ -	$ 175,365	$ 175,365
Statutory Tuition Estimate (Student's Portion)	$	445,000	$ -	$ 46,500	$ 107,750	$ 138,250	$ 152,500

Note: The table above converts the table below from calendar year to fiscal year. The general revenue presented above represents the estimated allocated portion based on the "Base Year." See assumption 2.

Starting (Calendar) Year	2017	2017			2018		
Starting Semester	Fall			Fall	Spring	Summer	Fall
Total Student Based Funding		$ -	$ -	$ 2,512,767	$ 2,512,567	$ -	$ 5,878,500
Student Fees		$ -	$ -	$ -	$ -	$ -	$ -
Board-Authorized Tuition		$ -	$ -	$ -	$ -	$ -	$ -
Designated Tuition (TEC, Section 54.0513)		$ -	$ -	$ 2,445,900	$ 2,445,900	$ -	$ 5,733,400
Formula Funding Estimate		$ -	$ -	$ 66,867	$ 66,667	$ -	$ 145,100
General Revenue Estimate (State's Portion)		$ -	$ -	$ 43,617	$ 43,417	$ -	$ 90,600
Statutory Tuition Estimate (Student's Portion) (TEC, Section 54.051)		$ -	$ -	$ 23,250	$ 23,250	$ -	$ 54,500
Full-Time Student Equivalents		-	-	31	31	-	73
Semester Credit Hours		-	-	465	465	-	1,090
Course List: Discipline	**Level**						
Engineering	Undergraduate Lower Level			120	135	0	160
Liberal Arts	Undergraduate Lower Level			45	90	0	225
Science	Undergraduate Lower Level			60	0	0	220
Engineering	Undergraduate Upper Level			90	135		315
Science	Undergraduate Upper Level			150	105		170
Estimated Formula Funding: Discipline	**Level**						
Engineering	Undergraduate Lower Level	$ -	$ -	$ 15,819.38	$ 17,796.81	$ -	$ 21,092.51
Liberal Arts	Undergraduate Lower Level	-	-	2,492.55	4,985.10	-	12,462.75
Science	Undergraduate Lower Level	-	-	5,915.65	-	-	21,690.72
Engineering	Undergraduate Upper Level	-	-	17,547.55	26,321.33	-	61,416.43
Science	Undergraduate Upper Level	-	-	25,091.67	17,564.17	-	28,437.23
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-
		-	-	-	-	-	-

2019			2020			2021		
Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
$ 5,739,915	$ -	$ 7,551,955	$ 7,357,325	$ -	$ 8,367,276	$ 8,087,050	$ -	$ 8,367,276
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 5,601,900	$ -	$ 7,364,000	$ 7,179,900	$ -	$ 8,153,000	$ 7,890,000	$ -	$ 8,153,000
$ 138,015	$ -	$ 187,955	$ 177,425	$ -	$ 214,276	$ 197,050	$ -	$ 214,276
$ 84,765	$ -	$ 117,955	$ 109,175	$ -	$ 136,776	$ 122,050	$ -	$ 136,776
$ 53,250	$ -	$ 70,000	$ 68,250	$ -	$ 77,500	$ 75,000	$ -	$ 77,500
71	-	93	91	-	103	100	-	103
1,065	-	1,400	1,365	-	1,550	1,500	-	1,550

240	0	200	300		200	300		200
255	0	285	330		300	375		300
160	0	275	200		275	200		275
285	0	420	375		525	450		525
125	0	220	160		250	175		250

$ 31,638.77	$ -	$ 26,365.64	$ 39,548.46	$ -	$ 26,365.64	$ 39,548.46	$ -	$ 26,365.64	$ 131.83
14,124.45	-	15,786.15	18,278.70	-	16,617.00	20,771.25	-	16,617.00	55.39
15,775.07	-	27,113.41	19,718.84	-	27,113.41	19,718.84	-	27,113.41	98.59
55,567.25	-	81,888.58	73,114.80	-	102,360.72	87,737.76	-	102,360.72	194.97
20,909.73	-	36,801.12	26,764.45	-	41,819.45	29,273.62	-	41,819.45	167.28
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
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