ABET
Self-Study Report

for the

Bachelor of Science in Mechanical Engineering Program

at

University at Buffalo,
The State University of New York

Buffalo, New York, 14260

July 1, 2020

CONFIDENTIAL

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Program Self-Study Report for
EAC of ABET
Accreditation or Reaccreditation

BACKGROUND INFORMATION

A. Contact Information

List name, mailing address, telephone number, fax number, and e-mail address for the primary pre-visit contact person for the program.

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B. Program History

Include the year implemented and the date of the last general review. Summarize major program changes with an emphasis on changes occurring since the last general review.

The Mechanical Engineering (ME) program at the University at Buffalo (UB) was founded in 1946 and last reviewed in 2014.

During 2014 and 2015 two significant initiatives resulted in the modification of all programs within the School of Engineering and Applied Sciences (SEAS). The revised programs became effective at the outset of the 2016-17 academic year. The first of these was the launch of SUNY Seamless Transfer, a policy introduced by the SUNY system to improve student mobility between SUNY schools. The policy resulted in the following constraints on SEAS programs.

- All engineering programs were restricted to 128 credit hours. This did not affect the environmental engineering program, as the program was 126 credit hours.

- SUNY Seamless Transfer Paths (SSTP) were developed for nearly all disciplines within the SUNY system. SSTPs consist of a collection of courses that students are expected to complete during the first two years of study. These courses are expected to be either (a) generally available at community colleges or (b) available in an online format. During 2014, colleagues from across the SUNY system contributed to the development of the SSTP for their discipline. The SUNY system then mandated that all programs align with the SSTPs by the 2016-17 academic year. In practice, SEAS programs were required to include all SSTP courses as required courses within their program and schedule these courses within the first two years of study. Moreover, programs needed to show that a student who transferred to UB with the SSTP complete was able to graduate with two additional years of study at UB. The SSTP for the mechanical engineering program is included in Appendix E.

The second initiative results from an extensive review of the University at Buffalo's general education requirements. After consideration discussion, reflection, and analysis, the revised program, termed the UB Curriculum, was launched at the outset of the 2016-17 academic year. This revision resulted in the following changes for SEAS programs.

- The communication literacy requirement was changed from two 3-credit courses taught by the English department to one 4-credit course taught by the English department and a second 3-credit course delivered by the discipline. The switch to this "writing in the discipline" approach was a welcome change from the perspective of SEAS. As a result of this change, SEAS developed a 3-credit course, EAS 360, that focuses on technical writing and professional communication and is delivered by faculty within SEAS. This course is now a degree requirement for all SEAS programs. The course is designed to support communication-intensive courses, such as laboratory and capstone courses, within SEAS.

- Five courses within the humanities, civilizations, arts, and social sciences areas were replaced by thematic and global pathways. Formally, each pathway consists of three 3-credit courses. However, SEAS students are able to select pathway courses such that one of the pathway courses aligns with the major. Therefore, the pathway requirement results in four additional courses outside their major (students are still required to take courses in the humanities, civilizations, arts, and social science) for a typical SEAS student. Also note that one of these four courses must be selected from a pool of Diversity Learning courses to satisfy UB Curriculum requirements in an efficient manner. The switch to this "pathways" approach was also a welcome change from the perspective of SEAS. Within the old system, three of the five courses were prescribed by the university. While more complex in nature, the new system affords considerable flexibility for students to explore topics that they are interested in.

- A 1-credit general education capstone course, UBC 399, was added as a requirement. Within this course, students are expected to produce an e-Portfolio that integrates the knowledge and experiences from their UB Curriculum courses into a meaningful, cross-disciplinary body of knowledge. Students are required to complete multiple reflective essays that bring together topics studied within the thematic and global pathways.

Collectively, these changes resulted in a 1-credit reduction in the credit hour load associated with the UB General Education program.

Since the 2014 review, changes were introduced into the curriculum that include:

a. MAE 177 Introduction to Engineering Drawing and CAD (1 Credit) was taught using (2-D) AutoCAD, which was deemed obsolete. Solidworks, a popular 3-D software, was selected, and the course was moved online using a series of self-guided tutorials. Students now learn the basic process of building a solid model while generating technical drawings. Exams are also given to reinforce the tutorial content and ensure individual comprehension.

b. MAE 277 – Introduction to Mechanical Engineering: Solid modeling, which has been introduced in MAE 177, is now integrated into the course project to reinforce the MAE 177 content.

c. MAE 377 – Product Design in a CAE Environment: Since solid modeling is covered in both MAE 177 and MAE 277, students now enter MAE 377 with a good background in it; previously the course assumed no prior knowledge. This allows MAE 377 to cover more advanced modeling functions and spend more time with Creo Simulate, which is the finite-element analysis software within Creo. Also, important technical drawing knowledge that was previously in MAE177 is now covered in MAE 377. Further, the course has a stronger focus on geometric dimensioning & tolerancing (GD&T), since this subject is increasingly important in contemporary CAD programs.

C. Options

List and describe any options, tracks, concentrations, etc. included in the program.

The official degree title conferred by this program is "**Bachelor of Science in Mechanical Engineering**." There is an option to choose two courses from a "professional practice" or "science and mathematics" track. No options or tracks are declared on diplomas or transcripts.

D. Program Delivery Modes

Describe the delivery modes used by this program, e.g., days, evenings, weekends, cooperative education, traditional lecture/laboratory, off-campus, distance education, web-based, etc.

The courses offered in the ME Program are held principally in the day and occasionally in the evening. A co-op opportunity has been developed within SEAS and is available to our students. In the standard co-op format, students who obtain a co-op position work during the Summer after their Junior year, during the Fall semester of their Senior year, and again during the following Summer. They complete their Senior-year course work during the Senior Spring semester and in an added Fall semester as "super Seniors." Pursuing the co-op opportunity does not change any of our ME course requirements or constitute a separate program mode. Students on a co-op may, however, choose to use their nine months of work experience as a Technical Elective required for the ME degree.

The educational experience in nearly every course is enhanced through web-based tools. The University at Buffalo (UB) supports the learning management system (LMS) *Blackboard* (implemented at UB as *UBLearns*).

Under normal circumstances, no required program courses are taught as web-only courses. Some general education courses are exclusively online. The second half of the Spring 2020 semester was taught exclusively online at the direction of the New York State Governor in response to the COVID-19 pandemic.

E. Program Locations

Include all locations where the program or a portion of the program is regularly offered (this would also include dual degrees, international partnerships, etc.).

The courses offered in the ME program are typically held throughout classrooms located on the North Campus of UB. Lab spaces are located within the Bell, Jarvis, and Furnas buildings. The same facilities at the same locations are used for the double ME/AE degree. We encourage students to study abroad at institutions approved by the UB International Student and Scholar Services (ISSS). All courses are assessed beforehand to ensure their equivalence to UB courses.

F. Public Disclosure

Provide information concerning all the places where the Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment, and graduation data specific to the program is posted or made accessible to the public. If this information is posted to the Web, please provide the URLs.

The PEOs are posted physically outside of the Department offices, and given publicly online along with the SOs online at:
http://engineering.buffalo.edu/mechanical-aerospace/undergraduate/programs/accreditation.html

Annual student enrollment and graduation data for all programs are posted publicly by the School of Engineering and Applied Sciences (SEAS) at:
http://engineering.buffalo.edu/home/academics/undergrad/data.html

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

Summarize the Deficiencies, Weaknesses, or Concerns remaining from the most recent ABET Final Statement. Describe the actions taken to address them, including effective dates of actions, if applicable. If this is an initial accreditation, it should be so indicated.

There are no unresolved issues from 2014.

CRITERION 1. STUDENTS

For the sections below, attach any written policies that apply.

Within the discussion that follows we frequently provide references to public webpages wherein the full details of our policies and procedures are provided. These policies are also included in Appendix E.

A. Student Admissions

Summarize the requirements and process for accepting new students into the program.

We begin by outlining two types of majors within SEAS at UB. The major types are differentiated by admission status and access to SEAS courses. Students within both of these major types are advised by SEAS.

Approved Major: Students within an approved SEAS program have satisfied admission criteria. They are eligible to participate in all courses required for the major. To be eligible to earn a degree from SEAS, a student must be admitted to the approved major.

Intended Major: Students within an intended SEAS program have an intention to pursue an engineering or applied science degree and are working toward satisfying admission criteria. Intended majors are permitted to enroll in 100- and 200-level SEAS courses (EAS, BE, CE, CIE, CSE, EE, IE, MAE, MDI) required for the major.

A.1. Admission for New UB Students

Figure 1.1 provides an overview of the admission review process for new UB students. The nature of the admission review depends upon the academic level (freshman versus transfer) and residency (domestic versus international) of the student. In what follows below, we describe the policies and procedures used to review each group for admission to a SEAS major.

A.1.a. Domestic Freshmen Admission

(reference: http://engineering.buffalo.edu/home/academics/undergrad/admissions/freshmen.html)

Overview

The UB SEAS Office of Undergraduate Education works closely with UB's Office of Admissions (UB OA) to review the applications of domestic freshmen applying to any of the undergraduate SEAS majors. Students seeking admission to UB apply through the State

University of New York (SUNY) Application, the Common Application, or the Coalition Application.

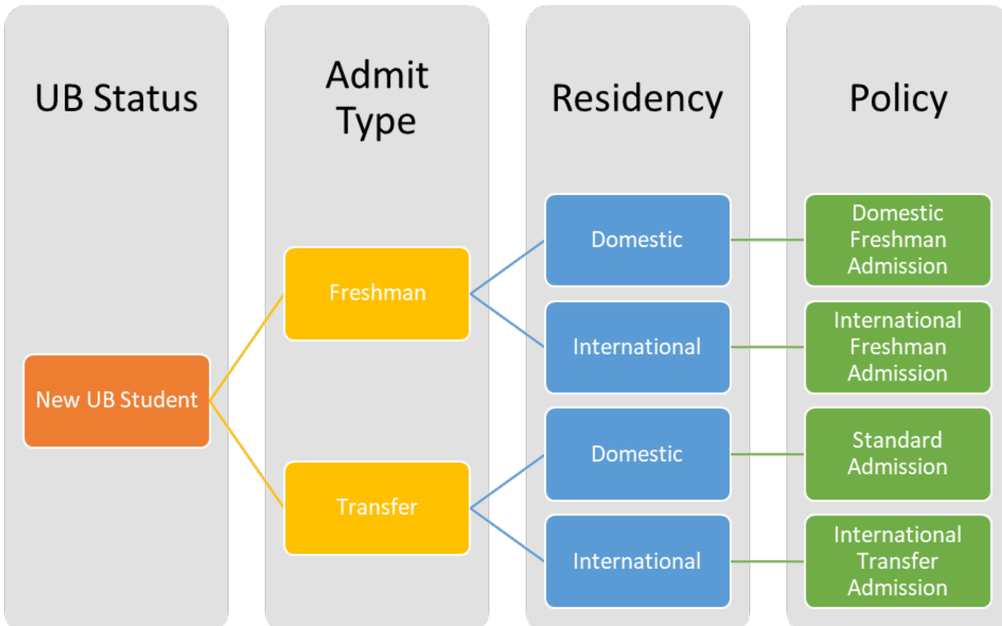

Figure 1.1. Admission process for new UB students interested in an SEAS major.

Admission Criteria

Admission to UB and the SEAS majors is competitive. Admission decisions are based on a holistic review of each application, with factors such as an applicant's high school academic performance, standardized test scores, Regents and Common Core Examination scores, personal statements, letters of recommendation, demonstrated leadership, community service, socio-economic environment, family unit and special life circumstances, and noncognitive attributes considered.

Admission Decisions

Early in the admissions cycle, representatives from SEAS and UB OA meet to discuss enrollment targets and standards for admission to the approved and intended SEAS majors. UB OA first reviews a student application. If the student clearly meets the standard for the approved major, UB OA finalizes the decision. If the case is less clear, the application is sent to SEAS for a second review. SEAS then conducts a holistic review, and subsequently renders a decision regarding admission to the approved or intended SEAS major. Admission decisions are guided by the following principles.

- Admission to the approved major: When the applicant is deemed to have a high likelihood of success within an engineering or applied science major, they are placed into the approved major.
- Admission to the intended major: When concerns are identified in an applicant's academic history (e.g., low high school average, SAT/ACT score, and/or Regents or Common Core Examination scores), the applicant is placed into the intended major.
- Declined admission: When significant concerns are identified in an applicant's academic record, the applicant is declined admission to UB.

A.1.b. International Freshmen Admission

(reference: http://www.buffalo.edu/internationaladmissions/get-ready-to-apply/admissions-criteria.html#title_1-1)

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International students apply to UB through the SUNY Application, the Common Application, the Coalition Application, or the UB International Application. Representatives from SEAS and the UB Office of International Admissions (UB OIA) meet periodically to review enrollment targets and the general approach for admission of international students. Admission decisions are based on a holistic review of each application, including consideration of academic and non-cognitive factors. UB OIA staff have the necessary expertise in evaluating international student transcripts and experiences. As such, this office renders all decisions regarding admission to approved and intended SEAS majors. The basic principles outlined above for domestic freshman admission are used to guide decisions.

A.1.c. Domestic Transfer Admission (Standard Admission)

(http://engineering.buffalo.edu/home/academics/undergrad/admissions/transfer.html)

Overview

UB considers a candidate a transfer student if they have completed at least 12 credit hours of college-level work after graduating from high school.

Transfer admission to UB SEAS comprises a two-step process:

1. Students must first apply to and be admitted by UB.
2. Students then submit a Supplemental Application that is reviewed by SEAS.

Admission requirements for UB

The review approach depends on the number of college credit hours completed:

- If a student has completed more than 24 college credit hours at the time they apply, UB OA reviews their previous college academic record.

- If a student has completed fewer than 24 credit hours at the time they apply, UB OA reviews their high school transcript, SAT and/or ACT test scores, and previous college academic record. Emphasis is placed on the student's college academic record.

In order to be considered for transfer admission to UB, it is recommended that students present a strong record of college study, earning a cumulative grade point average of at least 2.5 on a 4.0 scale.

Admission requirements for SEAS
Following admission to UB, the SEAS Office of Undergraduate Education reviews the applicant for admission to a SEAS major. Admission to the approved Mechanical Engineering major requires the following:

1. Completion of four required core courses (see below) with grades of C– or better and a combined core course grade point average of at least 2.5. Students are permitted to repeat at most two core courses one time.

   Note: An 'R' (resign) grade does not count as a repeat. Students are also permitted to repeat test and college credit originally earned while attending High School without penalty from this policy.
2. A minimum overall cumulative GPA of 2.8.

Core Courses
Engineering Majors:

1. Calculus 1 (MTH 141 or MTH 153)
2. Calculus 2 (MTH 142 or MTH 154)
3. General Chemistry 1 (CHE 101, CHE 105, or CHE 107)
4. General Physics 1 (PHY 107 or PHY 117)

In addition to these specific requirements, SEAS considers a student's entire academic record in reaching an admission decision. Factors such as a history of repeating, resigning, or failing classes, or low grades in classes relevant to the student's desired discipline may result in conditional admission or denial of admission.

As outlined below, these admission criteria are also used to review continuing UB students (non-SEAS majors and intended SEAS majors) seeking to join an approved SEAS major. We refer to these review criteria as our "standard admission" requirements.

Admission Decisions

After a careful review of an applicant's academic record, one of the following decisions is processed:

- Admission to the Approved Major: The applicant meets the criteria to join the major, and is placed into the approved major.
- Admission to the Intended Major: The applicant does not currently meet the criteria for the major, but could satisfy the standard admission criteria in the future, and is placed into the intended major. For example, this case applies to an applicant who has not completed all of the core courses relevant to the major.
- Conditional Admission: The applicant does not meet the standard criteria for admission to the major. They may have ungraded transfer credit for the core courses or have legitimate extenuating circumstances and have petitioned for exemption from the course repeat restriction. Specific examples of extenuating circumstances include documented medical issues of the student or an immediate family member, the death of an immediate family member, a disability, military orders, or other significant personal hardships. In most conditional admission cases the applicant has already completed the core courses, and we therefore use criteria other than the standard admission criteria to assess a student's readiness for the approved SEAS major. Conditionally admitted students are required to develop a semester course plan in consultation with an academic advisor. Admission to the approved major is dependent on satisfy performance in technical coursework during the first semester of study.
- Declined Admission: There are significant concerns regarding an applicant's academic record, and the student is not currently admissible. In such cases, the student is placed into the UB exploratory major. For example, this case applies to an applicant who has completed all of the core courses with multiple core course repeats and has a core course GPA below 2.5. Students are welcome to attend UB, but are not able to pursue an engineering or computer science degree during the first year of study at UB.

A.1.d. International Transfer Admission

(reference: http://www.buffalo.edu/internationaladmissions/get-ready-to-apply/admissions-criteria.html)

International transfer applicants are reviewed by UB OIA. Representatives from SEAS and UB OIA meet periodically to review enrollment targets and the criteria employed to evaluate international transfer applicants. The framework developed for domestic transfer admission is used to evaluate international transfer applicants. More specifically, staff from UB OIA look for performance within the core courses (or equivalents) noted above and an overall academic performance that are consistent with the standards adopted for domestic transfer students. UB OIA staff have the necessary expertise in evaluating international student transcripts and experiences. As such, this office renders all decisions regarding admission to approved and intended SEAS majors. The basic principles outlined above for domestic transfer admission are used to guide decisions.

A.2. Admission for Continuing UB Students

Figure 1.2 provides an overview of the admission review process for continuing UB students. The process for applying to an approved SEAS major depends on whether the student's current major is an intended SEAS major or is a major external to SEAS. Current intended SEAS majors are automatically reviewed for admission to the approved SEAS major at the end of each fall and spring semester as a component of the SEAS Periodic Review process (see Section B.1.c). Non-SEAS majors apply for admission by submitting a SEAS Supplemental Application.

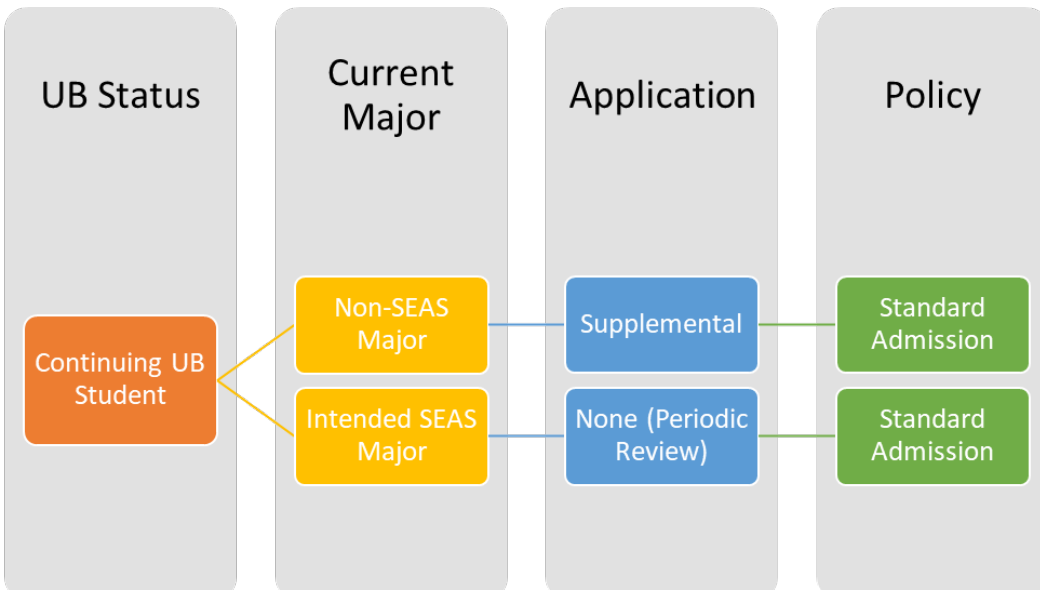


Figure 1.2. Admission process for continuing UB students.

SEAS admission criteria mirror the "Standard Admission" requirements outlined above for domestic transfer students. Specifically, students need to satisfactorily complete a core course requirement and attain an overall cumulative GPA consistent with the standards of the major. The principles outlined above for domestic transfer admission are used to guide decisions.

Before closing the discussion regarding admission to SEAS, we note that SEAS has well-developed policies for reentry of students who were once admitted to an approved or intended SEAS major as well as a policy that addresses change of major within SEAS.

B. Evaluating Student Performance

Summarize the process by which student performance is evaluated and student progress is monitored. Include information on how the program ensures and documents that students are meeting prerequisites and how it handles the situation when a prerequisite has not been met.

B.1. Monitoring Student Performance and Progress

Figure 1.3 provides an overview of the process through which students are reviewed. UB and SEAS evaluate student performance and monitor student progress via two independent academic review processes. Both reviews are conducted at the end of the fall and spring semesters. The UB review is applicable to all term-activated undergraduate students at UB. Within SEAS, an "Academic Review" process is used to monitor performance of approved SEAS majors and a "Periodic Review" process is used to monitor progress of intended SEAS majors. The former focuses on a student's progress towards satisfying SEAS degree requirements and the latter focuses on a student's progress towards meeting SEAS admission requirements. In both cases, the primary goal of the review process is to identify students unlikely to meet degree/admission requirements, to connect them with additional resources, and if necessary to redirect them to a major that better aligns with their strengths and interests, thereby increasing their likelihood of completing a bachelor's degree (at UB or elsewhere) in a timely manner. The relevant policies are outlined below.

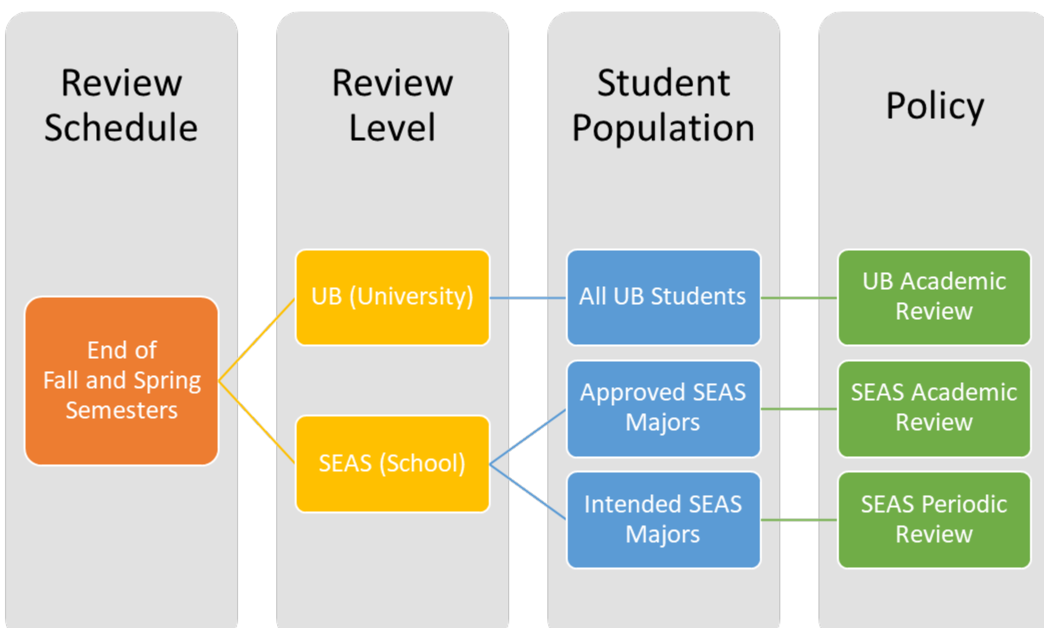


Figure 1.3. Process used to evaluate the performance and progress of SEAS majors.

B.1.a. UB Academic Standards Review

(reference: https://catalog.buffalo.edu/policies/academic-review.html)

The UB Office of Educational Affairs performs a review that focuses on a student's UB GPA (all coursework completed at the University at Buffalo).

Students with cumulative and most recent semester UB GPAs of at least 2.0 are considered to be in UB academic good standing. If these conditions are not met, then the student is placed on UB academic warning, UB academic probation, or is dismissed from UB. The academic standing is based on (1) how long the student has been at UB, (2) their previous academic history, and (3) the extent to which their cumulative GPA is below the standard for UB academic good standing.

Students placed on UB academic probation are not eligible to participate in university activities. In addition, students on UB academic probation may be subject to an advisement service indicator – a mandatory discussion with an academic advisor to help build an effective academic strategy before the student may complete any further registration activity.

Students dismissed from UB are not permitted to register for future fall or spring semester classes at UB. A dismissed student may appeal the dismissal in writing to the Dean of Undergraduate Education.

B.1.b. SEAS Academic Review

(reference: http://engineering.buffalo.edu/home/academics/undergrad/advisement/review.html#2015)

The SEAS Office of Undergraduate Education performs a review that focuses on a student's UB Technical GPA (TGPA). The TGPA is based on engineering, math, and science courses taken at UB.

Students with a cumulative UB technical GPA (CTGPA) and most recent semester technical GPA (STGPA) of at least 2.0 are considered to be in SEAS academic good standing. If these conditions are not met, then the student is placed on SEAS academic probation or is dismissed from SEAS. The SEAS academic standing is based on (1) how long the student has been at UB, (2) their previous SEAS academic standing, (3) their CTGPA, and (4) their STGPA. Figure 1.4 provides an overview of the SEAS Academic Review process.

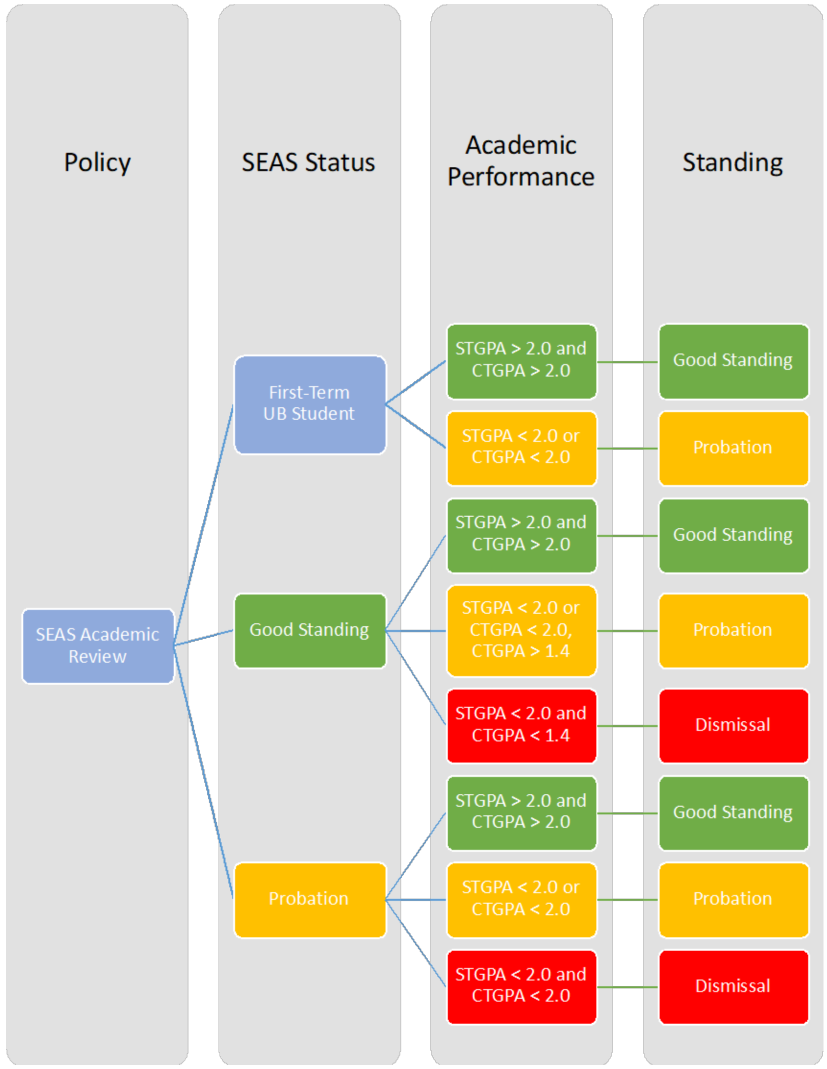


Figure 1.4. SEAS Academic Review process

After the first SEAS academic probation, students receive a hold that limits their ability to register in courses until they satisfy a required advisement session that requires them to reflect on their performance and develop a strategy to get back into good academic standing.

Students dismissed from SEAS are removed from the SEAS major and dropped from any SEAS courses they are enrolled in for the following fall or spring semester. Students may petition for immediate reinstatement to the SEAS Associate Dean for Undergraduate Education, based upon legitimate extenuating circumstances. Students dismissed from SEAS are strongly encouraged to work with UB's academic advisors to explore other majors.

B.1.c. SEAS Periodic Review

(reference:
http://engineering.buffalo.edu/home/academics/undergrad/advisement/review.html#periodic)

The SEAS Office of Undergraduate Education performs an analysis to evaluate the potential for intended majors to gain admission to the approved major. As a result of this review, students are either (1) admitted to the approved SEAS major, (2) retained within the intended SEAS major, or (3) dismissed from SEAS. Figure 1.5 provides an overview of the SEAS Periodic Review process.

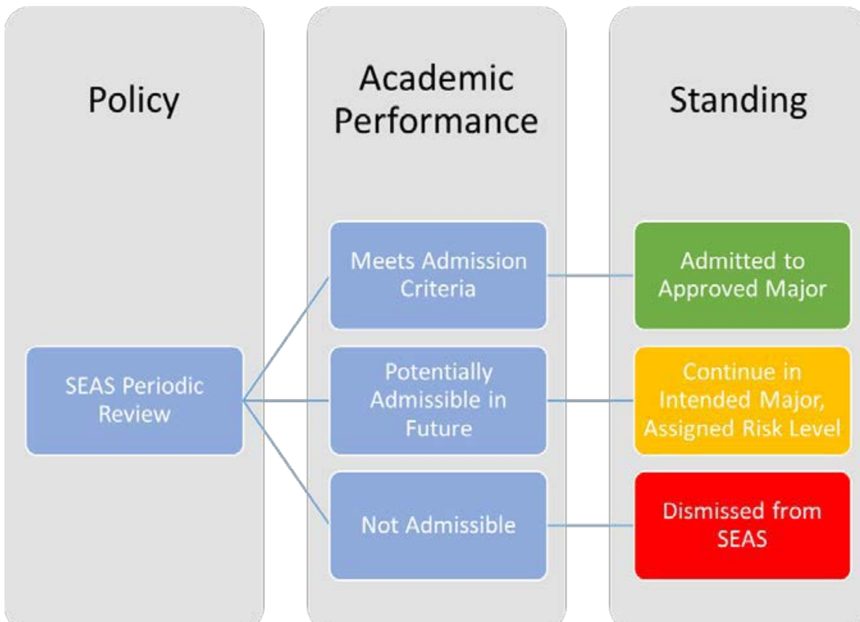


Figure 1.5. SEAS Periodic Review process.

Students who are not currently admissible, but are making reasonable progress towards completing admission requirements, remain in the intended SEAS major. Risk levels are used to convey the extent to which students are on track to complete SEAS admission requirements. All continuing students are placed into one of three risk categories (high, moderate, low). The risk level is based upon a student's performance in core courses associated with the major and ability to meet the overall GPA requirement for the major. Students placed in the high-risk category are required to (1) complete a Program Review Worksheet and (2) meet with an academic advisor. A hold is added to the student's record to prevent registration until the worksheet and meeting are completed.

Students who are unable to make satisfactory progress towards meeting SEAS admission requirements are dismissed from the intended SEAS major. Upon dismissal, students are removed from the SEAS major and dropped from any SEAS courses they are enrolled in for the following fall or spring semester. Students may petition for immediate reinstatement to the SEAS Associate Dean for Undergraduate Education, based upon legitimate extenuating circumstances. Students dismissed from SEAS are strongly encouraged to work with UB's academic advisors to successfully transition to another major.

B.2. Course Requisites

Students register for classes via the HUB Student Center (PeopleSoft Campus Solutions). The requisites associated with UB courses are encoded into the HUB system. Students are permitted to enroll in a course if they have satisfied or are in the process of satisfying (for a future term enrollment only) the requisites associated with a course.

Post-Enrollment Requisite Checking (PERC)
The HUB system provides a tool to analyze the extent to which students enrolled within a course have satisfied the requisites. The tool is particularly helpful in identifying students who enroll in a course while satisfying the requisite for that course, and subsequently fail to successfully complete the in-progress course. As an illustrative example, consider a student who enrolls in Calculus 2 while enrolled within Calculus 1, and then fails or resigns Calculus 1. The PERC tool is used by SEAS departments to identify students who no longer meet the requisites for SEAS courses. This review is completed at multiple points before a semester begins.

SEAS Forced Registration Process
Students who do not meet the requisites for a course may request to be enrolled via forced registration. The most common reason for such a request is a delay in receiving an official transcript from another academic institution. This action may also be appropriate when a student does not formally satisfy the requisites for a course, but has completed alternate coursework that adequately prepares them for the course. The review process is administered by the relevant Director(s) of Undergraduate Studies. Depending upon the course and situation, the Director may seek input from other faculty or staff and/or delegate the review process to another faculty or staff member.

SEAS has developed an online tool for submitting, reviewing, and documenting forced registration requests. Students submit requests via an online interface. The requests are initially reviewed by departmental staff and subsequently routed to relevant faculty for consideration. If the request is approved, departmental staff enroll the student via the HUB system.

C. Transfer Students and Transfer Courses

Summarize the requirements and process for accepting transfer students and transfer credit. Include any state-mandated articulation requirements that impact the program.

C.1. Requirements and process for accepting transfer students

This process is detailed in Sections A.1.c (domestic transfer students) and A.1.d (international transfer students).

C.2. Process for accepting transfer credit

(references: https://catalog.buffalo.edu/policies/transfer-policy.html, https://taurus.buffalo.edu/#slide2)

All credit-bearing courses (regardless of mode of delivery) from regionally accredited institutions of higher learning are considered transferable to UB; the grades earned in these courses are used in overall GPA calculations. Credit-bearing courses from institutions with other than regional accreditation are evaluated for transfer purposes on a case-by-case basis.

Applicants can check how their courses have been matched to UB's courses and requirements on TAURUS (https://taurus.buffalo.edu/), UB's course articulation website. Students must submit an official transcript from each institution they have attended to have their courses transferred and evaluated at UB. If a student has course work from a previous institution that does not appear in the TAURUS Course Equivalency Guide but may work towards their major degree or general education requirements, then they submit a course articulation request.

SEAS recently worked with the UB Office of the Registrar (UB OOR) to develop an online tool for submitting, reviewing, and documenting course articulation request. Students submit requests via an online interface. The requests are initially reviewed by UB OOR staff and subsequently routed to the appropriate academic department for consideration. Departmental personnel then review and match the course to an equivalent course at UB, if it is found to have one. Approved course articulation decisions are then processed and distributed to the public in the TAURUS Course Equivalency Guide. The new online system has resulted in significant reductions in the time required to process articulations and has facilitated improved communications between faculty reviewers and staff.

C.3. State-mandated articulation requirements – SUNY Seamless Transfer

(references: https://catalog.buffalo.edu/policies/suny-seamless-transfer.html, https://www.suny.edu/attend/get-started/transfer-students/suny-transfer-policies/, https://www.suny.edu/attend/get-started/transfer-students/suny-transfer-paths/pdf/transferSUNY_Mechanical_Engineering.pdf

The SUNY System maintains a comprehensive program to facilitate the transfer of qualified students from one SUNY institution to another. UB has implemented the components of SUNY Seamless Transfer and has developed an infrastructure that helps qualified students transfer seamlessly from one SUNY campus to another. The intention is that a student who adheres to the tenets of the program will not only be able to transfer seamlessly, but earn their degree in a timely manner.

Within the initiative, specific prescribed programs of study are indicated in SUNY Transfer Paths which should be followed by a student seeking to transfer to another SUNY campus in one of the selected fields of study. A student wishing to transfer to UB will generally be prepared to enter UB at the junior level and graduate with that major in two years of additional study.

The Mechanical Engineering transfer path is included in Appendix E.

D. Advising and Career Guidance

Summarize the process for advising and providing career guidance to students. Include information on how often students are advised, who provides the advising (program faculty, departmental, college or university advisor).

D.1. Advisement

Overview
Advisement of SEAS students is conducted using a two-tier system consisting of the SEAS Office of Undergraduate Education (SEAS OUE) academic advisors, mainly in the first two years, and program advisement by faculty, mainly in the junior and senior years. The concept is that early in their academic career students are not yet integrated in their major (or perhaps have not even selected a major) and academic advisement is best delivered through SEAS OUE professional academic advisors. In the junior and senior years, students need advice on technical electives and career paths and this advice is best delivered through faculty in their programs. This demarcation is not absolute and students are free to seek advice from the SEAS OUE advisors at any time they wish. Students are encouraged to meet with an advisor each semester.

SEAS Office of Undergraduate Education
SEAS OUE assists students in meeting their academic and career goals through student-centered, holistic advisement services that span personal, social, financial, emotional, cultural, and ethnic spheres. Advisors are guided by NACADA's Core Values of Academic Advising (https://www.nacada.ksu.edu/Resources/Pillars/CoreValues.aspx) and UB's Academic Advisement Vision & Mission, Values and Goals (http://advising.buffalo.edu/mission/index.php). Advisors empower SEAS students to be active,

responsible learners who will set goals, develop plans, learn to overcome difficulty, and take full advantage of the many opportunities UB provides in the areas of academics, research, and community and global engagement while maintaining timely degree completion. Particular advisement services include:

- advise students with regard to admission and graduation requirements
- assist with the selection and changing of SEAS degree programs and opportunities to enhance the educational experience provide academic planning, including course selection and resolution of scheduling difficulties
- convey and interpret necessary academic policies, including guiding students through appropriate petitions, withdrawals, leaves, and academic dismissals
- provide students with strategies for dealing with unsatisfactory performance
- assist with on-campus and off-campus recruitment activities and new student orientation
- assist with HUB exception processing, transfer credit articulation, admission decision review and processing, academic review for New York State Grants and Scholarships, and degree audit
- foster trusting relationships with students and campus partners and make referrals to additional offices on campus to help students

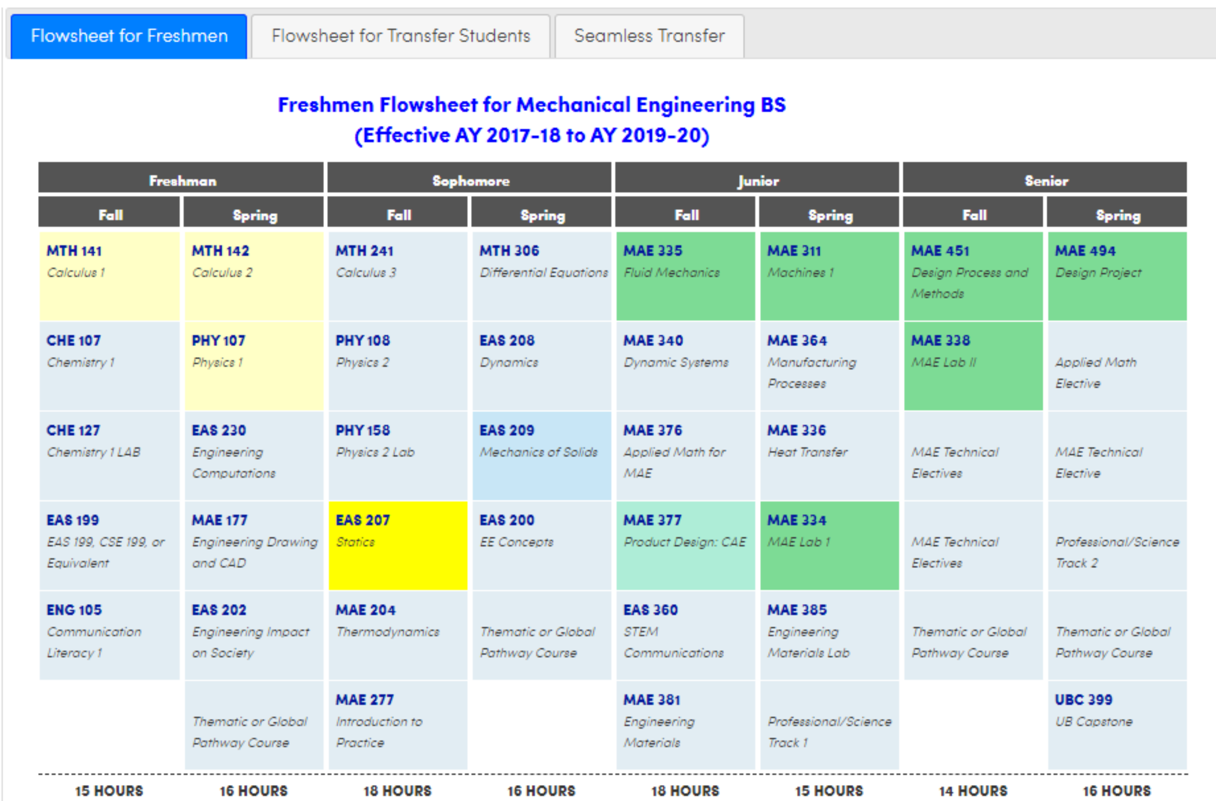
Nine full-time and two part-time academic advisors are available for student advisement within SEAS OUE, in addition to one advising administrator. Students may make appointments with any one of these advisors, however as of February 2020, students are assigned to a particular advisor and encouraged to meet with their assigned advisor for each appointment. Advisor assignments are based on the student's last name, with just a few exceptions. Those exceptions include some unique populations where additional case management was desired, such as students in our Dual Diploma Program, the Combined Degree Program with the School of Management, the Say Yes program, UB's ACE, Acker, or EOP programs, Athletes and Veterans. Ten full-time and one part-time academic advisors are available for student advisement within SEAS OUE. Students may make appointments with any one of the advisors; they are not assigned to a particular advisor based on their major or some other demographic. However, students are encouraged to meet with the same advisor for each appointment. Advisement activities are coordinated by the Assistant Dean, Dr. Kerry Collins-Gross. Additional full-time staff supporting SEAS OUE includes an Office Manager, an Academic Information Specialist (IT professional), and a Senior Administrative Associate.

Notes stemming from advisement appointments are entered into the EAB Student Success Portal, also known as UB Navigate, a web-based tracking system that UB implemented campus-wide for staff-based advisors (previously named "SSC Campus" from 2017 to 2019). Prior to the SSC, UB used another third-party service – AdvisorTrac – to track advisement notes. These notes were ported to the SSC (now EAB Navigate) system when it was brought online in 2017.

Flowsheets and Other Advisement Tools

The primary advisement tool used within SEAS is the flowsheet. SEAS maintains (1) publicly-available generic versions and (2) student-specific password-protected versions available to students, academic advisors, departmental staff, and faculty advisors.

The public versions are interactive guides that provide a semester-by-semester outline of the courses within a curriculum in a "flowsheet" format. Flowsheets enable students and advisors to visualize the pre-, co-, and post-requisites associated with a course. They include hyperlinks to detailed course information in the undergraduate catalog. The tool provides a means for students to understand how courses within a curriculum are linked and provides guidance regarding course scheduling. Three views are provided. The first view shows the curricular plan followed by a student that enters UB as a freshman (see Figure 1.6). The second view provides the curricular plan followed by a transfer student that joins UB after completing two years at a community college. The third view is a modification of the second, showing the courses in the first two years of the program in categories associated with the SUNY Seamless Transfer Paths.


Flowsheet for Freshmen | Flowsheet for Transfer Students | Seamless Transfer

Freshmen Flowsheet for Mechanical Engineering BS
(Effective AY 2017-18 to AY 2019-20)

Freshman		Sophomore		Junior		Senior	
Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
MTH 141 *Calculus 1*	**MTH 142** *Calculus 2*	**MTH 241** *Calculus 3*	**MTH 306** *Differential Equations*	**MAE 335** *Fluid Mechanics*	**MAE 311** *Machines 1*	**MAE 451** *Design Process and Methods*	**MAE 494** *Design Project*
CHE 107 *Chemistry 1*	**PHY 107** *Physics 1*	**PHY 108** *Physics 2*	**EAS 208** *Dynamics*	**MAE 340** *Dynamic Systems*	**MAE 364** *Manufacturing Processes*	**MAE 338** *MAE Lab II*	*Applied Math Elective*
CHE 127 *Chemistry 1 LAB*	**EAS 230** *Engineering Computations*	**PHY 158** *Physics 2 Lab*	**EAS 209** *Mechanics of Solids*	**MAE 376** *Applied Math for MAE*	**MAE 336** *Heat Transfer*	*MAE Technical Electives*	*MAE Technical Elective*
EAS 199 *EAS 199, CSE 199, or Equivalent*	**MAE 177** *Engineering Drawing and CAD*	**EAS 207** *Statics*	**EAS 200** *EE Concepts*	**MAE 377** *Product Design: CAE*	**MAE 334** *MAE Lab 1*	*MAE Technical Electives*	*Professional/Science Track 2*
ENG 105 *Communication Literacy 1*	**EAS 202** *Engineering Impact on Society*	**MAE 204** *Thermodynamics*	*Thematic or Global Pathway Course*	**EAS 360** *STEM Communications*	**MAE 385** *Engineering Materials Lab*	*Thematic or Global Pathway Course*	*Thematic or Global Pathway Course*
	Thematic or Global Pathway Course	**MAE 277** *Introduction to Practice*		**MAE 381** *Engineering Materials*	*Professional/Science Track 1*		**UBC 399** *UB Capstone*
15 HOURS	16 HOURS	18 HOURS	16 HOURS	18 HOURS	15 HOURS	14 HOURS	16 HOURS

Figure 1.6. Image of the freshman view of the public flowsheet.

The student-specific version of the flowsheet (accessed via the password-protected "SEAS Portal") populates the cells with information specific to a given student. Cells are color-coded based on the completion status of the degree requirement, and the course grade, credit hours earned, and term for the particular enrollment are displayed. These flowsheets provide students and advisors with a concise view of a student's progress in a SEAS degree program. Several views are available:

- General: shows the degree requirements in a standard eight semester plan
- Real Term: shows courses grouped by the actual term taken
- Readiness: indicates a student's readiness to take a course based on completion of requisites
- Real Term Optimization: provides a plan(s) for completing degree requirements that meets requisite, credit hour, and scheduling constraints.

Personal flowsheets are interactive and dynamic. Users can click on the boxes to see what courses can be used to satisfy a requirement (General) or see the requisites (Readiness). Clicking on the course number will open a link to that course in the Undergraduate Catalog. Figure 1.7 provides an example of the General view.

Report date: 2019-11-15

MECHANICAL ENGINEERING B.S. --- Fall 2018

Freshman		Sophomore		Junior		Senior	
Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Units: 17	Units: 17	Units: 17	Units: 16	Units: 18	Units: 16	Units: 14	Units: 16
MTH 141 *Calculus 1* TA (4) Sp 17	MTH 142 *Calculus 2* TC (4) Su 17	MTH 241 *Calculus 3* TB (4) Fa 17	MTH 306 *Differential Equations* TB (3) Sp 18	MAE 335 *Fluid Mechanics* TA (3) Su 19	MAE 311 *Machines 1* B (3) Sp 19	MAE 451 *Design Process and Methods/UBC: Thematic Pathway* (3) Fa 19	MAE 494 *Design Project/UBC: Global Pathway* (3) Sp 20
CHE 101 *Chemistry 1* TB+ (4) Sp 17	PHY 107 *Physics 1* MA (4) Sp 17(RGPA)	PHY 108 *Physics 2* MA (3) Sp 18	EAS 208 *Dynamics* TC (3) Su 18	MAE 340 *Dynamic Sys* A (3) Fa 18	MAE 364 *Manufacturing Processes* B- (3) Sp 19	MAE 338 *MAE Lab II* (2) Fa 19	*Applied Math Elective* (3)
STA 119 *EAS 140 or 100-Level Technical* (3) Sp 20	EAS 230 *Engineering Computations* TB+ (2) Fa 17	PHY 158 *Physics 2 Lab* MA (1) Sp 18	EAS 209 *Mechanics of Solids* B (3) Fa 18	MAE 376 *Applied Math for MAE* C- (3) Fa 18	MAE 336 *Heat Transfer* C (3) Sp 19	*MAE Technical Electives* (3)	*MAE Technical Elective* (3)
ECO 182 *UBC: Thematic Pathway* TA (3) Fa 16	EAS 999 *Civil Engineering CAD* TB+ (2) Sp 18	EAS 207 *Statics* TC (3) Sp 18	EE 202 *OR Circuit Analysis* TA (4) Sp 18	MAE 377 *Product Design: CAE* (3) Fa 19	MAE 334 *MAE Lab 1* A (2) Sp 19	MAE 345 *MAE Technical Electives* (3) Sp 20	ECO 405 *Prof./Science Track 2* (3) Sp 20
ENG 105 *UBC: Comm. Literacy CL* TA (3) Fa 16	EAS 198 *UB Seminar/UBC: T-Seminar* B+ (1) Fa 18	MAE 204 *Thermodynamics* C+ (3) Fa 18	HIS 251 *UBC: Global Pathway* TB+ (3) Fa 17	EAS 360 *STEM Comm.* B- (3) Sp 19	MAE 385 *Engineering Materials Lab* A (1) Sp 19	HIS 162 *UBC: Thematic Pathway* A (3) Sp 19	UBC 399 *UBC: Capstone* (1)
	MTH 121 *UBC: Math And Quantitative Mqr* TB (4) Fa 16	MAE 277 *Intro to ME Practice* (3)		MAE 381 *Engineering Materials* C (3) Fa 18	MTH 309 *Prof./Science Track 1* (4) Fa 19		MUS 115 *UBC: Global Pathway* (3) Fa 19

Figure 1.7. Image of the General view of a student-specific flowsheet.

Academic advisors also utilize tools available with the HUB system, including the Academic Advising Report (AAR) and the Transfer Credit Report, to identify details regarding which requirements the student has completed, what the student's deficiencies are, and what courses are offered next term. The AAR, which is also available to students through the HUB, is a detailed, multi-page report that is sometimes difficult for students and faculty to understand, so the flowsheet continues to serve as an important supplement. The AAR tracks a student's progress toward satisfying graduation requirements in the major and the UB Curriculum (UB's general education program).

Mechanical Engineering Advisement

From admission into SEAS until the end of sophomore year, students receive academic advisement from SEAS advisors. Students transition to academic advisement at the MAE Department for the remainder of the program. In summary, advisement is done on an as-needed basis, and the first point of contact is the Undergraduate Coordinator, who handles a variety of tasks described below. If the advisement issue is something beyond these, the Coordinator sends the student to the Director of Undergraduate Studies in Mechanical Engineering, or to a specific faculty member, if for example it involves the content or pre-requisites of a technical elective. For internships, the Coordinator directs students to a pre-identified Assistant Professor of Teaching. Faculty Mentors for career advice are discussed in Sect. D.2.d below.

Students are encouraged to seek advisement first through the Undergraduate Coordinator. Appointments can be made via e-mail to ensure a desired meeting time. However, walk-in advisement or simply e-mail correspondence occurs more often. The process begins at this point, and the Coordinator addresses a number of advisement tasks, given next. As a way of reaching and informing the students, the Coordinator sends e-mail each Monday, the "MAE Undergraduate Weekly Bulletin," which is a virtual flyer giving: important dates such as the last day to add/drop a course; advisement tips if e.g., registration is opening; a list of off-campus events; internships, clubs, scholarship opportunities; and other announcements.

The Undergraduate Coordinator's responsibilities are more intensive during two time periods. The first is when the schedule for the upcoming semester is made available, and students may require advisement on: course scheduling to ensure they remain on track for graduation; course offerings of MAE Technical Electives to plan future semesters; constructing a working schedule, given constraints including class offering times; and informal degree audits. The second peak time period is the first two weeks of a semester, which is the "add/drop" window. Students submit forced registration requests via the SEAS portal, which allow them to upload supporting documentation and/or a written description of why the forced registration is necessary.

The Undergraduate Coordinator also handles other forms of advisement:

- Referring students to various offices/services across campus, including Career Services, International Student Services, Accessibility Resources, etc.
- Questions regarding internship opportunities and requirements to earn course credit for internships and the internship course, MAE 496. This course is supervised by one of the Assistant Professors of Teaching, as mentioned above.
- Registration assistance for undergraduate research or independent study courses, MAE 498 and MAE 499, respectively.
- Transfer articulations: as a bridge between the SEAS staff who receive the request and the faculty member(s) who review the syllabi and decide on articulation.

To manage advisement, the Undergraduate Coordinator makes use of the SEAS advisement system, EAS Navigate, to access a variety of academic information for each advisee and track their progress in the program, past history, and make notes on advisement visits.

The Director of Undergraduate Studies for ME is responsible for more challenging advisement cases, including: students choosing a technical elective or undergraduate research, students considering graduate school and other career options, students desiring to change their major to the AE program which also requires career advice, students wishing to pursue the double AE and ME major, transfer students facing course-sequence problems, students pursuing an internship that may alter their graduation, students who are dismissed or on the verge of dismissal (making a plan with them to successfully return or avoid this), and academic leave advisement.

The MAE Department recognizes the need for a higher level of faculty involvement in undergraduate advising, and is planning a new advisement system with the SEAS Associate Dean for Undergraduate Education, Prof. Jeffrey Errington, which will become active at the start of the Fall 2020 semester. This system is already used by other SEAS Departments and is described below. All MAE faculty will take part in advising undergraduates, and each faculty member will be assigned a group of advisees; they will meet with each student twice per year. This advisement will be mandatory for students and enforced, for example a hold on their registration for the following semester. A Departmental faculty advising handbook has been created as one of the means for guiding faculty in this process.

The online system developed by SEAS to support faculty advisement is described here and is presently being employed by other departments. The student-facing version of the system provides a means for students to obtain a faculty advisor via a web interface, an advisement "roadmap" that directs students to various campus resources for topics of frequent interest, and access to important advisement tools, including their personal flowsheet.

The faculty-facing version of the system gives a list of a faculty's advisees, and advisement guidance for program faculty: for example, the Director of Undergraduate Studies can provide faculty a "to-do" list for advisement meetings. The system also provides access to academic information for each advisee, including a personal flowsheet, profile, schedule, course history, transfer credit, academic review history, SEAS communications log, response to the Professional Development Survey (see Section D.2.a.), UB Curriculum Pathways analysis, and advising-related documents. Further, the advisement system contains a mechanism to record advisement notes and to share concerns regarding an advisee with the Director of Undergraduate Studies and departmental staff.

The administrative version of the SEAS advisement system provides the following. First a means for departments to balance the advising load amongst program faculty, and the ability to generate a roster of students that includes the faculty adviser associated with each student and the date of the last recorded faculty advisement meeting. Also, it gives a mechanism to assign the advisement "level" of a student based on a student's course history. The level is initially set to "SEAS OUE" and subsequently shifts to "Department" when the student approaches junior-level coursework. Additionally, the system allows the Departmental leadership including the Director of Undergraduate Studies to share advising guidance with faculty. Further, it enforces student participation in advisement by connecting registration for select courses to participation in faculty advisement meetings.

D.2. Career Guidance

D.2.a. SEAS Professional Development Survey

In an effort to help students better prepare for their professional career, SEAS students are required to complete a Professional Development Survey every fall semester. The exercise helps students develop their resume and prepare for job interviews by reflecting on and documenting their experiences over the past year. Examples of relevant experiences include technical and non-technical work as well as participation in undergraduate research, student clubs, study abroad, and community service. Students are then asked to look forward and consider their career goals and to reflect upon the steps that they are taking to achieve them. The responses students provide to the survey are discussed with faculty advisors.

D.2.b. SEAS Professional Development Blueprint

(reference:
http://engineering.buffalo.edu/home/academics/beyond/professionalism/blueprint.html)

Representatives from SEAS and UB Career Services together developed the SEAS Professional Development Blueprint, an interactive roadmap to career readiness. The Professional Development Blueprint consists of an inventory of activities that prepare students to be an experienced, connected, and informed engineer or computer scientist. The tool is regularly used by students to plan activities and by advisors and faculty to guide discussions with students.

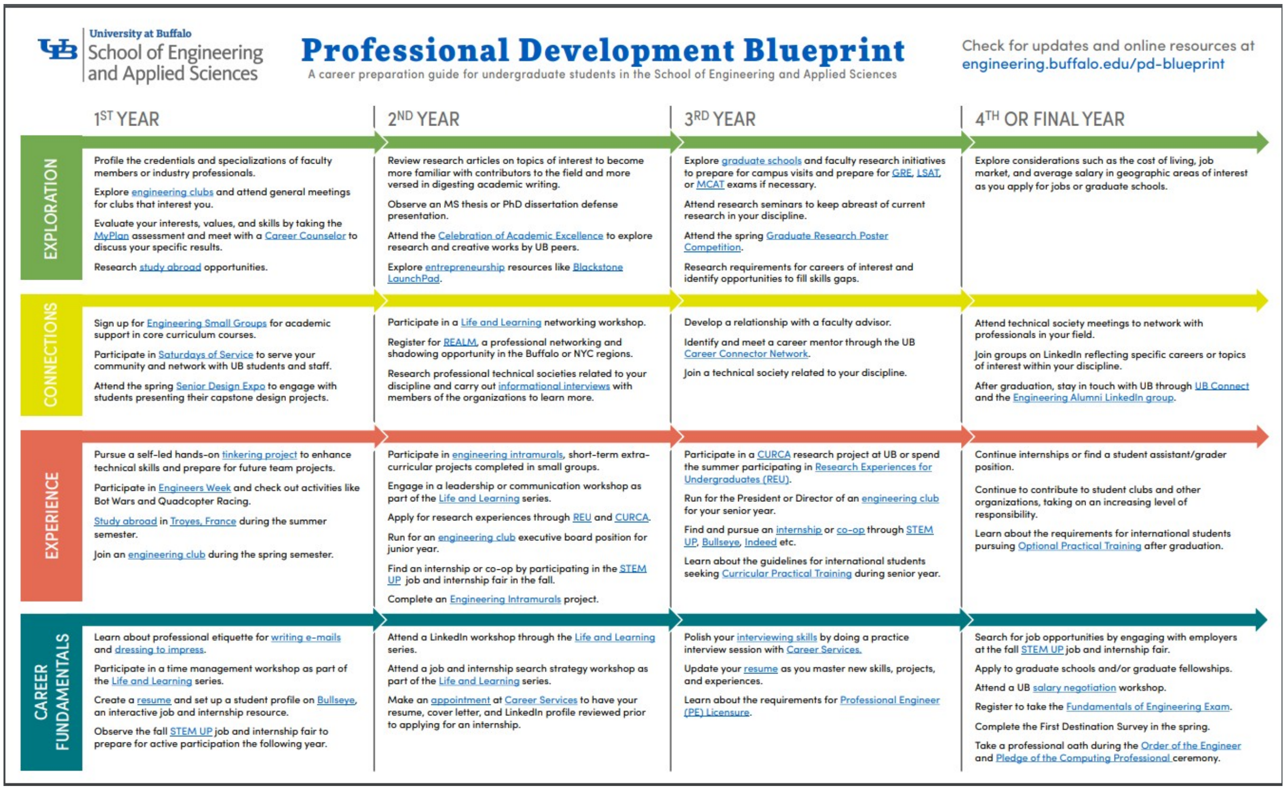


Figure 1.8. Screenshot of the Professional Development Blueprint

D.2.c. Career Services

(reference: https://www.buffalo.edu/career.html)

Career Services supports the missions of UB and SEAS, and serves as a liaison between diverse constituencies. Staff from Career Services educate students in the areas of self-assessment, career exploration, and job search techniques, with the goal of helping them achieve lifelong career satisfaction and success. The office also serves prospective employers through interactive and educational partnerships, exposing them to high quality candidates.

Career Services provides resources to augment the formal curriculum through educational programming, and provides services to SEAS faculty and staff. SEAS recognized the important role of Career Services to its students and in 1997 combined efforts to establish the position of "Engineering Career Counselor." Since then, the Engineering Career Counselor position has been financially supported by both Career Services and SEAS. The staff member currently in this position, Holly Justice, provides the same services as the other career counselors but focuses her attention on the needs of SEAS students. Her work is buttressed by the work of the other counselors and support staff for whom SEAS students make up a significant portion of their caseload.

The staff members work together to offer a variety of services. The staff provides Drop-in hours and individual career counseling by appointment. Individual career counseling is an opportunity for counselors to provide counsel, advice and education to students on topics including, self-assessment, career exploration, resume and cover letter creation, applying to graduate school, practice interviews, job searching strategies and networking. The counselors run related workshops throughout the academic year and regularly partner with Engineering Student Clubs for career-specific workshop topics.

The office coordinates a variety of workshops and events each year including a Fall STEAM Job + Internship Fair and the spring recruitment events. The Engineering Career Counselor works closely with the coordinator of the Fall STEAM Job + Internship Fair which is targeted towards engineering, computer science, applied sciences and other technology companies.

Career Services staff maintain the Bullseye online job posting system, including an on-campus interviewing program to offer students employment opportunities. The Bullseye online job posting system has a broad spectrum of positions and industry opportunities listed. The on-campus interviewing program typically has more companies from engineering and business disciplines. The staff hosts these employers on campus for interviews, information sessions, interactive events and competitions, as well as reaching out to students regularly about internship/full-time employment opportunities that are available through this program. In addition to this relationship with employers coming to campus, the staff enhances relationships with employers by regularly communicating through email, phone and conducting site visits.

The staff encourages alumni to connect with students through the "UB Career Connector Network" an online mentoring platform which provides students with the ability to expand their connections with alumni and gain valuable advice and assistance for their career exploration and job search.

D.2.d. Faculty Mentors

(reference: http://engineering.buffalo.edu/mechanical-aerospace/undergraduate/advisement/mentors.html)

The MAE Department Teaching Faculty serve as Faculty Mentors for undergraduates who desire one; this is not required, and each year a small group of dedicated students take advantage of this program. Faculty mentors assist with questions related to career aspirations, research goals, and graduate school guidance. To sign up to be connected with a mentor, students use an online form (hyperlink above) and identify their topic area, such as fluid mechanics or dynamics, controls, and mechatronics. Students meet regularly with the mentors for career-focused advice. Informally, this type of mentoring also often occurs when students engage in undergraduate research in a faculty member's laboratory (available via MAE 498), or in an independent study (MAE 499) with a professor who conducts research in their area of interest.

E. Work in Lieu of Courses

Summarize the requirements and process for awarding credit for work in lieu of courses. This could include such things as life experience, Advanced Placement, dual enrollment, test out, military experience, etc.

(reference: https://catalog.buffalo.edu/policies/alternative-credit.html)

After enrollment at UB, students may be awarded credit toward their university degree through methods other than completing UB course work. Examples are proficiency examinations and military training. In what follows below, we highlight the alternative methods for earning credit that are most relevant to SEAS majors.

Credit is not awarded for any exam or content that duplicates the content of a college course for which a student has already received credit or if a student has completed more advanced study, i.e. beyond the level covered by an exam. Students may decline exam or military credit that has been awarded by UB at any time with the Alternative Exam Credit Declination form. When exam credit is not declined and the exam or its articulated course content is subsequently repeated, credit will be awarded only for the second taking. UB does not award experiential credit or accept experiential credit transferred from other institutions. Evaluation of credit earned by alternative methods is based on articulated course and requirement equivalencies in effect at the time the credit is requested.

- Advanced Placement (AP): An official score report from the College Board showing a minimum score of 3 on any AP Exam guarantees credit will be awarded. In some cases, credit awarded may apply toward major, general education, or other university degree requirements. AP credit awards for the current academic year are listed on the Advanced Placement Exam (AP) chart (https://registrar.buffalo.edu/tc/pdfs/APchart.pdf).
- College Level Examination Program (CLEP): Official CLEP score reports showing the minimum score required by UB on exams considered university-level are awarded elective credit. UB articulation of CLEP exams is listed on the College-Level Examination Program (CLEP) chart (https://registrar.buffalo.edu/tc/pdfs/CLEPchart.pdf).
- International Baccalaureate
    - Students who have completed an IB diploma with a score of 30 or higher are awarded 30 credits.
    - Students who have completed an IB diploma with a score of 29 or less and students who did not complete a diploma are guaranteed credit for higher-level IB exams with scores of "5" or better.

- No credit is awarded for IB English language exams taken in a non-native English-speaking country or by a student whose native language is not English. A maximum of 30 credits may be awarded for an IB diploma or IB exams.

In some cases, the credit awarded is used to satisfy a student's UB degree requirements. Articulation of IB higher-level exams for these students is available on UB's International Baccalaureate (IB) chart (http://registrar.buffalo.edu/tc/pdfs/IBchart.pdf).

- Military Credit: Elective credit may be awarded for basic training and for certain approved educational experiences in the armed forces.
- UB College Credit Examinations: Students who are enrolled (matriculated) at UB may earn course credit by passing examinations administered by UB academic departments. These exams are comparable to final examinations. Departments determine whether to administer such examinations for their courses.

F. Graduation Requirements

Summarize the graduation requirements for the program and the process for ensuring and documenting that each graduate completes all graduation requirements for the program. If applicable, describe the process for how course deviations are handled to ensure that graduation requirements are met. State the name of the degree awarded (Master of Science in Safety Sciences, Bachelor of Technology, Bachelor of Science in Computer Science, Bachelor of Science in Electrical Engineering, etc.)

Name of the degree awarded: Bachelor of Science in Mechanical Engineering.

F.1. Degree Requirements

Students must satisfy all degree requirements specified by (a) UB, (b) SEAS, (c) the UB Curriculum (the University at Buffalo's general education program), and (d) the program (major).

F.1.a. UB Degree Requirements

(reference: https://catalog.buffalo.edu/policies/university-degree-requirements.html)

Students must obtain a minimum of 120 credits whereby at least 30 credits must be completed at UB, per the Academic Residency Requirement policy.

Students must also have a minimum cumulative GPA of 2.0, both at UB and Overall (transfer GPA plus UB GPA).

GPAs are computed in accordance with UB's grading policies (i.e., all attempted hours, including 'F' grades, will be used to determine the GPA. For repeated classes, the grade earned on the second attempt counts in calculating the GPA).

Students cannot graduate with an Incomplete 'I' grade on their record.

F.1.b. SEAS Degree Requirements

Students seeking an undergraduate degree from SEAS must have a minimum cumulative GPA of 2.0 in technical coursework completed at UB. In addition, students seeking an engineering degree must complete at UB 30 undergraduate credit hours of junior/senior level courses required in their major.

F.1.c. UB Curriculum Requirements

(reference: https://catalog.buffalo.edu/policies/ubcurriculum.html)

SUNY maintains an academically rigorous and comprehensive general education requirement applicable to all of its state operated campuses offering undergraduate degrees. The faculty of each institution retain responsibility for establishing the specific course requirements and content. At UB, the current general education program, known as the UB Curriculum, was introduced Fall 2016 and is an innovative, student-centered approach to general education. UB's categories of topics under these requirements include:

- **UB Seminar:** an introductory seminar centered around critical thinking, ethical reasoning and reflective discussions.
- **Foundations**: the building blocks of academic inquiry and life-long learning: communication literacy 1 and 2, math and quantitative reasoning, scientific literacy and inquiry, diversity learning
- **Pathways**: A series of courses linked together by a broad topic. Students must complete both a global and thematic pathway.
- **Capstone:** The culmination of the UB Curriculum, comprising a holistic reflection of learning experiences through use of an ePortfolio.

UB students must complete all components of the UB Curriculum. For SEAS students, some of these requirements, such as the math and quantitative reasoning requirement, also satisfy program requirements.

F.1.d. Program Degree Requirements

(reference: https://catalog.buffalo.edu/academicprograms/mechanical_engineering_bs_requirements.html)

Students continuously enrolled in a particular degree program (major, minor, or concentration) or on an official Leave of Absence from the program are governed by the requirements of that program as stated in the catalog in effect at the time of their initial entrance into the program. For example, students who are accepted into a major during the fall 2020 semester and are continuously enrolled through graduation must meet the requirements for the major as stated in this 2020-2021 catalog.

Requirements for each major are listed in the undergraduate catalog, SEAS flowsheets (see Advising and Career Guidance section of this report), and available from a student's AAR. The standard four-year curricular plan is provided in Figure 1.9.

Students seeking an undergraduate engineering degree from the SEAS must complete 30 undergraduate credit hours of junior/senior level courses required in their major at the UB.

Freshman Year

Fall Semester

Course	Category	Credit
EAS 199SL UB Seminar	M/UBS	3
CHE 107LLR Gen Chem for Engineers	M/SLI1	4
MTH 141LR College Calculus 1	M/MQR	4
Pathway or ENG 105LEC Writing and Rhetoric	P or CL1	3 or 4
		Total Credits: 14 or 15

Spring Semester

Course	Category	Credit
MAE 177LLB Engineering Drawing and CAD	M	1
PHY 107LR General Physics 1	M/SLI2	4
MTH 142LR College Calculus 2	M	4
Pathway or ENG 105LEC Writing and Rhetoric	P or CL1	3 or 4
EAS 230LLB Engineering Computations	M	3
EAS 202SEM Impact On Society	M	1
		Total Credits: 16 or 17

Sophomore Year

Fall Semester

Course	Category	Credit
EAS 207LR Statics	M	3
MAE 204LR Thermodynamics 1	M	3
MTH 241LR College Calculus 3	M	4
PHY 108LR General Physics 2	M	4
PHY 158LAB General Physics Lab 2	M	1
MAE 277LEC Intro to ME Practice	M	3
		Total Credits: 18

Spring Semester

Course	Category	Credit
EE 200	M	3
EAS 208LR Dynamics	M	3
EAS 209LR Mechanics of Solids	M	3
MTH 306LR Intro Diff Equations	M	4
Pathway	P	3
		Total Credits: 16

Junior Year

Fall Semester

Course	Category	Credit
MAE 377LLB Product Design-CAE Envirn	M	3
MAE 340LEC Dynamic Systems	M	3
MAE 335LR Fluid Mechanics	M	3
MAE 376LLB Applied Math for MAEs	M	3
MAE 381LEC Engng Materials 1	M	3
EAS 360LEC STEM Communications	M	3
		Total Credits: 18

Spring Semester

Course	Category	Credit
MAE 311LEC Machines & Mechanisms 1	M	3
MAE 364LEC Manufacturing Processes	M	3
MAE 336LEC Heat Transfer	M	3
MAE 385LAB Engng Materials Lab	M	1
MAE 334LLB MAE Laboratory I	M	2
Professional/Sci Track	M	3
		Total Credits: 15

Senior Year

Fall Semester

Course	Category	Credit
MAE 338LAB MAE Lab II	M	2
MAE 451LEC Design Process & Methods	M/P	3
MAE Tech Elective	M	3
MAE Tech Elective	M	3
Pathway	P	3
		Total Credits: 14

Spring Semester

Course	Category	Credit
MAE 494LT Design Project	M/P	3
Applied Math Elective	M	3
MAE Technical Elective	M	3
Professional/Sci Track	M	3
Pathway	P	3
UBC 399 UB Capstone	CAP	1
		Total Credits: 16

Total Credits Required for Degree:	128

Curricular Category Key

Category	Description
M	Course required for major (including pre-requisites needed for admission to major)
E	Elective (course not required for major or UB Curriculum)
	UB Curriculum
CAP	UB Capstone
CL1/CL2	Communication Literacy (2 required)
DL	Diversity Learning
MQR	Math and Quantitative Reasoning
P	Pathway Course (6 required: 3 Global, 3 Thematic)
SLI1/SLI2	Scientific Literacy and Inquiry (2 required)
UBS	UB Seminar

Note: Some classes may count toward both a major (M) and UB Curriculum (UBC) requirement. Courses that count toward more than one requirement are indicated by a "/" (slash) in the category column, indicating which categories the course will satisfy.

Figure 1.9. Standard four-year curricular plan.

F.2. Degree Audit

Degrees are conferred three times a year (Fall, Spring, Summer). To ensure that students have met all degree requirements, a degree audit is undertaken for each conferral date. Listed below is the sequence of events that occur as part of the degree audit.

- Students notify UB of their degree candidacy by submitting an application for degree.
- A list of SEAS students who applied for degree conferral is obtained from the UB OOR by electronic queries and displayed to advisors within the SEAS portal.
- Advisors are assigned students to review. For each student, the advisor completes a comprehensive review of requirements using data from the HUB AAR, the student's advisement flowsheet, and pertinent notes maintained in the advisor note system, the force registration request system, the exception request system, and the student's file. Each degree requirement is reviewed for proper completion, including all required courses, technical electives, and UB Curriculum requirements. Checks are made for any 'I' (incompletes) and 'J' (not assigned properly) grades. Requirements satisfied with test credit, transfer credit, or course substitutions are also verified for accuracy. Finally, GPAs are checked to ensure students have met the minimum 2.0 overall, UB, and technical GPAs.
- Following the review, SEAS notifies UB OOR degree audit staff of students who failed to satisfy any degree requirement. The student's conferral status is updated to "not

satisfied” and the advisor notifies the student about the need to change their conferral date and complete final requirements.

Throughout the process, correspondence with students or other offices is copied and included in the student’s advisement record. Students sometimes request a senior-year degree audit review to confirm their progress in meeting degree requirements. These records are also maintained in the student’s advisement record.

F.3. Exceptions

In some cases, students may satisfy degree requirements via a mechanism that is not formally articulated within the UB Catalog. Such an exception may be appropriate when a student does not formally satisfy a degree requirement, but has completed alternate coursework that adequately addresses the learning outcomes associated with the requirement. As an illustrative example, an exception may be granted when a student has completed two courses at another institution that collectively address the learning outcomes of a required program course, with neither course directly articulating to the required course. The exception process for program requirements is administered by the relevant Director(s) of Undergraduate Studies. Exception requests may be brought forward by the student, an academic advisor, and/or departmental staff.

SEAS has developed an online tool for submitting, reviewing, and documenting exception requests. These requests are typically submitted to the online tool by departmental staff after consultation with the program Director. Justification for the exception is required. The request is reviewed by SEAS OUE. If the exception is approved, it is processed within the HUB system by an academic advisor. All exceptions appear on a student’s AAR and are double checked through the degree audit process.

G. Transcripts of Recent Graduates

The program will provide transcripts from some of the most recent graduates to the visiting team along with any needed explanation of how the transcripts are to be interpreted. ***These transcripts will be requested separately by the Team Chair.*** *State how the program and any program options are designated on the transcript. (See 2019-2020APPM, Section I.E.3.a.)*

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

Provide the institutional mission statement.

The University at Buffalo (UB) Mission Statement

The UB mission statement is published on the President's website at:
http://www.buffalo.edu/president/vision.html

The University at Buffalo is a diverse, inclusive scholarly community dedicated to bringing the benefits of its research, scholarship and creative activity, and educational excellence to global and local communities in ways that impact and positively change the world.

We view the three traditional pillars of the public higher education mission—research, education, and service—as interdependent endeavors that continually enrich and inform each other. Groundbreaking research, transformative educational experiences, and deeply engaged service to all communities define the University at Buffalo's mission as a premier, research-intensive public university.

The School of Engineering and Applied Science (SEAS) Mission Statement

The SEAS mission statement is published on the SEAS website at:
http://engineering.buffalo.edu/home/school/about/strategy.html

> The mission of UB SEAS is to conduct high-impact original research in science and engineering, to produce graduates capable of innovating and leading in the engineering disciplines and related fields, and to find creative solutions to the most pressing challenges facing society.

The Department of Mechanical and Aerospace Engineering (MAE) Mission Statement

The MAE mission statement is published on the MAE website at:
http://engineering.buffalo.edu/mechanical-aerospace/about/mission.html

> The mission of the Department of Mechanical and Aerospace Engineering is to provide high-quality engineering education at the Bachelor, Master, and Doctorate levels, appropriate to

the discipline and consistent with our status as a first-rate research university. In particular, the elements of our mission are to:

- Prepare our students for careers or advanced study in mechanical engineering, aerospace engineering, or other relevant fields.
- Serve professional groups with excellence in scholarship, character, and integrity.
- Impact significant technical, societal, and environmental challenges through innovative research, transformative education, and leadership.

B. Program Educational Objectives

List the program educational objectives and state where they may be found by the general public as required by APPM Section I.A.6.a.

The Program Educational Objectives for the ME program are:

- **Career development:** Graduates will hold a position in mechanical engineering or another field leveraging their training, or be engaged in advanced study. (PEO 1)
- **Professional service with integrity:** Graduates will actively participate in professional and community groups while upholding the highest ethical standards. (PEO 2)
- **Addressing important problems:** Graduates will use their mechanical engineering training to recognize and make a significant, positive impact on current and future societal challenges. (PEO 3)

The PEOs are published as follows:

- Posters in Bell, Furnas, and Jarvis Halls.
- The undergraduate section of the MAE website: http://engineering.buffalo.edu/mechanical-aerospace/undergraduate/programs/accreditation.html
- The UB Undergraduate Catalog at: https://catalog.buffalo.edu/academicprograms/mechanical_engineering_bs.html

C. Consistency of the Program Educational Objectives with the Mission of the Institution

Describe how the program educational objectives are consistent with the mission of the institution.

Table 2.1 shows the mapping of the PEOs with the missions of the University, School, and Department.

Table 2.1: Mapping of University, School, and Departmental Mission Statements to PEOs

Level	Mission Components	PEO 1 Career development	PEO 2 Professional service with integrity	PEO 3 Addressing important problems
UB	Educational excellence... transformative educational experiences	●		●
	Bringing research, scholarship and creative activity, and educational excellence to global and local communities		●	●
SEAS	Capable of innovation	●	●	●
	Lead in engineering disciplines	●	●	
	Find creative solutions societal challenges			●
MAE	Career development	●		
	Professional service	●	●	
	Addressing important problems		●	●

D. Program Constituencies

List the program constituencies. Describe how the program educational objectives meet the needs of these constituencies.

Program Educational Objectives are broad statements that describe what graduates are expected to attain within a few years of graduation. Therefore, we concentrated on the professional activities of the students after graduation and sought to engage groups that work with students at and after the time of graduation.

- Faculty: have knowledge of skills required in the profession and are focused on providing suitable education to achieve those skills;

- Departmental Advisory Board (DAB): working as professionals from industry and universities; Ten of the eleven current (2019) board members are also alumni of UB, and so stand as an effective proxy for our alumni;

- Undergraduate Studies Committee (UGSC): responsible for oversight of the educational program and has knowledge of modes of instruction.

E. Process for Review of the Program Educational Objectives

Describe the process that periodically reviews the program educational objectives including how ALL of the program's various constituencies are involved in this process. Describe how this process is systematically utilized to ensure that the program's educational objectives remain consistent with the institutional mission, the program constituents' needs and these Criteria.

The Mechanical Engineering Program Educational Objectives were revised in 2014 and then again in 2019. The most recent review of the PEOs is summarized below; this process is consistent with our previous reviews.

On April 29, 2019, the Department Chair sent our draft PEOs to our Departmental Advisory Board members for their review, feedback, and approval. The request form is shown below in Figure 2.1. On May 3, 2019, the departmental faculty were sent the same request and survey. On May 20, 2019, the collective feedback from these two groups were compiled and reviewed by the Department Chair and Directors of Undergraduate Studies. Two small changes were made to clarify the PEOs based on this feedback.

On May 23, 2019, the members of the Undergraduate Studies Committee were asked to review the revised set of PEOs. After feedback from the committee members, the Department Chair and Directors of Undergraduate Studies again made some minor revisions to the PEOs. On June 6, 2019, the Directors of Undergraduate Studies approved of the final PEOs and these versionswere subsequently published on the departmental webpage and student communications. The next review is planned for 2025.

MAE Stakeholder Survey

As part of our upcoming ABET Accreditation visit in 2020, we are soliciting your feedback on our Program Educational Objectives (PEOs).

According to ABET, we must have PEOs that are consistent with the mission of the institution and the needs of the program's various constituencies. In essence, PEOs are broad statements that describe what graduates of our program are expected to attain within a few years after graduation.

Program Educational Objectives

Our Program Educational Objectives are currently as follows:

1. Holding and/or studying towards a professional career: Graduates will hold a position in mechanical/aerospace engineering or other professional careers or will be engaged in advanced study
2. Serving their professional communities: Graduates will serve their profession and their community by participation in professional and community groups
3. Impacting big problems: Graduates will use the unique problem-solving skills from their engineering training to make a significant, informed impact on current and future societal challenges

PEO 1 deals with attaining professional success; PEO 2 deals with graduates' commitment to their community; and PEO 3 captures the fact that engineers are trained to solve significant problems.

Please indicate your overall satisfaction with these PEO's:

☐ Yes, I approve them.

☐ No, they need changes as I describe below.

If you don't approve of them, please comment below. What has been left out? What is inappropriate or irrelevant or unrealistic?

Long answer text

Figure 2.1. MAE stakeholder survey to obtain feedback used PEO revisions.

CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

List the student outcomes and state where they may be found by the general public as required by APPM Section I.A.6.a.

If the student outcomes used by the program are stated differently than those listed in Criterion 3, provide a mapping of the program's student outcomes to the student outcomes (1) through (7) listed in Criterion 3. In the event that a program has not stated any student outcome verbatim as cited in the Engineering Accreditation Criteria, all elements required by that outcome must be retained. Further, the program must not alter the intent or otherwise diminish the meaning of that outcome.

The Student Outcomes (SOs) for ME are identical to the ABET SOs. They may be found at:

https://catalog.buffalo.edu/academicprograms/mechanical_engineering_bs.html

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Please note that in the UB Undergraduate Catalog, the student outcomes are referred to as Learning Outcomes, the term used at UB for all program outcomes.

B. Relationship of Student Outcomes to Program Educational Objectives

Describe how the student outcomes prepare graduates to attain the program educational objectives.

Student Outcomes, which can be measured at the time of graduation, are the way by which the program prepares its graduates to achieve their professional and career accomplishments. Each of the PEOs is supported by a number of SOs. The relationship between the Mechanical Engineering PEOs and SOs is shown in Table 3.1.

Table 3.1. Mapping of PEO's to Student Outcomes

	Program Educational Objective	**Required Skills**	**Specific Skills**	**Student Outcomes**
PEO 1	**Career development:** Graduates will hold a position in mechanical engineering or another field leveraging their training, or be engaged in advanced study.	Technical competence in Mechanical engineering and in STEM preparation areas	Solve complex problems	1
			Design, conduct experiments	6
			Engineering Design	2
			Communicate effectively	3
			Professional & Ethical Responsibility	4
PEO 2	**Professional service with integrity:** Graduates will actively participate in professional and community groups while upholding the highest ethical standards.	Social Awareness, Professional Development	Engineering Design	2
			Function on team	5
			Professional & Ethical Responsibility	4
			Communicate effectively	3
			Acquire new knowledge	7
PEO 3	**Addressing important problems:** Graduates will use their mechanical engineering training	Use training to solve societal problems	Engineering Design	2
			Function on team	5
			Communicate effectively	3
			Professional & Ethical Responsibility	4

	to recognize and make a significant, positive impact on current and future societal challenges.		Acquire new knowledge	7

CRITERION 4. CONTINUOUS IMPROVEMENT

This section of your Self-Study Report should document your processes for regularly assessing and evaluating the extent to which the student outcomes are being attained. This section should also document the extent to which the student outcomes are being attained and describe how the results of these processes are utilized to affect continuous improvement of the program. Each program must independently assess all student outcomes; when programs share courses, assessment data must be disaggregated by program in order to ensure the individual program's outcomes are being independently assessed.

Assessment is defined as one or more processes that identify, collect, and prepare the data necessary for evaluation. Evaluation is defined as one or more processes for interpreting the data acquired though the assessment processes in order to determine how well the student outcomes are being attained.

Although the program can report its processes as it chooses, the following is presented as a guide to help you organize your Self-Study Report.

A. Student Outcomes

It is recommended that this section include the following (a table may be used to present this information):

1. A listing and description of the assessment processes used to gather the data upon which the evaluation of each student outcome is based. Examples of data collection processes may include, but are not limited to, specific exam questions, student portfolios, internally developed assessment exams, senior project presentations, nationally-normed exams, oral exams, focus groups, industrial advisory committee meetings, or other processes that are relevant and appropriate to the program.
2. The frequency with which these assessment processes are carried out
3. The expected level of attainment for each of the student outcomes
4. Summaries of the results of the evaluation process and an analysis illustrating the extent to which each of the student outcomes is being attained
5. How the results are documented and maintained

The process of assessment and evaluation of student outcomes has been evolving as part of our continuous-improvement process. This section describes the current processes that are in place and explains the changes that have been made since the 2014 EAC ABET visit.

A.1. Assessment Process:

Direct Outcome Assessment

All undergraduate courses were assessed for content in SO's 1-7, and a matrix was constructed showing coverage and courses selected for an Assessment. Normally, this process is repeated every 3 years, but with the change-over from SO's a-k to 1-7, this process was performed in Summer 2018. Going forward, this table will be reviewed every 3 years.

The table below shows the coverage level of the SO 1-7 mapping for the required MAE courses in the program, from level 1 (content introduced in the course), to level 2 (content practiced in the course), to level 3 (content mastered in the course). For each SO, courses (highlighted yellow or blue) having coverage levels of 2 or 3 are selected to perform the Assessment as described below. The outcomes assessed in each year of the 3-year cycle are indicated in the left-most column. The right-most column gives the courses assessed for each SO.

		Course Names	UB Seminar	Introduction to CAD	Thermodynamics I	Intro. to Mech. Eng. Practice	Fluid Mechanics	Dynamic Systems	Applied Math for MAE	Product Design in a CAE Env.	Eng. Materials Lab	Machines & Mechanisms I	MAE Lab I	Heat Transfer	Manufacturing Processes	Eng. Materials Lab	MAE Lab II	Design Process & Methods	Design Project	
		Outcomes 1-7	EAS 199 Fall	MAE 177 Sp	MAE 204 Fall	MAE 277 Fall	MAE 335 Fall	MAE 340 Fall	MAE 376 Fall	MAE 377 Fall	MAE 381 Fall	MAE 311 Sp	MAE 334 Sp	MAE 336 Sp	MAE 364 Sp	MAE 385 Sp	MAE 338 Fall	MAE 451 Fall	MAE 494 Sp	Courses selected for evaluation
		Instructor Responsible		Armstrong	Khan, Meng, Salac	Trinidad	Battaglia, Burge, Snoeyink	Estes, Karami, Mook	Darrall, Chowdhury	Armstrong	Armstrong, Wetherhold	Khan	Armstrong, Estes	Burge	Trinidad	Armstrong	Khan, Sobato	Mashhadi	Hall	
Year 1	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1	1	3	2	3	3	3	1	2	3	2	3	2	1	1	1	3	MAE 335, MAE 340
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	1		1	2		2		3		2	1		2			3	3	MAE 377, MAE 451, MAE 494
	3	an ability to communicate effectively with a range of audiences	1		1			1		1	1		3	0		2	3	3	3	MAE 334, MAE 338, MAE 494
Year 2	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	1			3		1							1		1	3	3	MAE 277, MAE 451
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	1		2	2						1	3		2		1	2	3	MAE 334, MAE 494
Year 3	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	1					1	2				3			2	3	1	1	MAE 334, MAE 338
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	1	3	1	2	1	1	2	2	1		1	1	1	1			2	MAE 381, MAE 177

1 = Content introduced in the course | 2 = Content practiced in the course | 3 = Content mastered in the course

Table 4-1: SO coverage level (1-3) matrix for each required course, also indicating which two courses are to be assessed for each SO (highlighted cells), and the year which they will be assessed in the 3-year cycle (left-most column).

The achievement of SOs is based primarily on direct Outcome Assessments within the selected courses. Performance Indicators (PIs) were formulated for SOs 1-7 (sect. A.4 below), and the process started in Fall 2018. For a given SO, an assessment of the PIs is done by the instructor for each selected course using samples of student work from an assignment or assignments relevant to the PIs, supervised by a UGSC member. Afterward, a summary assessment report is produced for each SO, based on the PIs assessed in the chosen courses; these SO 1-7 summary assessments are given in Sect. A.4 below. In addition to these direct Outcome Assessments, an indirect method is also used, described next.

Indirect measures of Outcome Assessment—the Senior Exit Survey

Senior Exit Surveys (SES): The annual Mechanical Engineering senior exit survey has been used to collect indirect assessment data regarding student outcomes. In Spring 2019, SEAS piloted a new school-wide senior exit survey in conjunction with the UB Office of Educational Effectiveness. This change coincided with our adoption of the new student outcomes 1-7. The questions related to attainment of student outcomes were given on a 4-point scale to be consistent with other institutional assessments and with our direct Outcome Assessments.

In questions 59-65 of the survey, students respond to questions of the form: “Based upon your program curriculum, to what extent to you feel prepared to:” followed by the Student Outcome statements. Possible responses were “Very little, Some, Quite a Bit, Very Much.”

The level of attainment required in the direct Outcome Assessment is ≥ 70% responded “Quite a Bit” or “Very Much” – the two highest categories. Senior exit surveys are conducted anonymously.

Table 4-2a, ME response to SES, 2019

ME, 45 respondents, results in %

Outcome	Very little	some	Quite a bit	Very much	Sum of quite a bit plus very much
1	0.00	15.56	44.44	40.00	84.4
2	4.44	15.56	40.00	40.00	80.0
3	2.22	13.33	35.56	48.89	84.5
4	2.22	4.44	40.00	53.33	93.3
5	0.00	13.33	37.78	48.89	86.7

6	0.00	11.11	40.00	48.89	88.9
7	4.44	2.22	33.33	60.00	93.3

These indirect results have value in that they reflect student impressions of their learning; however, it is not an assessment of competency as given by the direct Assessments. Nonetheless, it does reflect the confidence that students feel in the Outcome areas.

Essentially all indirect Outcomes in the ME program show a higher degree of accomplishment than the direct Outcomes, which are acceptable if scores of 3 and 4 are attained by ≥ 70% of students (see A.4 below).

The SES was repeated in 2020 with similar results.

Table 4-2b, ME response to SES, 2020

ME, 44 respondents, results in %

Outcome	Very little	some	Quite a bit	Very much	Sum of quite a bit plus very much
1	2.27	20.45	38.64	38.64	77.28
2	4.55	20.45	38.64	36.36	75.00
3	0.00	6.82	52.27	40.91	93.18
4	2.27	15.91	50.00	31.82	81.82
5	2.27	9.09	29.55	59.09	88.64
6	6.82	15.91	36.36	40.91	77.27
7	0.00	13.64	40.91	45.45	86.36

A.2. The direct Assessments are expected to be carried out on a 3-year cycle:

Table 4-3, Assessment Cycle

Year	Outcomes Assessed
1	1-3
2	4-5
3	6-7

However, years 2 and 3 have been joined in this first Assessment cycle, so that Outcomes 1-7 could be completed in time for the submission of this Self-Study Report in Summer 2020. Thus, the current cycle is Fall 2018–Spring 2020; the next cycle will begin in Fall 2020 and will last until Spring 2023.

The direct Outcome Assessment shall demonstrate that 70% of the students will attain PI levels 3 and 4 (two top grades, please see the scale in A.4 below) to be viewed as acceptable. If this level is not achieved for an SO, then the UGSC reviews the issue and the UGSC member assigned to that SO takes the agreed upon action to resolve it. Typically, this involves meeting with the instructor of the course that showed unsatisfactory performance for the PI, and changes are made to the course, with effect in the next year's course offering. Any deficient PI is re-assessed 1 year later for acceptability (for an example, please see the Outcome 3 assessment summary below in A.4). This process is repeated until the PI is acceptable. If the unsatisfactory performance is deemed to be a more systemic problem in the program, the UGSC develops a broader plan. For example, lab-report quality was poorer than desired with inconsistent reports from student to student, so our lab instructors developed new MAE lab-report guidelines for content and presentation, including tables and graphs (please see Continuous Improvement Action 5, 2018-2019, Sect. B below).

A.3. Each ABET Student Outcome is mapped to three Performance Indicators that cover each aspect of that Outcome. In addition, all course-level Performance Indicators are mapped one-to-one, and in order, to the Performance Indicators, for all Student Outcomes. This is done to ensure consistency in the assessments from year to year.

Example of consistency which is enforced between the Performance Indicators and the course-level Performance Indicators:

ABET Student Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

The Performance Indicators developed in MAE for Student Outcome 1 are:

1. Recognize that the situation is governed by scientific relationships that can be experimentally or analytically determined;

2. Develop a mathematical representation of these relationships when possible and appropriate;

3. Solve the descriptive mathematical equations or analyze the technical issues at hand to arrive at an engineering solution to the problem.

The corresponding course-level Performance Indicators for Outcome 1, from the course MAE 340 Dynamic Systems, are:

1. Use a scientific representation of component behavior to mathematically model each component;

2. Solve complex engineering problems which involve many subsystems by combining the component mathematical models in a coupled dynamics model;

3. Solve the dynamic system equations to characterize the system response to a variety of inputs. This includes both the transient and steady-state response of the system using techniques from the time and frequency domain.

Note: All course-level Assessments of all SO's are available in cloud storage (UB Box)

For all Performance Indicators, for all Student Outcomes, the following scale is used for assessment (this scale defines the values of 3 and 4 mentioned above):

4	Meets all or nearly all of the criteria
3	Meets most of the criteria
2	Meets some of the criteria
1	Meets few or none of the criteria

Summaries of the assessments for each Performance Indicator for Student Outcomes 1–7 are provided here.

Outcome (1) – Performance Indicators

This assessment demonstrates successful achievement for Student Outcome (1) and applies to both Mechanical and Aerospace Engineering Programs. Success is defined by ABET as:

"An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics."

In Mechanical and Aerospace Engineering we have further refined this statement to define the following program-level performance indicators to be applied to all of the courses which we have selected to be subject to evaluation under this outcome:

Given a physical situation of engineering significance, students should be able to:

1. Recognize that the situation is governed by scientific relationships that can be experimentally or analytically determined;
2. Develop a mathematical representation of these relationships when possible and appropriate;
3. Solve the descriptive mathematical equations or analyze the technical issues at hand to arrive at an engineering solution to the problem

Summary of results and recommendation

The following courses were evaluated for this outcome during the semester shown in parenthesis:

MAE 335, Fluid Mechanics (Fall 2018)
MAE 340, Dynamic Systems (Fall 2018)

The results of the assessment for these courses are presented in the table below. To satisfy the requirement the total number of scores with a 3 or 4 must be above 70% for all of the performance indicators for all of the courses assessed. The results in the table indicate the percentage of students who scored at least a 3 or 4 on the performance indicators.

Table 4-SO1

Performance Indicator	MAE 335	MAE 340
1	83%	94%
2	81%	79%
3	79%	90%

In conclusion, the requirements have been met since all of the scores are above 70%. In light of this outcome, no changes are planned for these courses. The courses will be monitored to ensure the requirements continue to be met.

Prepared by: James Chen
UGSC approved: 10/15/2019

Outcome (2) – Performance Indicators

This assessment demonstrates successful achievement for Student Outcome (2) and applies to the Mechanical Engineering Program. Success is defined by ABET as:

"An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors."

In Mechanical and Aerospace Engineering we have further refined this statement to define the following program-level performance indicators to be applied to all of the courses which we have selected to be subject to evaluation under this outcome.

Starting with an open design problem best suited for a mechanical engineering solution, through a formal process of design, students should be able to:

1. Formulate an engineering problem that specifies performance requirements and design constraints cognizant of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
2. Develop a step-by-step plan that identifies materials, tools, and the use of engineering theory to conduct the design process. Moreover, explain how this approach is used in light of the performance requirements and constraints that have been established.
3. Evaluate the design solution in terms of how well it performs within the design requirements and constraints. Describe the engineering analyses completed as part of this work and how the outcome was validated.

Summary of results and recommendation

The following courses were evaluated for Outcome 2 during the semester shown in parenthesis:

MAE 377, Product Design in a CAE Environment (Fall 2018)
MAE 451, Design Process and Methods (Fall 2018)
MAE 494, Design Project (Spring 2019)

The results of the assessment for these courses are presented in the table below. To satisfy the requirement the total number of scores with a 3 or 4 must be above 70% for all of the performance indicators for all of the courses assessed. The results in the table indicate the percentage of students who scored at least a 3 or 4 on the performance indicators.

Table 4-SO2

Performance Indicator	MAE 377	MAE 451	MAE 494
1	97%	81%	87%
2	92%	97%	87%
3	80%	85%	83%

In conclusion, the requirements have been met since all of the scores are above 70%. In light of this outcome, no changes are planned for these courses. The courses will be monitored to ensure the requirements continue to be met.

Prepared by: John F. Hall
UGSC approved: 10/15/2019

Outcome (3) – Performance Indicators

This assessment demonstrates successful achievement for Student Outcome (3) and applies to the Mechanical Engineering Program. Success is defined by ABET as:

“An ability to communicate effectively with a range of audiences.”

In Mechanical and Aerospace Engineering we have further refined this statement to define the following program-level performance indicators to be applied to all of the courses which we have selected to be subject to evaluation under this outcome.

When required to communicate technical information, students should be able to:

1. Convey an introduction that briefly describes the importance, and objectives, of the present work;
2. Develop a clear and professional description of the work performed, supported by results presented in well-organized tables, plots, and figures, whenever possible;
3. Draw, and appropriately convey, meaningful conclusions from results.

Summary of results and recommendation

The following courses were evaluated for this outcome during the semester shown in parenthesis:

MAE 334, Mechanical and Aerospace Engineering Lab I (Spring 2019)
MAE 338, Mechanical and Aerospace Engineering Lab II (Fall 2018)
MAE 494, Design Project (Spring 2019)

The results of the assessment for these courses are presented in the table below. To satisfy the requirement the total number of scores with a 3 or 4 must be above 70% for all of the performance indicators for all of the courses assessed. The results in the table indicate the percentage of students who scored at least a 3 or 4 on the performance indicator.

Table 4-SO3

Performance Indicator	MAE 334	MAE 338	MAE 494
1	100%	83%	100%
2	87.5%	93%	97%
3	100%	80%	100%

In conclusion, each course met the requirement of having 3 or 4 above 70% individually in each performance indicator. Average of each performance indicator in different course is also above 70% and overall average of these averages is also above 70%. No further assessment is necessary for any course until the next cycle.

Prepared by: Jobaidur Rahman Khan
UGSC approved: 10/15/2019

Outcome (4) – Performance Indicators

This assessment demonstrates successful achievement for Student Outcome (4) and applies to the Mechanical Engineering Program. Success is defined by ABET as:

"An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts."

In Mechanical Engineering we have further refined this statement to define the following program-level performance indicators to be applied to all of the courses which we have selected to be subject to evaluation under this outcome:

Given an engineering analysis problem, students should be able to:

1) approach engineering design and analysis problems with structure and professionalism;
2) recognize, appreciate, and articulate the ethical, professional, economic, environmental, and societal issues in engineering design and analysis
3) develop a structured plan to address ethical, professional, economic, environmental, and societal issues in the context of the engineering design and analysis

Summary of results and recommendation

The following courses were evaluated for this outcome during the semesters shown in parenthesis:

MAE 277, Introduction to Mechanical and Aerospace Engineering Practice (Fall 2019)
MAE 451, Design Process and Methods (Fall 2019)

The results of the assessment for these courses are presented in the table below. To satisfy the requirement the total number of scores with a 3 or 4 must be above 70% for all of the performance indicators for all of the courses assessed. The results in the table indicate the percentage of students who scored at least a 3 or 4 on the performance indicator.

Performance Indicator	MAE 277	MAE 451
1	76%	78%
2	88%	77%
3	80%	74%

In conclusion, each course meet the requirement of having 3 or 4 above 70% individually in each performance indicator. The average of each performance indicator in different course is also above 70% and the overall average of these averages is also above 70%. No further assessment is necessary for any course until the next cycle.
Prepared by: Amin Karami
DUGS approved: 6/4/2020

Outcome (5) – Performance Indicators

This assessment demonstrates successful achievement for Student Outcome (5) and applies to the Mechanical Engineering Program. Success is defined by ABET as:

"An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives."

In Mechanical Engineering we have further refined this statement to define the following program-level performance indicators to be applied to all of the courses which we have selected to be subject to evaluation under this outcome:

When required to work on group assignments, students should be able to:

1. Work collaboratively and inclusively in a team environment;
2. Create project objectives along with the tasks and milestones for completion;
3. Collectively provide leadership to successfully complete engineering problems.

Summary of results and recommendation

The following courses were evaluated for this outcome during the semester shown in parenthesis:

MAE 494, Design Project (Spring 2020)

MAE 334, Engineering Lab 1 (Spring 2020)

The results of the assessment for these courses are presented in the table below. To satisfy the requirement the total number of scores with a 3 or 4 must be above 70% for all of the performance indicators for all of the courses assessed. The results in the table indicate the percentage of students who scored at least a 3 or 4 on the performance indicators.

Performance Indicator	MAE 334	MAE 494
1	95%	92%

2	90%	95%
3	95%	97%

In conclusion, the requirements have been met since all of the scores are above 70%. In light of this outcome, no changes are planned for these courses. The courses will be monitored to ensure the requirements continue to be met.

Prepared by: Ardeshir Raihanian
DUGS Approved: 6/5/2020

Outcome (6) – Performance Indicators

This assessment demonstrates successful achievement for Student Outcome (6) and applies to the Mechanical Engineering Program. Success is defined by ABET as:

"An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions."

In Mechanical Engineering we have further refined this statement to define the following program-level performance indicators to be applied to all of the courses which we have selected to be subject to evaluation under this outcome:

When required to work on group assignments, students should be able to:

1. Perform the experiment, understanding the selection of equipment and instrumentation, identify the relevant independent parameters to be controlled, and determine the dependent parameters to be recorded; this may include the design of the experiment such as selection of the equipment and methods;
2. Conduct the experiment with an understanding of the nature and limitations of the instrumentation and apparatus;
3. Analyze and interpret the data and draw conclusions that reflect the significance of the data in relation to the experimental uncertainty.

Summary of results and recommendation

The following courses were evaluated for this outcome during the semester shown in parenthesis:

MAE 334, Engineering Lab 1 (Spring 2020)
MAE 338, Engineering Lab 2 (Spring 2020)

The results of the assessment for these courses are presented in the table below. To satisfy the requirement, the total number of scores with a 3 or 4 must be above 70% for all of the performance indicators for all of the courses assessed. The results in the table indicate the percentage of students who scored at least a 3 or 4 on the performance indicators.

Performance Indicator	MAE 334	MAE 338
1	77%	96%
2	97%	92%
3	83%	81%

The requirements have been met, as all performance indicator scores are above 70%. No further assessment is necessary for these courses until the next cycle. The courses will be monitored to ensure the requirements continue to be met.

Prepared by: Bradley Darrall
DUGS Approved: 6/5/2020

Outcome (7) – Performance Indicators

This assessment demonstrates successful achievement for Student Outcome (7) and applies to both Mechanical and Aerospace Engineering Programs. Success is defined by ABET as:

“an ability to acquire and apply new knowledge as needed, using appropriate learning strategies”

In Mechanical and Aerospace Engineering we have further refined this statement to define the following program-level performance indicators to be applied to all of the courses which we have selected to be subject to evaluation under this outcome:

Given an open-ended task that requires extending the knowledge presented in a given course to a new but related topic, students should be able to:

1. Use suitable sources at an appropriate level to acquire the information needed for the task;
2. Integrate this information in order to complete the task;

Summary of results and recommendation

The following courses were evaluated for this outcome during the semester shown in parenthesis:

MAE 177, Introduction to CAD (Spring 2020)
MAE 381, Engineering Materials (Fall 2019)

The results of the assessment for these courses are presented in the table below. To satisfy the requirement the total number of scores with a 3 or 4 must be above 70% for all of the performance indicators for all of the courses assessed. The results in the table indicate the percentage of students who scored at least a 3 or 4 on the performance indicators.

Performance Indicator	MAE 177	MAE 381
1	92%	94%
2	88%	95%

In conclusion, the requirements have been met since all of the scores are above 70%. In light of this outcome, no changes are planned for these courses. The courses will be monitored to ensure the requirements continue to be met.

Prepared by: A Mashhadi, J Armstrong, R Wetherhold
DUGS Approval: 6/5/2020

A.4. All assessment results are kept in cloud storage (UB Box) and maintained through the 6-year accreditation cycle. The course-level assessments are included in this folder, along with the summaries given above.

B. Continuous Improvement

Describe how the results of evaluation processes for the student outcomes and any other available information have been systematically used as input in the continuous improvement of the program. Describe the results of any changes (whether or not effective) in those cases where re-assessment of the results has been completed. Indicate any significant future program improvement plans based upon recent evaluations. Provide a brief rationale for each of these planned changes.

Section A also lists the action plan for continuous improvement for each SO if SO is not satisfied. In addition, as part of our continuous improvement process, since the last ABET visit in 2014 we have implemented a number of significant changes in our program. These activities stem from the assessment process described above in Section A, from faculty, student, and Advisory Board feedback, and from activities of the Undergraduate Studies Committee. Below, we tabularize our actions related to significant program improvements since the previous ABET review in 2014. Actions taken by the School (SEAS) and the University (UB) that have significantly impacted our program/students are also included in the accounting in Table 4-4 and noted in the subsequent Action listing.

Table 4-4: Accounting of the number of Continuous Improvement Actions since the last Accreditation Visit.

AY 14-15	AY 15-16	AY 16-17	AY 17-18	AY 18-19	AY 19-20
6	**8**	**9**	**12**	**7**	**4**

AY 2014-2015

Action 1: UB (Administration)

Action Taken	Administration of the first collaborative placement survey, the UB "First Destination Survey." This comprised an initial survey, supplemented with information from LinkedIn, Facebook and UB graduate school records.
Basis for Action	At the time of graduation, seniors were receiving separate senior exit surveys from their department, from the school, and from the University. Many times, the same questions were being asked. In addition, response rates were low because of survey fatigue and placement data was poor because students were surveyed at the time of graduation.
Date	Summer/Fall 2015.
Results	Good initial effort. Survey in second year was less successful due to personnel changes. UB ultimately hired a new staff member to focus on this effort (see entry AY 2017-2018)

Action 2: UB (Administration)

Action Taken	Administration of the first UB-wide end of semester course evaluation.
Basis for Action	Different units were administering using different questions etc. making comparison across the university difficult.
Date	Fall 2014
Results	University-wide survey provides consistency across the university. UB-wide course evaluation committee provides guidance on issues and concerns arising from the operation of the course evaluation system.

Action 3: SEAS (Program Educational Objectives)

Action Taken	Engineering Partnership Program Launched to provide single program for corporate sponsors to support the School of Engineering and Applied Sciences.

Basis for Action	Companies were often contacted by various different entities to support a number of school/departmental/student club events. Closer partnerships also provide additional professional development opportunities for students.
Date	Fall 2014
Results	New approach provides more streamlined approach for corporate partners. Funds are used to support various school recruitment events. More importantly, over $30K used to support student clubs activities resulting in
	broader participation in student competitions and attendance at regional/national conferences.

Action 4: SEAS (Program Educational Objectives and Student Outcomes)

Action Taken	Appointment of a Director of Experiential Learning (ExL) Programs and subsequent development of an ExL "continuum."
Basis for Action	Response to calls for increased opportunities for learning in the form of "experiential learning" occurring nationally, within the SUNY system, and within the institution. This typically takes the form of "hands-on", co-curricular activities that provide opportunities for exploration/discovery, personalized learning, and putting theory to practice.
Date	Spring 2014 (while director was hired academic year, programs were built out starting AY 2014-15)
Results	Appointment of an ExL Director has led to: (i) development of Tinkering and Engineering Intramurals programs; (ii) creation of an interdisciplinary capstone design course; (iii) improved channels for outreach and engagement with industry partners, community groups, and departments on student projects in Engineering Intramurals and senior design; and (iv) continuous improvement efforts to expand and shape these programs through education research and evidence-based practice.

Action 5: SEAS (Student Outcomes)

Action Taken	Implemented guidelines regarding common sections taught under the Office of Undergraduate Education (EAS courses) to ensure consistency in student outcomes between sections.
Basis for Action	As the school worked to decrease class size, there was a need to improve coordination between sections to ensure consistent preparation of students for advanced courses in their programs
Date	Fall 2014
Results	Shared syllabi and faculty team meetings to prepare course materials, leading to improved consistency between sections.

Action 6: SEAS (Student Outcomes)

Action Taken	First ABET retreat for all SEAS Departments
Basis for Action	Dissemination of information learned at ABET IDEAL Workshop
Date	Spring 2015
Results	Programs gained better understanding of assessment best practices

AY 2015-2016

Action 1: UB (Administration)

Action Taken	Major revision of the UB General Education.
Basis for Action	UB initiative to improve general education program and support more deliberate choice by students of general education electives along themes, or pathways.
Date	New program developed over 2015-2016 year
Results	New innovative program (UB Curriculum) adopted and implemented Fall 2016 (see entry under AY 2016-2017)

Action 2: UB (Administration)

Action Taken	Blackstone Launchpad at UB opened its doors.
Basis for Action	To fill recognized need to provide additional resources for students, alumni, faculty and staff to learn about entrepreneurship.
Date	March 2016
Results	Center provides individualized mentorship and ideation support, as well as seminars and training sessions related to starting and growing a business. Results in heightened awareness and interest in entrepreneurship.

Action 3: SEAS (Student Outcomes)

Action Taken	Implementation of new SEAS academic review policy to reduce the number of students with prolonged periods of poor performance prior to dismissal and to motivate students to seek alternative majors before requesting readmission.
Basis for Action	Previous policy allowed prolonged period of poor performance, which is inconsistent with professional expectations.
Date	Fall 2015
Results	Earlier intervention for poor performance.

Action 4: SEAS (Program Educational Objectives)

Action Taken	Launch of SEAS “Professional Development Survey.” The survey is designed to help students reflect upon and document their experiences (jobs, clubs, study abroad etc.) over the past year.

Basis for Action	Some employers had indicated that students where not well prepared to articulate their skills and experiences during an interview.
Date	Fall 2015
Results	By graduation, students have complete record of all extra-curricular activities that they can use to build their resume. The survey also provides valuable information about student participation in extra-curricular activities.

Action 5: SEAS (Student Outcomes)

Action Taken	Development of SEAS online tool to document laboratory spending plans.
Basis for Action	No formal process to approve and track laboratory expenses was in place. The new tool was developed to both improve tracking of laboratory expenses and to encourage collaboration between departments.
Date	Fall 2015
Results	Departments are better able to plan laboratory improvements and track associated expenses, leading to improvements in the quality of the laboratory experience for students.

Action 6: SEAS (Program Educational Objectives)

Action Taken	New office of STEM Diversity
Basis for Action	Need to improve admission, retention and success of all student populations in SEAS
Date	Spring 2016
Results	Diversity Plan developed. SEAS recognized by ASEE as Exemplar recipient of a Bronze Award in 2019.

Action 7: SEAS (Student Outcomes)

Action Taken	Renovation of space on 4th floor of Bonner Hall including The Steven's Center
Basis for Action	Space outdated and under-utilized.
Date	Spring 2016
Results	Addition of more student study/collaboration space was well-received. Students continue to make good use of the space for individual and group projects.

Action 8: (Student Outcomes)

Action Taken	Revision of the BS ME engineering program requirements to accommodate SUNY Seamless Transfer (as described in the Background)
Basis for Action	SUNY and State Department of Education requirements
Date	Developed over 2015-2016 year, implemented in Fall 2016

Results	New program changes implemented in Fall 2016. MAE 177 (Intro to Eng Dwg and CAD), changed to self-guided online tutorial experience, allowing more flexibility to student.

AY 2016-2017

Action 1: UB (Administration)

Action Taken	Implemented UB Curriculum, an innovative, student-centered approach to general education. The program aims to enrich students' educational experience and help prepare them to succeed in today's world.
Basis for Action	Earlier program was a traditional "checklist" approach, where courses taken where often disconnected. The new program is highly customizable and allows students to design a path that best suits their interests while also complementing their major. The new program also revised the English language requirement to include a writing course in the discipline (see below).
Date	Fall 2016
Results	First students to complete the new program will graduate Spring 2020. Assessment of UB Curriculum led by Office of Educational Effectiveness.

Action 2: SEAS (Student Outcomes)

Action Taken	Development and introduction of a STEM Communications course (EAS 360) taught by technical communications faculty hired by SEAS
Basis for Action	Course assessment and faculty feedback indicated that students were weak in technical communication. The new UB Curriculum allowed for the introduction of a communication class in the discipline.
Date	Fall 2016
Results	All students take EAS 360. This has helped prepare them for laboratory and capstone course writing requirements.

Action 3: SEAS (Student Outcomes)

Action Taken	Revision of the EAS 140 (Engineering Principles) course into EAS 199 (3-credit seminar) for first-year students and addition of EAS 198 (1-credit seminar) for transfer students.
Basis for Action	UB Curriculum revision required that every student take a seminar class during their first semester to help students adjust to academics at UB.
Date	Fall 2016
Results	All students take one of the seminar courses. Course evaluations are highly positive.

Action 4: SEAS (Student Outcomes)

Action Taken	Revision of transfer admissions policy
Basis for Action	Prior policy was vague resulting in some confusion during the admissions process.
Date	Fall 2016
Results	Admissions requirements for transfer students are clearly articulated. The same policies apply for intended students and other UB students applying from outside SEAS. New policy ensures students are prepared to be successful once admitted to the program.

Action 5: SEAS (Student Outcomes)

Action Taken	Responsibility for advisement of intended engineering students transferred to the School of Engineering and Applied Sciences, 410 Bonner Hall.
Basis for Action	Intended engineering and computer science students did not feel connected to SEAS and did not feel they were getting good advice specific to their intended major.
Date	Fall 2016
Results	Intended engineering students have access to the same advisement structure as students who have already been accepted into the program. Five additional advisers hired to meet the additional demand.

Action 6: SEAS (Student Outcomes)

Action Taken	Implemented periodic review of all intended students for admission to the major.
Basis for Action	Prior to change, intended students were required to submit an application to SEAS when they believed they had met all the admissions requirements.
Date	Fall 2016
Results	Streamlined the admission process into SEAS. Ensures students remain on track. Struggling students are identified early.

Action 7: MAE (Student Outcomes)

Action Taken	MAE 385 Materials Lab—purchase of suite of materials testing systems (Pasco).
Basis for Action	Students were viewing demonstrations instead of being able to conduct experiments themselves.
Date	2016-2017
Results	Students were able to perform accurate mechanical tests themselves.

Action 8: MAE (Student Outcomes)

Action Taken	MAE 385 Materials Lab—purchase of camera systems that students can use and capture images.
Basis for Action	Allows students to capture images instead of relying on demonstrations.
Date	2016-2017
Results	Provided better images for student discussion.

Action 9: ME (Student Outcomes)

Action Taken	MAE 338 Engineering Lab II—developed 1-D heat-conduction experiment in-house.
Basis for Action	The prior sphere heat-conduction experiment was aging and not giving reasonable results; the hot-water bath conditions were not well-characterized. A part-time TA was supported to create a simpler 1-D rod time-varying conduction experiment, with insulation and a well-controlled ice-water bath for one condition.
Date	2016-2017
Results	The new setups provided physically-meaningful results and a more tractable conduction analysis.

AY 2017-2018

Action 1: UB (Administration)

Action Taken	Capen 1 (UB's one-stop location for student services) was opened
Basis for Action	Student services were distributed across campus making it confusing and time consuming for students to get their questions answered/issues resolved.
Date	August 2017
Results	Very positive response. Streamlined experience for students.

Action 2: UB (Administration)

Action Taken	Adoption of University-wide scholarship management system
Basis for Action	As number of scholarships grew, software was needed to manage the scholarship process to ensure funds are correctly utilized. SEAS was an early adopter and supporter of this initiative, taking part in the initial pilot.
Date	Fall 2017
Results	Increased visibility of SEAS scholarships has resulted in additional applications and improved utilization of funds. Reviewer groups have also allowed increased participation by school faculty.

Action 3: UB (Administration)

Action Taken	Implementation of Student Success Collaborative (SSC), a web-based tracking system for staff-based advisors
Basis for Action	New system integrates advising notes with ability to track student success markers and outcomes. Earlier notes from the previous system, AdvisorTrac, were ported into SSC
Date	Fall 2017
Results	System allows for early identification of at-risk students. Notes from SSC (renamed EAB Navigate in 2019) are now available to departmental faculty advisors providing better continuity of advisement.

Action 4: UB (Program Educational Objectives)

Action Taken	Assistant Director of Assessment and Research hired to administer the university-wide placement survey. Survey rebranded as "UB Next."
Basis for Action	University identified the need for additional staff to administer the survey.
Date	Assistant Director hired April 2018. Survey administered November 2018, 6 months after graduation.
Results	Process in place to obtain reliable placement data for our graduates, providing accurate information for prospective and current students.

Action 5: SEAS (Program Educational Objectives)

Action Taken	Launch of "Professional Development Blueprint". This document replaced the earlier Career Development Curriculum.
Basis for Action	Need to provide guidance to students on timeline and available resources for professional development throughout the curriculum.
Date	Fall 2017
Results	Initial version in pdf form only. Current version is digital. Blueprint is introduced during freshmen orientation. Also used by advisement staff. Document has received positive feedback from students.

Action 6: SEAS (Student Outcomes)

Action Taken	Development of Healthy Engineers pamphlet
Basis for Action	Advising staff has observed an increase in the number of students visiting the office because of mental health concerns.
Date	Fall 2017
Results	Students are better informed about campus resources. SEAS has also built a stronger relationship with the UB counseling office, and have integrated lectures on stress management by UB counselors into the freshmen seminars. Currently the information is maintained on the SEAS website.

Action 7: SEAS (Program Educational Objectives)

Action Taken	Addition of minors in Electrical Engineering and Manufacturing.
Basis for Action	SEAS only had one minor which was in computer science.
Date	Fall 2017
Results	Number of minors has been increasing, providing students with increased opportunities to specialize in areas outside of their major. Additional minors in Robotics, Human Factors, Operations Research and Quality added in 2018. In 2016, only 32 students were enrolled in a minor offered by SEAS. This number has increased to 86 (Fall 2019).

Action 8: SEAS (Program Educational Objectives)

Action Taken	Investment by SEAS in tools to support faculty advisement.
Basis for Action	Faculty advise students in their junior and senior year. However, they did not have access to the student records and prior advising notes, leading to a more time-consuming advisement process. Without appropriate information, faculty were also more likely to make errors.
Date	Fall 2017
Results	Improved access to information improves the advisement process, leaving more time for faculty to discuss extracurricular opportunities and career development etc.

Action 9: SEAS (Student Outcomes)

Action Taken	President Tripathi approved establishment of the new Department of Engineering Education within SEAS.
Basis for Action	New interdisciplinary department created with the aim to transform the way in which engineering students are educated.
Date	March 2018
Results	New department currently has 4 tenure track faculty. PhD program in Engineering Education is pending. It is hoped that research conducted within the department will result in improvements in how we deliver engineering education at UB.

Action 10: ME (Student Outcomes)

Action Taken	Replaced Creo (Pro-E) software for CAE in MAE 377 with Solidworks
Basis for Action	Creo customer support was poor, had steep learning curve; it is a less-popular program in industry.
Date	2018-2019

Results	Students find Solidworks easier to learn, with same or improved level of engineering analysis.

Action 11: ME (Student Outcomes)

Action Taken	MAE 334 Engineering Lab I—micro-controllers, sensors, motors, and actuators have been purchased, along with associated software.
Basis for Action	Needed to keep up with the rapid pace of hardware and software advances in controls.
Date	2017-2018
Results	Students are now able to study more complex systems of sensors and actuators.

Action 12: ME (Student Outcomes)

Action Taken	MAE 494 Design Project— a student "elevator pitch" assignment was added; student groups were asked to produce a 3-minute video pitching their design project to a non-technical investor or relative
Basis for Action	Provide students with further experience communicating with a range of audiences, in this case a non-technical audience; **(SO 3)**
Date	2017-2018
Results	Students produced excellent videos leveraging their "soft" skills, and in some cases added creative elements since the details of the video content were left to them.

AY 2018-2019

Action 1: SEAS (Student Outcomes)

Action Taken	Academic Review policy revised. Students doing poorly in their first semester at UB are no longer dismissed from the program.
Basis for Action	Many students find adjustment to university very stressful. Eliminating dismissal after the first semester gives students time to "get back on track."
Date	Spring 2019
Results	Monitoring the effect of this policy change on first semester students.

Action 2: SEAS (Student Outcomes)

Action Taken	Administered first school-wide senior exit survey to complement the UB Next placement survey.

Basis for Action	Need to standardize the senior exit survey across departments. Survey was run in conjunction with the Office of Educational Effectiveness as a pilot for a possible university-wide senior exit survey.
Date	Spring 2019
Results	Response rate was approximately 40%. Students provided feedback on student outcomes and their general experience will at UB.

Action 3: SEAS (Student Outcomes)

Action Taken	Results of the periodic review communicated to intended students to provide information on progress towards acceptance into the major. Students at “high risk” of not meeting the requirements are required to meet with an academic advisor.
Basis for Action	Improve communications to ensure intended students are aware of their academic standing.
Date	Spring 2019
Results	Earlier intervention for students who are at-risk.

Action 4: Department (Student Outcomes)

Action Taken	Adoption of ABET student outcomes 1-7
Basis for Action	Change in ABET Criterion 3
Date	Fall 2018
Results	Program aligned with ABET requirements

Action 5: MAE (Student Outcomes)

Action Taken	Lab report guidelines written, applied to all MAE lab courses.
Basis for Action	Students were producing poor or inconsistent lab reports.
Date	2018-2019
Results	Students now have clear guidance regarding the content and presentation of MAE lab reports, including tables and graphs.

Action 6: ME and AE (Student Outcomes)

Action Taken	MAE 338 and MAE 339—two FLIR IR (thermal imaging) cameras purchased for a new heat transfer experiment.
Basis for Action	The existing heat-conduction experiment was giving inconsistent results and using thermocouples only; it was desired to give students experience with further modern hardware, specifically IR imaging.
Date	2018-2019
Results	The new setup gives students practice with thermal imaging, allowing them to safely perform a more complex heat-transfer analysis on a body by obtaining non-invasive spatiotemporal temperature measurements.

Action 7: ME (Student Outcomes)

Action Taken	MAE338 Engineering Lab II—purchase of hydrometers.
Basis for Action	Density measurements for two of the fluids-related labs using liquids, such as glycerin and ethylene glycol, previously relied on tables from the literature and were inaccurate. To improve this and add further hands-on experience, hydrometers were purchased.
Date	2018-2019
Results	The students now have experience with using hydrometers, and the consistency and accuracy of the experimental results have improved.

AY 2019-2020

Action 1: UB (Student Outcomes)

Action Taken	New academic integrity policy adopted together with the formation of a new university-wide Office of Academic Integrity
Basis for Action	Former academic integrity policy was onerous, involving several levels of administration from faculty to department to school to UB administration. The policy also resulted in non-uniform application of the policy across campus and inability to track repeat offenders.
Date	Fall 2019
Results	New policy has been simplified with greater emphasis on education and remediation. New office is conducting outreach across campus with goal of changing the culture on campus. Participated in the fourth international day against contract cheating, Oct 14, 2019

Action 2: SEAS (Program Educational Objectives)

Action Taken	Administration of WiSE (Women in Science and Engineering) transferred from the College of Arts and Sciences (CAS) to SEAS
Basis for Action	The majority of students attending programs are from SEAS.
Date	Fall 2019
Results	Fall 2019 saw increased participation in programs hosted by WiSE, and additional financial support from program sponsors. It is hoped that investment by SEAS in WiSE will help to increase the percentage of female students in SEAS.

Action 3: SEAS (Student Outcomes)

Action Taken	"Personal Flowsheets" made available to all SEAS undergraduate students. These electronic flowsheets have been used by academic advisors, but were made available to students.
Basis for Action	Students still used paper flowsheets in discussions with advisors.
Date	Fall 2019
Results	Electronic flowsheets provide students and advisors (including faculty advisors) with personalized tool to improve course planning.

Action 4: ME and AE (Student Outcomes)

Action Taken	MAE 385 Materials Lab—new heat treatment furnaces were purchased to replace older furnaces.
Basis for Action	Improve accuracy and safety of furnaces that students use.
Date	2019-2020
Results	New furnaces are installed and tested; they are safer and more accurate.

C. Additional Information

Copies of any of the assessment instruments or materials referenced in 4.A and 4.B must be available for review at the time of the visit. Other information, such as minutes from meetings where the assessment results were evaluated and where recommendations for action were made, could also be included.

The results of the Senior Exist Survey can be found in the UB Box cloud storage, in the directory: /UG_APC/Senior Exit Survey/2019 Pilot Results/ and /UG_APC\Senior Exit Survey\2020 Results

CRITERION 5. CURRICULUM

A. Program Curriculum

1. Complete Table 5-1 that describes the plan of study for students in this program including information on course offerings in the form of a recommended schedule by year and term along with maximum section enrollments for all courses in the program for the last two terms the course was taught. If there is more than one curricular path or option for a program, a separate Table 5-1 should be provided for each path or option. State whether the institution operates on quarters or semesters.

The University at Buffalo operates on a semester schedule. The current plan of study for students that enter the university as freshmen is presented in Table 5-1, toward the end of this Criterion.

Students who enroll in the BSME/MBA program must meet all the degree requirements of each program. The scheduling of classes is the same as for the BS degree up to the end of the junior year. In the final (fifth) year, BSME/MBA students are only required to take two senior MAE engineering technical electives and the MAE 451 & 494 design sequence.

2. Describe how the curriculum aligns with the program educational objectives.

General: The program curriculum supports the PEOs by providing a strong technical preparation in the mechanical engineering sciences, while fostering skill development in mechanical engineering design, innovation and, analytical and open-ended problem solving, modeling and computation/simulation, written and oral communication, and an appreciation of the "soft skills" needed to succeed. Students also receive an extensive general education experience.

- **PEO 1 Career development:** Graduates will hold a position in mechanical engineering or another field leveraging their training, or be engaged in advanced study.
- **PEO 2 Professional service:** Graduates will actively participate in professional and community groups while upholding the highest ethical standards.
- **PEO 3 Addressing important problems:** Graduates will use their mechanical engineering training to recognize and make a significant, positive impact on current and future societal challenges.

The curricular structure of the program equips our students with a well-rounded educational experience that prepares them to be adaptable and succeed in a world characterized by rapidly developing technology, growing complexity, and globalization. The broad-based curriculum prepares students to have both successful careers (**PEO 1**) and the ability to engage in subsequent service to the profession and the community (**PEO 2 and 3**, respectively).

PEO 1: The education and training listed below enables our graduates to be successful in a broad array of traditional professional careers as well as many non-traditional careers.

As part of the introductory freshmen sequence, students take EAS 199 Engineering Principles. In this course, students learn how to "think" like engineers by building and optimizing a wind turbine. This common freshman experience allows the mechanical engineering students to work in multidisciplinary teams with other UB Engineering students. In the following Spring semester, students take a 1-credit seminar to provide continuity in the first-year engineering experience and to provide general exposure to the NAE Grand Challenge themes.

Other courses in the first two years of study build the basic science and mathematics skills needed for the practice of mechanical engineering: two semesters of physics, one semester of chemistry, one semester of earth science, and math through differential equations. In the sophomore year students take the introductory mechanics sequence, statics, dynamics and mechanics. These courses provide a solid foundation in problem solving and analytical thinking, essential skills for success in the mechanical engineering program.

The third year builds on the basic science, mathematics and mechanics courses and provides fundamental knowledge in areas of mechanical engineering, such as fluid mechanics and heat transfer, dynamics of mechanical systems, computational methods, materials science and manufacturing, and CAE. Hands-on laboratories build practical skills from the classroom instruction. The junior year thus provides broad exposure to mechanical engineering topics.

With the background acquired in the junior year, students are equipped to take design classes and to engage in the capstone design sequence in their senior year. There is also an opportunity to choose three (ME) technical electives.

PEO 2: This PEO deals with the students' activity in their future professional and non-professional communities. Students are expected to learn to be active and to work successfully in groups, and we try to imbue them with a community spirit. Specific courses which encourage this type of service and group activity include the courses MAE 277, MAE 334, MAE 338, MAE 385, and MAE 451. MAE also actively supports clubs including Society of Automotive Engineers (SAE), American Society of Mechanical Engineers (ASME), and American Association of Aeronautics and Astronautics (AIAA) as well as providing support for Students for the Exploration and Development of Space (SEDS), the UB Robotics Club, and the Air Force/NASA Nanosatellite Program ("Nanosat").

PEO 3: This is a combination of two efforts. Wherever possible, current critical world-wide technological challenges and problems, such as sustainability, are woven directly into the appropriate core courses along with a dose of societal, global, and economic issues. These are a critical part of our students' experience. Our students also are unique in a way that we often overlook: *They are trained to be problem-solvers*. Our students leave the program with a knowledge of and a passion for engineering and science and an ability to solve problems. They are exactly the people who will be needed to solve future societal challenges.

3. Describe how the curriculum and its associated prerequisite structure support the attainment of the student outcomes.

As shown in Table 4-1, the curriculum has been mapped to the Student Outcomes and the mapping for each course is characterized by a coverage level. Table 5-2 below repeats the coverage level of SO 1-7 for the required MAE courses in the program, from level 1 (content introduced in the course), to level 2 (content practiced in the course), to level 3 (content mastered in the course). Coverage levels of 1 and 2 are found throughout the program. However, coverage levels of 3 generally become more frequent for 300 and 400-level courses (primarily in the Junior and Senior years) as expected. The major capstone design experience (MAE 494) has the most coverage levels of 3 as it requires the accumulated skills related to all Student Outcomes to accomplish the design tasks.

	Complex Problems	Design	Communication	Ethics	Teamwork	Experiments	Life-long Learning
EAS 199 UB Seminar	1	1	1	1	1	1	1
MAE 177 Introduction to CAD	1						3
MAE 204 Thermodynamics I	3	1	1		2		1
MAE 277 Intro. to Mech. Eng. Practice	2	2		3	2		2
MAE 335 Fluid Mechanics	3						1
MAE 340 Dynamic Systems	3	2	1	1		1	1
MAE 376 Applied Math for MAE	1					2	2
MAE 381 Eng. Materials	2		1				2
MAE 311 Machines & Mechanisms	3	2			1		
MAE 334 MAE Lab I	2	1	3		3	3	1
MAE 336 Heat Transfer	3						1
MAE 364 Manufacturing Processes	2	2		1	2		1
MAE 377 Product Design in a CAE Env.	1	3	1				2
MAE 385 Eng. Materials Lab	1		2			2	1
MAE 338 MAE Lab II	1		3	1	1	3	
MAE 451 Design Process & Methods	1	3	3	3	2	1	
MAE 494 Design Project	3	3	3	3	3	1	2

Table 5-2. How the curriculum supports the SO's.

Contribution Level: 1 = Introduced, 2 = Practiced, and 3 = Mastery

4. Attach a flowchart or worksheet that illustrates the prerequisite structure of the program's required courses.

The flow chart shown in Figure 5-1 illustrates the pre-requisite structure of the program. This structure ensures students are prepared for the material covered in post-requisite classes. From Figure 5-1, the critical importance of the following course sequences is noted:

- The mathematics sequence: MTH 141, MTH 142, MTH 241, MTH 306
- The mechanics sequence: PHY 107, EAS 207, and EAS 209
- The fluid and thermal sciences sequence: MAE 335, MAE 336, MAE 338
- The design sequence: MAE 277, MAE 377, MAE 451, MAE 494;

Course pre-requisites and co-requisites are enforced at the time of registration through HUB, the comprehensive, university-wide student information system. This system contains information on all course co-requisites and pre-requisites. Students cannot register for a class unless they have already completed, or are in the process of completing a course pre-requisite. In addition, they must register for all course co-requisites. Problems could arise if a student subsequently fails the pre-requisite class. However, post-enrollment-requisite checking (PERC), a part of the HUB, checks that pre-requisites have been satisfied after exam grades have been posted and identifies students who no longer satisfy the course pre-requisites.

The Office of Undergraduate Education in SEAS is responsible for checking all EAS classes. The primary EAS courses of concern are EAS 207 (Statics), EAS 209 (Mechanics of Solids), and EAS 230 (engineering computations). The Undergraduate Academic Coordinator in the Department of Mechanical and Aerospace Engineering is responsible for checking all MAE classes, in consultation with the Director of Undergraduate Studies. Students who do not meet the pre-requisites are dropped from the courses and are contacted and advised to meet with the Director of Undergraduate Studies to discuss their progress and to select suitable alternative courses.

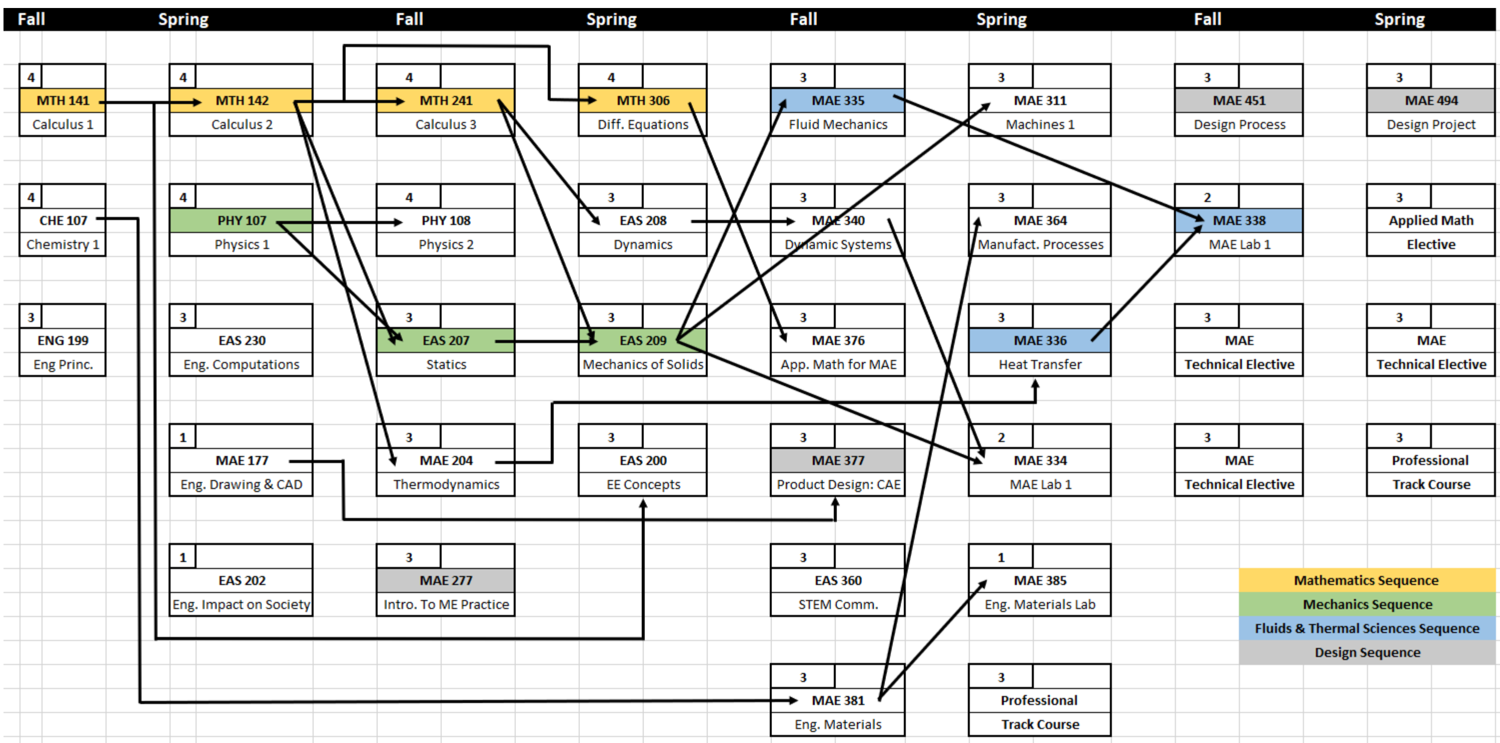


Figure 5-1. Pre-requisite chart.

To improve academic planning, students can view the course pre-requisites and co-requisites using electronic, curricular flowsheets. The flowsheets can be viewed at http://www.eng.buffalo.edu/undergrad/advisement/flowsheets/. When a pointing device is hovered over a course the pre-, co-, and post-requisites for that course are shaded with different colors.

5. Describe how the program meets the requirements in terms of hours and depth of study for each subject area (Math and Basic Sciences, Engineering Topics) specifically addressed by either the general criteria or the program criteria.

The minimum credit hours and distribution, as specified in Criterion 5, are as follows:

a) minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program

b) minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design, and utilizing modern engineering tools

College-level math and basic science: As shown in Table 5-1, the college-level math and basic science requirement consists of nine courses and two laboratory courses totaling 36 credit hours for the ME professional practice track, 42 credit hours for the ME science and math track; these exceed the requirement of 30 credit hours. The three-course calculus sequence and differential equations are all in the first two years of study. These four courses provide the background required for the program criteria (mathematics through differential equations). The basic science component of the program comprises four courses, two with labs (CHE 107 + CHE 127 and PHY 107 + PHY 158). The two physics courses (PHY 107 and PHY 108) are both calculus-based. They are all taken in the first two years of the program.

Engineering Topics: The engineering topic requirement is 45 credits. The professional practice track requires 72 credit hours, and the science and math track requires 66 credit hours. These are substantially higher than the minimum credits required.

6. Describe the broad education component and how it complements the technical content of the curriculum and how it is consistent with the program educational objectives.

Broad Education Component

This section will describe the broad education component and how it complements the technical content of the curriculum and how it is consistent with the program educational objectives.

As outlined in Criterion 1, the general education program across UB, known as the UB Curriculum, was introduced Fall 2016 and is an innovative, student-centered approach to general education. The UB curriculum complements the technical content of the ME program through the following components:

- **EAS199 UB Seminar:** an introductory seminar centered around critical thinking, ethical reasoning and reflective discussions. The seminar is taken in the fall of the freshman year.
- **Foundations:** The foundations comprise scientific literacy, quantitative reasoning and the **communication literacy sequence**: a two-course writing sequence. The first course ENG105 establishes strong foundations in writing, rhetoric, and oral and visual communication, while developing strategies to organize, evaluate and manage enormous quantities of information. The second course EAS 360 adopts a "writing in the disciplines" model that transmits the skills required to develop a professional voice through opportunities to write on substantive issues arising from the major.
- **Diversity in the United States:** Cultural competence is a foundational skill that our students should be able to demonstrate prior to graduation. As such, students are required to take a course formally acknowledged to have a Diversity-in-the-United-States component which serves to equip students with the cultural knowledge and awareness necessary to live, work and create with the diverse groups that characterize the United States.
- **Pathways:** The Pathways are built on the broad disciplinary areas that serve as the building blocks of a liberal arts education. These "UB Areas" correspond to the knowledge areas of the State University of New York General Education Requirements (SUNY-GER): Arts, Civilization and History, Humanities, Social Sciences, and Languages. In the Pathways, students are required to complete two pathways (a global pathway and a thematic pathway) each spanning three courses. Each course series is linked together by a broad topic. Some examples of thematic pathway topics include "Environments, Technologies and Policy," "Cultures, Art and Imagination" and "Human Nature." The Global Pathway can be satisfied by studying a language, participating in study abroad or by completing coursework with global content. Mechanical engineering students may include MAE 451 Design Process and Methods, and MAE 494 Design Project in their choice of courses in the Pathways.
- **UBC 399 Capstone:** The culmination of the UB Curriculum requires students to create a reflective and integrative Capstone ePortfolio based on their UB Curriculum coursework and lived experiences outside of the classroom.

The UB Curriculum is strongly aligned with the PEOs as it assists graduates of the program to successfully contribute to the profession while advancing in their careers and in addition lays the building blocks of academic inquiry and life-long learning. The relationship of the UB Curriculum and PEOs are outlined in Table 5-3.

Table 5-3. Relationship of UB Curriculum to Program Educational Objectives.

(●●=Strongly supports, ●=Supports)

UB Curriculum component	PEO 1 Career Development	PEO 2 Professional Service	PEO 4 Addressing Important Problems
UB Seminar	●		●●
Communication Literacy	●●	●	●
Diversity	●●	●●	●●
Pathways	●	●	●●
Capstone	●●	●●	●●

7. Describe the major design experience that prepares students for engineering practice. Describe how this experience is based upon the knowledge and skills acquired in earlier coursework and incorporates appropriate engineering standards and multiple design constraints.

Major Design Experience

The program begins practice-oriented coursework with Engineering Drawing and CAD (MAE 177) for Freshmen followed immediately in the Sophomore year by Introduction to MAE Practice (MAE 277). This course contains an introductory treatment of design concepts, a communication component, an exposure to reverse engineering and a design-and-build experience. In the Junior year students are required to take the course Product Design in a CAE Environment (MAE 377). This course emphasizes three-dimensional CAD packages (currently ProEngineer (Creo) and requires that students become competent CAD users, and are comfortable with designing components and assemblies in CAD. It additionally requires then to master the program component Creo Simulate and incorporate FE analysis in their designs. The final MAE 377 project requires students to develop a complete set of drawings for a practical product.

In the Senior year, our design and practice sequence culminates in the Design Process and Methods course (MAE 451) and the Design Project course (MAE 494). MAE 451 covers a most general approach to design, presenting the principles and strategies for dealing with design problems of all types. Decision making, experimental design, group exercises, optimization with multiple design constraints, and communications are all considered. MAE 494 is our capstone design course. Students work in small groups guided by individual faculty and solve real design problems. Typically, these are industrially based, but may also include projects of interest for faculty laboratories, SAE or ASME group projects, assistive devices for the handicapped, etc.

Recent design projects have included: On-Demand Power-Assist Attachment for a Manual Wheelchair, Triboelectrification Generator - A STEM Education Package, Fish-inspired robot with reduced inertial recoil, and Graphic Rain System (in collaboration with the Theater Department) https://alltogether.swe.org/2019/08/engineering-and-theatre-collide-at-university-at-buffalo/ .

Codes and Standards: The students were given the following assignment: If you are given standards which should be considered, please demonstrate that you have addressed the requirements of these standards. If you have not been supplied with standards, please investigate any and all requirements or specifications that should be considered for your type of design project. Use your imagination! The results were gratifying: For example, the Oven Assist project was to design a device that would help place and remove a prepared dish into and out of the oven for persons with disabilities. The students found and applied standards from NSF, ISO/DIS, ANSI, IEC, and ASTM.

8. If the program allows cooperative education to satisfy curricular requirements specifically addressed by either the general or program criteria, describe the academic component of this experience and how it is evaluated by the faculty.

The University at Buffalo's Mechanical Engineering program allows cooperative education to satisfy curricular requirements specifically addressed by the program criteria. Below is a description of the academic component of this experience and how it is evaluated by the faculty.

Students can choose to take MAE 496 Internship or EAS 496 Co-op to fulfill an MAE technical elective or an ME professional practice course. The course requirements are the same; the main difference is that EAS 496 allows a student to work full-time and still remain a full-time student. Students are evaluated through a series of assignments that are collected throughout the course of their internship. Course requirements are communicated to the student before the start of the co-op period in the form of a formal syllabus (available on request). Reports include an internship overview, a midterm report, and a final report. Students are also required to give a midterm presentation and a final presentation to all of the other students enrolled in MAE 496 and EAS 496 that term. Students are required to submit bi-weekly email updates to the instructor for evaluation; these update the instructor on the student's progress. Students are evaluated by the course instructor on both technical content and professionalism.

9. Describe the materials that will be available for review during and/or prior to the visit to demonstrate achievement related to this criterion. (See 2020-2021 APPM Section I.E.5.b.(2))

Materials that will be available for review during the visit to demonstrate achievement related to this criterion include: course syllabi; textbooks; and sample student work. Course syllabi and examples of student work for all required courses are stored in pdf format in cloud storage, available to the reviewers. The textbooks can be shipped to the Reviewers if desired.

Table 5-1 Curriculum

Science & Math Track

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	Subject Area (Credit Hours)				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Maximum Section Enrollment for the Last Two Terms the Course was Offered[2]
		Math & Basic Sciences	Engineering Topics; (√) = design	General Education	Other		
MTH 141 - Calculus I	R	4				*F19;Sp20*	*55; 90*
CHE 107 - Chemistry 1	R	3.5				*F19; Sp20*	*376; 88*
CHE 127 - Chemistry 1 Lab	R	0.5				*F19; Sp20*	*24; 24*
EAS 199 - Engineering Principles	R		3			*F19; Sp20*	*150; 74*
ENG 105 - Communications Literacy 1	SE			4			
MTH 142 - Calculus II	R	4				*F19;Sp20*	*90; 90*
MAE 177 - Eng. Drawing &CAD	R		1			*Sp19;Sp20*	*489; 399*
PHY 107 - General Physics I	R	4				*F18;F19*	*278; 251*
EAS 230- Engineering Computation	R		3			*F18; F19*	*78; 75*
EAS 202 - Engineering Impact on Society	R		1			*Sp19;Sp20*	*277; 266*
Thematic or Global Pathway Course	SE			3			
MTH 241 - Calculus III	R	4				*F19;Sp20*	*90; 90*
PHY 108 - General Physics II	R	4				*F18;F19*	*248; 250*
PHY 158 - General Physics II Lab	R	1				*F18;F19*	*27; 28*
EAS 207 - Statics	R		3			*F18;F19*	*80; 78*
MAE 204 - Thermodynamics I	R		3			*F18;F19*	*79; 78*
MAE 277 - Intro to Mechanical Engineering	R		3(√)			*F18;F19*	*83; 73*
MTH 306 - Intro to Differential Equations	R	4				*F19;Sp20*	*90; 90*
EAS 208 - Dynamics	R		3			*F18;F19*	*44; 56*
EAS 209 - Mechanics of Solids	R		3			*F18;F19*	*71; 67*
EAS 200 - Electirical Eng Concepts Nonmajors	R		3			*F19;Sp20*	*71; 80*

Thematic or Global Pathway Course	SE			3			
MAE 340 - Dynamic Systems	R		3			*F18; F19*	*92; 87*
MAE 335 - Fluid Mechanics	R		3			*F18; F19*	*75; 98*
MAE 376 - Applied Math for MAE	R	3				*F18; F19*	*94; 94*
MAE 381 - Engineering Materials	R	1	2			*F18; F19*	*85; 88*
MAE 377 - Product Design: CAE	R		3(√)			*F18; F19*	*92; 94*
EAS 360 - STEM Communications	R			3		*F19;Sp20*	*25; 25*
MAE 311 - Machines & Mechanisms I	R		3			*Sp19;Sp20*	*97; 98*
MAE 364 - Manufacturing Processes	R		3			*Sp19;Sp20*	*96; 118*
MAE 336 - Heat Transfer	R		3			*Sp19;Sp20*	*86; 96*
MAE 334 - MAE Laboratory I	R		2			*Sp19;Sp20*	*292; 332*
MAE 385 - Engineering Materials Lab	R		1			*Sp19;Sp20*	*42; 37*
Science Track I	SE	3					
MAE 451- Design Process & Methods	R		3(√)			*F18;F19*	*107; 81*
MAE 338 - MAE Lab II	R		2			*F18;F19*	*26; 26*
MAE Tech Elec 1	SE		3				
MAE Tech Elec 2	SE		3				
Science Track 2	SE	3					
Thematic or Global Pathway Course	SE			3			
MAE 494 - Design Project	R		3(√)			*Sp19;Sp20*	*179; 229*
Applied Math Elective	SE	3					
MAE Tech Elective 3	SE		3				
UBC 399 - UB Capstone	R			1			
Thematic or Global Pathway Course	SE			3			
Add rows as needed to show all courses in the curriculum.							
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		42	66	20	0		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM	128						
PERCENT OF TOTAL		32.81%	51.56%	15.63%	*0*		
Total must satisfy either credit hours or	Minimum Semester Credit Hours	30 Hours	45 Hours				
	Minimum Percentage	25%	37.50%				

Professional Practice Track

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)*				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Maximum Section Enrollment for the Last Two Terms the Course was Offered[2]
		Math & Basic Sciences	Engineering Topics; (√) = design	General Education	Other		
MTH 141 - Calculus I	R	4				*F19;Sp20*	*55; 90*
CHE 107 - Chemistry 1	R	3.5				*F19; Sp20*	*376; 88*
CHE 127 - Chemistry 1 Lab	R	0.5				*F19; Sp20*	*24; 24*
EAS 199 - Engineering Principles	R		3			*F19; Sp20*	*150; 74*
ENG 105 - Communications Literacy 1	SE			4			
MTH 142 - Calculus II	R	4				*F19;Sp20*	*90; 90*
MAE 177 - Eng. Drawing &CAD	R		1			*Sp19;Sp20*	*489; 399*
PHY 107 - General Physics I	R	4				*F18;F19*	*278; 251*
EAS 230- Engineering Computation	R		3			*F18; F19*	*78; 75*
EAS 202 - Engineering Impact on Society	R		1			*Sp19;Sp20*	*277; 266*
Thematic or Global Pathway Course	SE			3			
MTH 241 - Calculus III	R	4				*F19;Sp20*	*90; 90*
PHY 108 - General Physics II	R	4				*F18;F19*	*248; 250*
PHY 158 - General Physics II Lab	R	1				*F18;F19*	*27; 28*
EAS 207 - Statics	R		3			*F18;F19*	*80; 78*
MAE 204 - Thermodynamics I	R		3			*F18;F19*	*79; 78*
MAE 277 - Intro to Mechanical Engineering	R		3(√)			*F18;F19*	*83; 73*
MTH 306 - Intro to Differential Equations	R	4				*F19;Sp20*	*90; 90*
EAS 208 - Dynamics	R		3			*F18;F19*	*44; 56*
EAS 209 - Mechanics of Solids	R		3			*F18;F19*	*71; 67*
EAS 200 - Electirical Eng Concepts Nonmajors	R		3			*F19;Sp20*	*71; 80*

Thematic or Global Pathway Course	SE			3			
MAE 340 - Dynamic Systems	R		3			*F18; F19*	*92; 87*
MAE 335 - Fluid Mechanics	R		3			*F18; F19*	*75; 98*
MAE 376 - Applied Math for MAE	R	3				*F18; F19*	*94; 94*
MAE 381 - Engineering Materials	R	1	2			*F18; F19*	*85; 88*
MAE 377 - Product Design: CAE	R		3(√)			*F18; F19*	*92; 94*
EAS 360 - STEM Communications	R			3		*F19;Sp20*	*25; 25*
MAE 311 - Machines & Mechanisms I	R		3			*Sp19;Sp20*	*97; 98*
MAE 364 - Manufacturing Processes	R		3			*Sp19;Sp20*	*96; 118*
MAE 336 - Heat Transfer	R		3			*Sp19;Sp20*	*86; 96*
MAE 334 - MAE Laboratory I	R		2			*Sp19;Sp20*	*292; 332*
MAE 385 - Engineering Materials Lab	R		1			*Sp19;Sp20*	*42; 37*
Professional Practice Track I	SE		3				
MAE 451- Design Process & Methods	R		3(√)			*F18;F19*	*107; 81*
MAE 338 - MAE Lab II	R		2			*F18;F19*	*26; 26*
MAE Tech Elec 1	SE		3				
MAE Tech Elec 2	SE		3				
Professional Practice Track 2	SE		3				
Thematic or Global Pathway Course	SE			3			
MAE 494 - Design Project	R		3(√)			*Sp19;Sp20*	*179; 229*
Applied Math Elective	SE	3					
MAE Tech Elective 3	SE		3				
UBC 399 - UB Capstone	R			1			
Thematic or Global Pathway Course	SE			3			
Add rows as needed to show all courses in the curriculum.							
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		36	72	20	0		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM	128						
PERCENT OF TOTAL		28.13%	56.25%	15.63%	*0*		
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	30 Hours	45 Hours				
	Minimum Percentage	25%	37.50%				

B. Course Syllabi

In Appendix A of the Self-Study Report, include a syllabus for each course used to satisfy the mathematics, science, and discipline-specific requirements required by Criterion 5 or by any applicable program criteria.

Appendix A includes a syllabus for each course used to satisfy the mathematics, science, and discipline-specific requirements required by Criterion 5 and any other applicable program criteria.

CRITERION 6. FACULTY

A. Faculty Qualifications

Describe the qualifications of the faculty and how they are adequate to cover all the curricular areas of the program and also meet any applicable program criteria. This description should include the composition, size, credentials, and experience of the faculty. Complete Table 6-1. Include faculty resumes in Appendix B.

Presently, the Department of Mechanical and Aerospace Engineering (MAE) has 32 highly qualified ladder (tenure and tenure-track) faculty members, with nearly all actively engaged in the three phases of academic life; namely, teaching, research and service. As can be seen in Table 6-1, all tenured and tenure track faculty members have doctoral degrees. Furthermore, we are a diverse group in terms of technical interests, age, and ethnicity with a shared interest in providing the highest level of engineering education for our students. Since we are a Department of Mechanical and Aerospace Engineering at an AAU institution, degrees in both Mechanical Engineering and Aerospace Engineering are offered at the B.S., M.S., and Ph.D. levels. Our degree programs complement each other very well and our faculty members span the range of technical backgrounds needed to cover the technical areas of interest to both mechanical and aerospace engineers.

In particular, the Department has six focus areas: Computational and Applied Mechanics (CAM), Design, Optimization, and Manufacturing (DOM), Dynamics, Control, and Mechatronics (DCM), Fluid and Thermal Sciences (FTS), Materials (MAT), and Bioengineering (BIO). This enables us to offer breadth and depth in our curriculum across both mechanical engineering and aerospace engineering.

Our faculty members form a highly accomplished group, which includes seven American Society of Mechanical Engineering (ASME) Fellows (Battaglia, Bayandor, Lewis, Mollendorf, Ren, Singh, Wetherhold), an American Institute of Aeronautics and Astronautics (AIAA) Fellow (Crassidis), five American Institute of Aeronautics and Astronautics (AIAA) Associate Fellows (DesJardin, Lewis, Madnia, Singh, Wetherhold), an American Association for the Advancement of Science (AAAS) Fellow (Singh), an American Society of Thermal and Fluids Engineers (ASTFE) Fellow (Battaglia), an American Astronautical Society (AAS) Fellow (Crassidis), an American Society of Materials (ASM) Fellow (Chung), and an American Institute for Medical and Biological Engineering (AIMBE) Fellow (Meng). In addition, our MAE faculty includes seven National Science Foundation (NSF) CAREER Award recipients (DesJardin, Lewis, Madnia, Meng, Nouh, Ren, Salac), two National Institutes of Health (NIH) K25 Awardees (Hua, Meng), two Air Force Office of Scientific Research (AFOSR) Young Investigator Awardees (Ringuette, Chen), and one Army Research Office (ARO) Young Investigator Awardee (Ren). We currently have two endowed professors: Professor Lewis is the Moog Endowed

Professor of Innovation and Professor Crassidis is the Samuel P. Capen Professor. Crassidis has also recently been promoted to SUNY Distinguished Professor. Prof. Meng has also recently been named as a UB Distinguished Professor.

MAE faculty also have received numerous awards related to teaching, including Prof. Mollendorf being recently promoted to SUNY Distinguished Teaching Professor. In addition, Prof. Lewis was awarded the 2019 ASME Donald N. Zwiep Innovation in Education Award, the 2010 American Society for Engineering Education (ASEE) Fred Merryfield Award, and the 2013 UB Meyerson Award for Distinguished UG Teaching and Mentoring. Additionally, Professors Mollendorf, Madnia, Lewis, DesJardin, and Dargush have received the SUNY Chancellor's Award for Excellence in Teaching, while Professors Mook, Lewis, and Armstrong were recognized with the Milton Plesur Excellence in Teaching Award from the UB Student Association, and, in 2014, Professor Crassidis received the Richard T. Sarkin Award for Excellence in Teaching by the UB Alumni Association. Our single Adjunct Faculty member, Paul Schifferle, was also awarded in the 2017 Chancellor's Award for Excellence in Adjunct Teaching, the first ever award of this kind in the School of Engineering and Applied Sciences. We are very proud to have such a large collection of highly qualified faculty, having earned distinction in both scholarship and teaching.

In addition to ladder faculty, we have eight full-time non-tenure-track Instructors in MAE with responsibilities focused on undergraduate teaching and advisement. They each hold doctoral degrees. We also have a non-tenure-track Professor of Practice (Kalanovic) who conducts applied research and teaching the robotics area. He also directs our academic programs in Robotics (Undergraduate Minor, MS in Robotics).

Additional details on faculty background and activity can be found in Tables 6-1 and 6-2, and in the abbreviated resumes in Appendix B. From this information, one may observe that all of our full-time faculty in Mechanical and Aerospace Engineering are active in research or consulting and, as such, are involved in engineering practice. As can be seen from the faculty resumes, participation in research, archival journal publication and academic conferences is routine. Most of our faculty members have been actively involved in technical societies, such as ASME or AIAA in conference organization, in editorial roles on the national level, or in local technical programs. Contacts with local companies are frequent and we regularly make use of local Buffalo industry as a source for design projects, guest speakers, and internships. Of course, the active nature of our faculty is ideal for teaching, for providing guidance and counseling during the advisement of students, and also for the continual review and evaluation of our undergraduate programs.

For some specialty courses or for particular part-time teaching needs, we have a considerable technical community available in the Buffalo area and we also have a very competent cadre of graduate students at the PhD level. Table 6-1 includes one part-time Instructor (Schifferle) who has been involved in our teaching mission in recent years. Schifferle has many years of experience in the aerospace industry and is an outstanding instructor, having been recently awarded the SUNY Chancellor's Award for Excellence in Adjunct Teaching as mentioned above.

B. Faculty Workload

Complete Table 6-2, Faculty Workload Summary and describe this information in terms of workload expectations or requirements.

The School of Engineering and Applied Sciences has recently implemented a new Workload Agreement policy. For research active tenure-track faculty, this workload is nominally 40% research, 40% teaching, and 20% service. The 40% teaching load equates to three course-sections per year. For faculty involved in major administrative/service activities, such as Chair, Associate Chair, or Director of our Undergraduate or Graduate Programs, this teaching load is reduced accordingly and the service portion of their workload is increased. Thus, for example, a research-active Director of Undergraduate Studies would teach two course-sections per year. We also have a departmental teaching buyout policy for faculty who have an extraordinarily large research load and need to reduce their teaching by a single course-section using funds from a large research grant. Table 6-2 provides detail for each person engaged in our teaching mission. First, all tenured and tenure-track faculty are listed, followed by full-time Instructors and then the part-time Adjunct Instructor.

The overall teaching schedule is decided and coordinated by the Chair and managed with University Central Scheduling by the Undergraduate Coordinator, with major input from our six disciplinary groups: Computational and Applied Mechanics (CAM), Design, Optimization, and Manufacturing (DOM), Dynamics, Control and Mechatronics (DCM), Fluid and Thermal Sciences (FTS), Materials (MAT), and Biomechanics (BIO). These groups meet several times each year to plan the required and elective courses in their areas, taking into account individual faculty workload levels and sabbaticals, and then make recommendations to the Chair. This process has worked well for many years, with the group recommendations nearly always providing the final schedule.

C. Faculty Size

Discuss the adequacy of the size of the faculty and describe the extent and quality of faculty involvement in interactions with students, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners including employers of students.

Over the past six years, we have hired twenty-two new faculty members: 12 Assistant Professors, 1 Associate Professor, 2 Full Professors, 6 Instructors, and 1 Professor of Practice. As a result, we have been able to grow the department faculty from 32 at the time of the previous ABET self-study in 2014 to the current level of 41, factoring in some faculty attrition due to retirement, other academic opportunities, and personal reasons. In the last 6 years, we have grown the female representation in the department to over 20%, which is well above the national average (13% in Mechanical Engineering, 11% in Aerospace Engineering). As a result, the faculty size, including tenured faculty, tenure-track faculty, full-time and part-time instructors, is sufficient to handle the teaching workload. The base teaching load for our full-time instructors is six course-sections a year. Course reductions are given to the Chair, any Associate Chair, the two Undergraduate Program Directors and the Director of Graduate Studies.

Due to the increase in our instructors, we have been able to shift in the last few years all of our required undergraduate courses to multiple sections of no more than 100 students each, with rare exceptions. For each multi-section course, we designate a course coordinator who is teaching at least one of the sections to ensure that all the course sections are coordinated and sharing the same basic course elements (syllabus, exams, homeworks). Teaching style and approach differs among the sections according to the instructor's teaching philosophy and plans.

The feedback from students for this multi-section initiative has been very positive and overall student evaluation averages have risen significantly in these courses for both the course and the instructors. Laboratories operate at nearly full capacity with many sections, and multiple instructors for the two primary lab courses MAE334 and MAE338 are used in order maintain the hands-on experiential learning mode. Our primary undergraduate courses and laboratories are also supported by our large cadre of TAs (approximately 42 per semester on average over the last three years) and a number of graders (roughly 50 per semester) from among our graduate or undergraduate students. Beyond the academic year offerings, we also offer a broad range of sophomore and junior level courses in the University's summer term. This provides an opportunity for our students to remain on schedule or to lighten their course load during the regular academic year.

Our faculty members serve as advisors to active student clubs (e.g., SAE, ASME, AIAA, Students for the Exploration and Development of Space (SEDS) and Robotics Club) and various Honor Societies. An increasing number of our students also perform undergraduate research directly with faculty members during the academic year and summer. We have financial support for this activity through a Zimmer Scholarship program that funds approximately a dozen undergraduate students each year in research activities. We also have a new award for the top Undergraduate Research Student that is presented each year based on faculty nominations.

Our undergraduate program had been growing significantly each year from 2010-2016. While we were confident that we are serving our students well, we also realized that continued growth at the undergraduate level at the same pace would not be sustainable. In 2018-19, for example, we conferred 303 BS (219 ME and 84 AE) degrees. To address this, we began implementation of a progression criterion with a minimum GPA of 2.5 (2.8 for transfer students) in a select group of five lower-division courses that we judge to be crucial to the continued success of our students in Mechanical or Aerospace Engineering. All five courses are normally completed by the end of the third semester in the curriculum sequence. These courses are: MTH 141 Calculus 1, MTH 142 Calculus 2, PHY 107 Physics 1, MAE 204 Thermodynamics, and EAS 207 Statics.

Furthermore, our faculty size is sufficient to allow our faculty to pursue a broad variety of scholarly and service interests. In particular, MAE faculty members are quite active in research of both a basic and applied nature, in industry-related development projects and in professional service activities at UB and within their professional societies. Naturally, this in turn enriches the educational experience for our students. MAE faculty are working to help create the future and to bring that excitement to our students.

D. Professional Development

Provide detailed descriptions of professional development activities for each faculty member.

All of our faculty members are expected to be active in the field in which they are teaching and to stay abreast of developments in research, education, and technology. Faculty members are also encouraged to create new or updated courses that draw upon their unique knowledge on cutting-edge topics.

Of the five criteria for evaluation and promotion in the Policies of the Board of Trustees in the consideration of rewards (mastery of subject matter, effectiveness in teaching, scholarly ability, effectiveness of University service, and continuing growth), we hold scholarship as the primary and most enabling element of our Department's mission. Accordingly, we give scholarly ability and mastery of subject matter the greatest weight in consideration of promotion and awards. We consider both productivity and qualitative aspects consistent with practice in the discipline. We also greatly value effective teaching and promote deserving faculty for available teaching distinctions. For example, we have on our faculty five recipients of the SUNY Chancellor's Award for Excellence in Teaching (Dargush, DesJardin, Lewis, Madnia, Mollendorf).

As part of each faculty member's annual report, they are asked to describe new course materials and revisions. Furthermore, they are also asked to address new teaching techniques or technologies introduced and meetings, conferences, courses, or seminars attended primarily to improve teaching techniques or substantive knowledge for courses taught. Among the recent activities in this category include Experiments in Active Learning in Dynamics (Dargush) supported by the philanthropic UB President's Circle Program and the simulcast of MAE 381 Engineering Materials (Chung) to students at UB and Thai Nguyen University of Technology (TNUT) in Vietnam, supported by the Vietnam Education Foundation. This latter initiative was an outgrowth of the current cooperative agreement with TNUT, where they are offering a special program in English at TNUT that follows exactly our undergraduate Mechanical Engineering B.S. program. A long-term goal of TNUT is to receive ABET accreditation for that program.

For all Assistant Professors, we have long had a formal mentoring and development program. Two years ago, we enhanced this program which now includes a Career Development Committee (CDC) for each Assistant Professor. Each CDC consists of three tenured faculty, chosen by the Assistant Professor. The CDC members are dedicated to providing career development mentoring in research, teaching, and/or service. The Department Chair meets each year with each Assistant Professor along with members of their CDC. At this meeting, progress in all three elements of development is reviewed and plans are established for the coming year. The Department Chair also has “brown bag” lunch meetings with all of the Assistant Professors to discuss any relevant topic including research, teaching, policies, tenure, service, space, etc. In addition, the Dean of SEAS organizes meetings of all Assistant Professors to discuss policies and careers, research and teaching, and to learn from each other. With the significant number of faculty hires in recent years, we have also created two teaching mentoring programs:

- A Pilot Program with the UB Center for Educational Innovation (CEI): Pedagogy experts from the CEI provide teaching mentoring to two MAE faculty each semester where they evaluate their syllabus, observe their teaching, and discuss ways to improve.
- Peer Mentoring Program: Dr. Armstrong (Associate Professor of Teaching) created a peer mentoring program where faculty are paired up and asked to observe each other teaching. These faculty then share best practices so that they mutually benefit from their collective experience and insights.

More broadly, the UB Center for Educational Innovation (CEI) provides a wide range of services and a number of MAE faculty members have taken advantage of those services. A new program which started in 2018 is the New Faculty Academy run by the Vice Provost for Faculty Affairs and the CEI. This program allows new faculty to be trained in the latest pedagogy developments and create a tangible outcome in the form of concrete, new teaching material.

Over 90% of our tenured and tenure-track faculty members have active grants and a similar percentage attend and present their work in at least one technical conference each year.

The department conducts a MAE Seminar Series with weekly seminars nearly every week during the academic year. These seminars, which feature invited speakers from academia, federal agencies, and industry, are attended primary by our faculty and graduate students. Most faculty attend a few seminars of interest each semester, while several faculty attend nearly each week.

E. Authority and Responsibility of Faculty

Describe the role played by faculty members with respect to course creation, modification, and evaluation, their role in the definition and revision of program educational objectives and student outcomes, and their role in the attainment of the student outcomes. Describe the roles of others on campus, e.g., dean or provost, with respect to these areas.

Course creation or modification must follow well-defined processes that include formal review at both the School and University levels. The process begins with the faculty member completing a Course Proposal Form. The proposer provides course details, learning outcomes, rationale, and a syllabus and completes a duplication check. The MAE Undergraduate Studies Committee reviews the form and provides relevant feedback to the faculty member (proposer). The Course Proposal is then reviewed by, and if appropriate approved by, the Department Chair. The proposal is then evaluated by the undergraduate Academic Programs Committee (APC) within the School of Engineering and Applied Sciences, which provides relevant feedback to the faculty member (proposer). The APC is led by the Associate Dean for Undergraduate Education and includes as members the Directors of Undergraduate Studies from all of the engineering programs. The Course Proposal Form is then reviewed by, and, if appropriate, approved by, the Associate Dean for Undergraduate Education. The proposal is then forwarded to the Office of the Dean of Undergraduate Education. At this level, the Undergraduate Associate Deans Council (UADC), which is comprised of Associate Deans of Undergraduate Education (or equivalent) for all UB decanal units, reviews the course proposal. The UADC may require clarifications, additional materials or revisions to the course proposal. Upon approval from the UADC, the course can be offered, advertised, and appear in the Undergraduate Catalog.

Students also are engaged in the evaluation process through the on-line Course Evaluation surveys, a process managed by the Office of the Dean in SEAS. Quantitative and qualitative data from the completed Course Evaluations are compiled each semester and shared on-line with all faculty members within each department within a week or two of the close of the semester. These are a primary means for faculty to receive feedback on teaching technique, as well as on course content, from the student perspective at the end of each semester. For Assistant Professors, these evaluations are discussed during the annual review meeting with the MAE Chair and their Career Development Committee. These evaluations also form a part of the tenure and promotion dossiers for all faculty progressing through the tenure track and in the reappointment package for full-time lecturers.

The role of faculty in the development of the AE program PEOs is given in Criterion 2.E above, and the AE program has adopted ABET's SOs 1-7 as described in Criterion 3.A. Their role in attaining the SOs comes through their teaching, in that the specific Learning Outcomes of each course are mapped to the SOs and assessed by certain assignments (please see Appendix A). The overall mapping of the SO coverage (levels 1-3) for each required course is given in Table 4-1, and the SO assessment process and continuous improvement efforts for the AE program are described in Criterion 4.

Table 6-1. Faculty Qualifications

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment [2]	FT or PT [3]	Years of Experience			Professional Registration/ Certification	Level of Activity [4] H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/summer work in industry
Armstrong, Jason N.	Ph.D. – Mechanical Engineering, 2010	I	NTT	FT	3	10	10	--	L	L	M
Battaglia, Francine	Ph.D. – Mechanical Engineering, 1997	P	T	FT	0	22	3		H	H	L
Bayandor, Javid	Ph.D. - Aerospace Engineering, 2000	ASC	T	FT	6	19	3		M	M	M
Botta, Eleonora	Ph.D. - Mechanical Engineering, 2017	AST	TT	FT	0	1	1		M	M	L
Burge, Matthew	Ph.D. - Mechanical Engineering, 2017	I	NTT	FT	0	7	7		L	M	L
Chen, James	Ph.D. - Mechanical Engineering, 2011	ASC	T	FT	0	9	2		H	M	L
Chowdhury, Souma	Ph.D. - Mechanical Engineering, 2012	AST	TT	FT	0	8	4		H	L	L
Chung, Deborah D.L.	Ph.D. – Materials Science, 1977	P	T	FT	0	43	34	--	L	M	L

Crassidis, John L.	Ph.D. – Mechanical and Aerospace Engineering, 1993	P	T	FT	3	22	18	--	H	M	H
Dargush, Gary F.	Ph.D., Civil Engineering, 1987	P	T	FT	X	X	X	--	L	L	M
Darrall, Bradley	Ph.D. - Mechanical Engineering, 2016	I	NTT	FT	0				L	M	L
DesJardin, Paul E.	Ph.D. – Mechanical Engineering, 1998	P	T	FT	4	18	18	--	M	M	L
English, Ken	Ph.D. – Mechanical Engineering, 2001	A	NTT	PT	3	16	16	--	L	M	L
Esfahani, Ehsan T.	Ph.D. – Mechanical Engineering, 2012	ASC	T	FT	3.5	8	7.5	--	M	M	L
Estes, Aaron	Ph.D. - Mechanical Engineering, 2016	I	NTT	FT	0	7	7		L	M	L
Faghihi, Danial	Ph.D. - Civil Engineering, 2012	AST	TT	FT	0	7	1		M	M	L
Hall, F. John	Ph.D. – Mechanical Engineering, 2012	AST	TT	FT	15	9	7	PE	L	M	M
Hassan Ali, Alaa Eldeen A.	Ph.D. - Mechanical Engineering, 2000	I	NTT	FT	1	16	4		L	L	L
Hua, Zonglu (Susan)	Ph.D. – Materials Science and Engineering, 1993	P	T	FT	6	24	20	--	L	M	L
Kalanovic, Vojislav	Ph.D. - Mechanical Engineering, 1991	O	NTT	FT	3	33	3		L	M	H
Kang, Jiyeon	Ph.D. - Mechanical Engineering, 2018	AST	TT	FT	0	1	1		L	L	L
Karami, M. Amin	Ph.D. – Engineering Mechanics, 2011	ASC	T	FT	0	7	7	--	M	L	L
Khan, Jobaidur	Ph.D. – Mechanical Engineering, 2009	I	NTT	FT	3	11.5	7	--	L	L	M
Lagor, Francis	Ph.D. - Mechanical Engineering, 2017	AST	TT	FT	0	2	2		M	M	L
Lewis, Kemper E.	Ph.D. – Mechanical Engineering, 1996	P	T	FT	0	24	24	--	H	H	M

Liang, Zach	Ph.D. – Degree Program, 1976	A	NTT	FT	X	X	X	--	L	L	L
Madnia, Cyrus K.	Ph.D. – Aerospace Engineering, 1989	P	T	FT	0.5	28	28	--	L	L	L
Mashhadi, Ardeshir Raihanian	Ph.D. - Mechanical Engineering, 2018	I	NTT	FT	0	9	6		L	M	L
Meng, Hui	Ph.D. – Mechanical Engineering, 1994	P	T	FT	0	24	21	--	L	M	L
Mollendorf, Joseph C.	Ph.D. – Mechanical Engineering, 1971	P	T	FT	3.5	44.5	46	--	L	L	L
Mook, D. Joseph	Ph.D. – Engineering Mechanics, 1986	P	T	FT	X	X	X	--	L	L	L
Nouh, Mostafa	Ph.D., Mechanical Engineering, 2013	AST	T	FT	1	6	5		H	M	L
Rai, Rahul	Ph.D. – Mechanical Engineering, 2006	ASC	T	FT	3	12	8	--	M	L	L
Ren, Shenqiang	Ph.D. - Materials Science, 2009	P	T	FT	0	9	2		L	M	L
Ringuette, Matthew J.	Ph.D. – Aeronautics, 2004	ASC	T	FT	0	20	12	--	H	M	L
Salac, David	Ph.D. – Mechanical Engineering, 2007	ASC	T	FT	0	13	10	--	M	M	L
Schifferle, Paul	M.S. – Mechanical Engineering, 2004	A	NTT	PT	26	18	18	--	M	H	H
	* FAA Commercial Pilot Certificate (Gliders)										
	FAA Private Pilot Certificate (Single Engine, Land)										
	FAA Designated Engineering Representative (DER) – Flight Analyst										
	American Institute of Aeronautics and Astronautics (AIAA) Niagara Frontier Chapter Secretary										
	American Helicopter Society (AHS) Handling Qualities Technical Committee (former Chair)										
Singh, Tarunraj	Ph.D. – Mechanical Engineering, 1991	P	T	FT	0.5	26	26	--	M	M	L

Snoeyink, Craig	Ph.D. - Mechanical Engineering, 2012	AST	TT	FT	0	6	2		M	L	L
Stamm, Jennifer	Ph.D. - Mechanical Engineering, 2015	I	NTT	FT	3	15	15		L	M	L
Wetherhold, Robert C.	Ph.D. – Applied Sciences, 1983	P	T	FT	3	37	37	--	L	M	L
Zheng, Minghui	Ph.D. - Mechanical Engineering, 2017	AST	TT	FT	0	3	3		M	L	L

Instructions: Complete table for each member of the faculty in the program. Add additional rows or use additional sheets if necessary. Updated information is to be provided at the time of the visit.

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: T = Tenured TT = Tenure Track NTT = Non-Tenure Track
3. FT = Full-Time Faculty or PT = Part-Time Faculty
4. The level of activity (high, medium or low) should reflect an average over the three years prior to the visit.

Table 6-2. Faculty Workload Summary

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the Program[5]
			Teaching	Research or Scholarship	Other[4]	
Armstrong, Jason	FT	Fall 19: MAE 377 (3), MAE 381 (3); S20: MAE 385 Lab 1-8 (1), MAE 485/585 (3)	60	20	20	100
Ball, Zachary	PT	F19: MAE 277 (3); S20: no courses	100	0	0	50
Battaglia, Francine	FT	F19: MAE 539 (3); S20: no courses (administrative assignment)	20	20	60	100
Bayandor, Javid	FT	F19: MAE 460 (3), MAE 513(3); S20: MAE 400 (3), MAE 600 (3)	40	40	20	100
Botta, Eleonora	FT	F19: MAE 502 (3); S20: EAS 208 (3)	40	40	20	100
Burge, Matthew	FT	F19: MAE 335 (3) A, B, MAE 339 Lab 1, 2; S19: MAE 336 (3) A, B	80	10	20	100
Chen, James	FT	F19: MAE 422 (3); S20: MAE 631 (3)	30	50	20	100
Chowdhury, Souma	FT	F19: MAE 376 (3), MAE 550 (3); S20: MAE 552 (3)	40	40	20	100
Chung, Deborah	FT	F19: MAE 381 (3); S20: MAE 438/538 (3), MAE 489/589 (3)	50	50	0	100
Crassidis, John	FT	F19: MAE 674 (3); S14: MAE 425/525 (3), Assoc. Chair	20	60	20	100
Dargush, Gary	FT	F19: MAE 529 (3); S20: MAE 316 (3), MAE 500 (3)	40	40	20	100
Darrall, Bradley	FT	F19: MAE 315 (3), MAE 376 (3); S20: MAE 345 A, B (3)	60	20	20	100
DesJardin, Paul	FT	F19: no courses (sabbatical); S20: MAE 423 (3), MAE 520 (3)	20	60	20	100
T-Esfahani, Ehsan	FT	F19: MAE 464/564 (3), MAE 509 (3); S20: no courses (sabbatical)	20	60	20	100

Estes, Aaron	FT	F19: MAE 454/554 (3); S20: MAE 334 (2), MAE 444/544 (3)	60	20	20	100
Faghihi, Danial	FT	F19: MAE 376 (3); S20: MAE 555 (3)	30	60	10	100
Felske, James	FT	F19: MAE 470/570 (3), MAE 545 (3); S20: no courses (retirement)	100	0	0	100
Hall, John	FT	F19: MAE 410/510 (3); S20: MAE 494 (3)	40	40	20	100
Hassan Ali, Alaa	FT	F19: MAE 204 (3); S20: EAS 230 A, B (3)	80	0	20	100
Hua, Zhonglu	FT	F19: MAE 487/587 (3); S20: no courses (sabbatical)	20	60	20	100
Kalanovic, Vojislav	FT	F19: MAE 493/593 (3); S20: MAE 490/594 (3)	40	40	20	100
Kang, Jiyeon	FT	F19: MAE 476/576 (3); S20: no courses	30	60	10	100
Karami, M Amin	FT	F19: MAE 340 (3); S20: MAE 568 (3), MAE 671 (3)	40	40	20	100
Khan, Jobaidur	FT	F19: MAE 204 (3), MAE 338 (2); S20: MAE 311 A, B, C (3), MAE 442/542 (3)	80	0	20	100
Lagor, Frank	FT	F19: MAE 436 (3), MAE 503 (3); S20: MAE 503 (3), MAE 562 (3)	40	50	10	100
Lewis, Kemper	FT	F19: no courses; S20: no courses; Dept. Chair; Director of SMART CoE	0	40	60	100
Liang, Zach	FT	F19: MAE 507 (3); S20: MAE 536 (3), MAE 537 (3)	50	50	0	100
Madnia, Cyrus	FT	F19: MAE 415/515 (3); S20: MAE 516 (3), MAE 519 (3)	60	40	0	100
Mashhadi, Ardeshir	FT	F19: MAE 451 (3), MAE 494 (3); S20: MAE 177 (3), MAE 477/577 (3)	60	20	20	100
Meng, Hui	FT	F19: no courses (on administrative leave); S20: MAE 478/578 (3)	20	80	0	100
Mollendorf, Joseph	FT	F19: MAE 431 (3); S20: MAE 336 (3)	40	20	40	100
Mook, D Joseph	FT	F19: MAE 340 C, D (3); S20: no courses	40	20	40	100
Nouh, Mostafa	FT	F19: MAE 467/567 (3), MAE 565 (3); S20: EAS 208 (3)	40	40	20	100
Rai, Rahul	FT	F19: MAE 451 B, C (3), MAE 600 (3); S20: no courses	40	40	20	100
Ren, Shenqiang	FT	F19: MAE 430 (3); S20: MAE 581 (3); 25% appointment in Department of Chemistry	30	60	10	75
Ringuette, Matthew	FT	F19: MAE 502 (3); S20: MAE 424 (3); Director of Undergraduate Studies for AE	30	30	40	100
Sabato, Jude	FT	F19: MAE 338 (2); S20: EAS 230 (3)	80	0	20	30

Salac, David	FT	F19: MAE 204 D, E (3); S20: MAE 432/532 (3), MAE 598 (3); Director of Graduate Studies	30	30	40	100
Schifferle, Paul	PT	F19: MAE 278 (3); S20: MAE 434 (3)	100	0	0	30
Singh, Tarunraj	FT	F19: MAE 443/543 (3), MAE 568 (3); S20: MAE 670 (3)	40	40	20	
Snoeyink, Craig	FT	F19: MAE 335 C, D (3); S20: no courses	30	60	10	100
Stamm, Jennifer	FT	F19: no courses; S20: MAE 364 A, B, C (3)	80	0	20	100
Wetherhold, Robert	FT	F19: MAE 315 (3), MAE 381(3); S20: MAE 316 (3); Director of Undergraduate Studies for ME	50	0	50	100
Zheng, Minghui	FT	F19: MAE 340 (3), MAE 571 (3); S20: no courses	30	60	10	100

1. FT = Full-Time Faculty or PT = Part-Time Faculty, at the institution

2. For the academic year for which the Self-Study Report is being prepared.

3. Program activity distribution should be in percent of effort in the program and should total 100%.

4. Indicate sabbatical leave, etc., under "Other."

5. Out of the total time employed at the institution.

CRITERION 7. FACILITIES[1]

A. Offices, Classrooms and Laboratories

Summarize each of the program's facilities in terms of their ability to support the attainment of the student outcomes and to provide an atmosphere conducive to learning.

1. Offices (such as administrative, faculty, clerical, and teaching assistants) and any associated equipment that is typically available there.

The University at Buffalo occupies three campuses in the Buffalo area. The North Campus is now the heart of the University (particularly for undergraduates and for STEM disciplines) and is located in the suburban Town of Amherst. Construction on the North Campus began in the 1970s and the Department of Mechanical and Aerospace Engineering (MAE) began to occupy its space in 1978. The Department is contained in the ten-story Furnas Hall and in the adjacent Jarvis and Bell Halls. In Furnas Hall, the Dynamics, Control, and Mechatronics (DCM) Group occupies the 8th and 10th floors, while the Computational and Applied Mechanics (CAM) and Materials (MAT) Groups are located on the 6th floor. In Jarvis Hall, the Fluid and Thermal Sciences (FTS) and Biomechanics (BM) Groups are located on the 3rd floor. Primarily in Bell Hall, the Design and Optimization (DO) Group and the Teaching Faculty members are located on the 2nd floor along with the Department Administrative Offices. Some MAE research groups have recently expanded into Lockwood Hall and Hochstetter Hall as the department continues to grow. Another new engineering building, currently in the planning stages, will focus on enhancing the undergraduate experience with space for reconfigurable classrooms, student clubs and group study.

The South Campus is located at the Northeast corner of the City of Buffalo. It is the original campus of the University and now serves largely as a professional school campus containing the Dental School, the School of Architecture and Planning, the Law School, and a few other programs in social sciences. MAE Faculty members with interests in biomechanics have additional offices and/or laboratories on the South Campus or on the new Downtown Medical Campus in the state-of-the-art Clinical and Translational Research Center (CTRC). Other developments related to the "Buffalo Billion," a state investment in Buffalo, have created additional facilities for collaboration of MAE Faculty and Students including the downtown Medical School campus and Buffalo Manufacturing Works at the Northland Training Facility.

All full-time MAE Faculty and Staff are provided with private offices on the North Campus. Faculty members also are given space to conduct their research and to house all graduate students having either Teaching or Research Assistantships. The overall space allocation is shown in Table 7-1. We note that after the first year, Teaching Assistants (TA) are typically accommodated in the research space assigned to individual faculty members.

[1]Includes information concerning facilities at all sites where program courses are delivered.

Table 7-1. MAE Space Usage (Update 6/23/14 BLB)

Type of Space	Square Footage
Department Common Space (meeting rooms, mail rooms, etc.)	2,500
Departmental Faculty/Staff Offices	5,100
Teaching Laboratories (Undergraduate)	6,600
Research Facilities/Labs/RA Offices	20,400
TA Office Space	1,200
Student Organization Space	1,200
Total MAE Space	**37,000**

2. Classrooms and associated equipment that are typically available where the program courses are taught.

The MAE Department utilizes multiple classrooms throughout the North Campus of varying size depending on the class size. Many classrooms on the North Campus have been recently renovated with better seating, technology, and spacing. For the larger rooms, stadium-style seating is employed for maximum visibility. Typical classrooms contain a host of technology, usually operated from a central podium. This includes a projector and screen, local computing options, laptop video and audio inputs, audio supplied through in-room speakers, a video player with audio, a digital-camera-based visualizer for projecting images and written notes on the screen, and both fixed and portable microphones. The podiums contain room control panels for projector controls and adjusting lighting and audio settings. All classrooms also have at least one whiteboard if not more. Additionally, all classrooms have wireless Internet which can be accessed by the students and the instructor. “Clicker” devices may also be used (purchased by students) to provide instant electronic responses e.g. to an example engineering problem with multiple-choice answers, which can be automatically compiled and viewed on the projector screen; this provides the instructor with real-time feedback from the class. These available technologies allow for a variety of traditional and multi-media classroom instruction strategies, which enhance the educational experience for students. Instructors can quickly switch among the various media, e.g. to show a flow visualization movie on YouTube during a fluid mechanics lecture.

MAE has also developed their own classroom in 250 Bell Hall where we can schedule classes of size 30 students or smaller. This classroom is used extensively during the spring, summer, and fall terms with most days being at or near capacity. When not in use, this classroom supports other events such as thesis and dissertation defenses, faculty meetings, etc.

Moreover, we also offer a number of on-line learning options through platforms developed with UB, SUNY, and Coursera. For instance, a number of MAE faculty were part of the first UB Massive Open On-line Course (MOOC) developed in partnership with Coursera, a global leader in MOOCs. This course has had more than 30,000 students globally.

3. Laboratory facilities including those containing computers (describe available hardware and software) and the associated tools and equipment that support instruction. Include those facilities used by students in the program even if they are not dedicated to the program and state the times they are available to students. Complete Appendix C containing a listing of the major pieces of equipment used by the program in support of instruction.

The Department of Mechanical and Aerospace Engineering has a dedicated set of computational and hardware labs across our footprint to support a number of our courses. All of them have undergone substantial upgrades since 2014.

- MAE Computational Design Lab (1019 Furnas Hall)
  - This lab is dedicated to the computational-based instruction in the department including our entire thread of computational design courses, MAE 177, MAE 377, MAE 477, among others. This lab was recently completely renovated and upgraded, supported by the department and SEAS. The lab includes approximately 40 PC workstations and access to all relevant engineering and institutional software necessary to support our educational program including Matlab and SolidWorks. This lab is available to MAE students 24 hours, 7 days a week through swipe access.

- MAE 334 Engineering Lab 1 (810 Furnas Hall)
  - Quanser equipment (https://www.quanser.com/) is used for half of the laboratory experiments that are performed in this course. New DAQ cards, terminal boards, and power amplifiers were purchased for all 10 stations, resulting in more reliable data (2017). Additional pendulum and flex-beam setups were also purchased to expand the scope of these labs.
  - A series of workshops are now being used to introduce the students to a variety of sensors and actuators, so that they are better prepared for the more complex systems they analyze later in the course (2017). A number of microcontrollers, sensors, motors, and actuators have been purchased to implement these workshops.

- MAE 338 Engineering Lab 2 (216 Jarvis Hall)
  - Hydrometers were added to provide density measurements, which previously relied on data from the literature (2018). The density measurements yield more consistent experimental results.

- Two FLIR IR thermal imaging cameras were purchased in the preparation of a new heat transfer experiment (2018), giving the students practice with thermal imaging and allowing them to safely perform a complex heat-transfer analysis after non-invasively interrogating the thermally-energized system.
- MAE 385 Materials Lab (620 & 621 Furnas)
    - A suite of materials testing systems were purchased (2016). These systems provide more hand-on experience in two new lab experiments covering the behavior of materials under mechanical loading (https://www.pasco.com/prodCompare/materials-testing-system/index.cfm).
    - Camera microscopes were purchased (2016), and a Metallograph has been updated (2019), providing better images for student discussion.
    - New heat treatment furnaces were purchased to replace older furnaces that were out-dated, providing a safer work environment and more consistent results (2019).

In addition to laboratories directly administered by MAE, there are additional shared-use SEAS laboratories that are available to students; these are listed below, along with the required undergraduate courses supported.

SEAS Engineering Machine Shop (105/111 Jarvis Hall); MAE 494, MAE 364

The SEAS Engineering Machine Shop supports experimental research, student clubs and course requirements. Highly skilled staff provide technical support for faculty, staff and students. A photograph of the lab looking from the top is shown in Figure 7-1.

Figure 7-1. The SEAS Machine Shop housed in Jarvis Hall.

The machine shop offers:

- Design assistance, repairs, fabrication and assembly of laboratory components, equipment and machinery using a wide range of materials, including steel, stainless steel, aluminum, plastics and wood.
- Full complement of modern precision tooling and machinery, including CNC (Computer Numerical Controlled) machining.

- Supervised student workshop that, following a safety orientation, allows hands-on access to machines and equipment for undergraduate and graduate engineering students involved in designing and fabrication of research equipment and class projects. It is also available to engineering cub members that are involved in designing and fabrication of competitive intercollegiate projects.

The main shop is located in 105 Jarvis Hall, and is open Monday-Friday from 8:00 a.m. to 4:30 p.m. The Student Machine Shop, located in 111 Jarvis Hall, is open after hours on Monday through Friday from 4:00 p.m. to 10:00 p.m. and Saturday from 10:00 a.m. to 4:00 p.m.

Digital Manufacturing Lab (118 Bonner Hall); MAE 364

The Digital Manufacturing Laboratory houses a variety of 3D printing/additive manufacturing technologies, software and capabilities for modeling and digital design, and manufacturing and analysis. Home to high-definition 3D digital scanners, desktop and professional grade printers, the lab provides capabilities for precision rapid prototyping, tooling and manufacturing of highly-detailed and durable 3D objects and parts.

The DML is equipped to provide the following:

- 3D Printing Services – timely print services of 3D parts for research, classroom and club projects, industrial or entrepreneurial prototypes or parts
- Teaching / Education – access to 3D printing tools, design software and expertise to assist instructors in incorporating 3D printing / additive manufacturing into course curriculum
- Design Assistance and Evaluation – providing design evaluation, guidance and assistance to advance skills and understanding of those interested in designing for 3D printed parts
- Hands-on Training & Equipment Use – helping to ready the next generation of engineers and designers through training and hands-on experience in use of additive manufacturing technologies and processes
- Industry services – engaging in consultations and collaborations with business and industry in the design and fabrication of prototypes and parts

The Digital Manufacturing Lab is available for shared use by UB students, faculty, researchers at other academic institutions, government, and industry. Typical hours are Monday through Friday 12-6pm.

Design Studio (416 Bonner Hall); MAE 177, MAE 377

The Design Studio comprises a Reverse Engineering Lab (RevEng Lab) and the Da Vinci Lab (a collaborative meeting space with white boards, a large monitor, and prototyping materials). The studio consists of a variety of tools, measurement devices, 3D printing and other materials to support tinkering via product teardown, ideation and modification. Concepts can be implemented through the complementary tinkering spaces. Typical hours are Monday through Friday 2-7pm.

B. Computing Resources

Describe any computing resources (workstations, servers, storage, networks including software), in addition to those described in the laboratories in Part A, which are used by the students in the program. Include a discussion of the accessibility of university-wide computing resources available to all students via various locations such as student housing, library, student union, off-campus, etc. State the hours the various computing facilities are open to students. Assess the adequacy of these facilities to support the scholarly and professional activities of the students and faculty in the program.

Overview. Science and Engineering Node Services (SENS) is the main support group providing information technology services and support to SEAS as well as five departments in the College of Arts and Sciences. Support from SENS is tailored for the needs of the engineering, natural sciences, and mathematics disciplines, complementing the broader range of university-wide support provided by University at Buffalo Information Technology (UBit). Whereas UBit reports to the Office of the Chief Information Officer, SENS reports to the Offices of the Deans in the School of Engineering and the College of Arts and Sciences. The Dean of Engineering serves as the lead dean and oversees the normal "day-to-day" activities of the group. Each of the nine departments within SEAS also provides computing resources to its faculty and students.

SENS staff includes a director and nine full-time professional staff. This group provides support for specifying, configuring and maintaining clients and servers running Microsoft Windows, CentOS and Ubuntu Linux, and Mac OS X. This support extends to instructional laboratories, research laboratories, and faculty and staff desktop and laptop systems. SENS works with UBit to facilitate local user needs for network access, account creation, email configuration, and other centrally-provided services. SENS also provides services including; file storage, web services, network-accessible software, and timeshare services. Members of SENS participate in campus-wide IT initiatives and serve on various committees.
SENS embraces a philosophy called "UBiquity," where students, faculty, and staff can access their data regardless of what type of computer they are using or where they are located. Each user gets a "home directory" that follows them on Linux, Microsoft Windows, and Mac OS X systems. SENS also makes use of shared software repositories and timeshare systems so that users of one type of computer can use software written for another type of system. For example, Windows users can use X-Win32 to run Linux applications on timeshare systems, and Linux users can run Windows applications via Windows Remote Desktop Protocol.

Computing Laboratories. SENS manages and maintains the departmental computing laboratories and lab PCs already noted for Furnas 1019, Furnas 810/811 and Jarvis 216. In addition, SENS manages the following UB Engineering labs, which run Microsoft Windows 10.

- Engineering Workstation Classroom – 211/212 Furnas Hall
  - Open 8 a.m. to 8 p.m. Mon-Fri plus swipe card access
  - Used for undergraduate instruction (EAS199, EAS230, etc.)
  - 41 Dell OptiPlex 7010 Microsoft Windows Systems
  - Dual projectors and an instructor console
- SENS Public Workstation Laboratory – 1018 Furnas Hall
  - Open 8 a.m. to 5 p.m. Mon-Fri plus swipe card access
  - Used for small courses, seminars, ad-hoc lectures, overflow
  - 19 Dell OptiPlex All-in-One Microsoft Windows Systems

SENS maintains a public Linux workstation laboratory in 101 Bell Hall, which is open for general use by anyone at the university but where the computers are configured similarly to Linux systems in the Engineering labs:

- Public Unix Workstation Lab – 101 Bell Hall
  - Open 8 a.m.-Midnight Mon-Thu, 8 a.m.-6 p.m. Fri, 9 a.m.-9 p.m. Sat, Noon-Midnight Sun; additionally, it is open 24 hours for the three weeks prior to end of every semester
  - 68 Dell OptiPlex Systems (790, 9020 AIO and 9030 AIO)
  - Public printer and print release station
  - Wireless work area

The following centrally managed computing sites are available for student use on the North Campus; in addition to the features shown, all labs have wireless network access:

- Blake Center, Ellicott Complex
  - Open 9 a.m.-Midnight Mon-Fri, Noon-8 p.m. Sat, Noon-Midnight Sun
  - 10 Cybrary stations
  - 2 Express stations
  - Public printer and print release station
- Capen 2nd Floor
  - Open 24 hours, seven days a week
  - 52 Cybrary stations and 1 assistive station
  - 20 Express stations
  - Public printer and 2 print release stations
  - Scanner stations
- Capen 3rd Floor
  - Open 24 hours, seven days a week
  - 95 Cybrary stations
  - 41 iMacs
- Clinton Hall Room 114
  - Open 24 hours, seven days a week
  - 13 Cybrary stations and 1 assistive station
  - Public printer and print release station
- Lockwood 2nd Floor Cybrary (North)

- Open 8 a.m.-Midnight Mon-Thu, 8 a.m.-9 p.m. Fri, 9 a.m.-5 p.m. Sat, Noon-Midnight Sun
    - UBit Help Desk walk-up service
    - iMacs 20
    - 58 Cybrary stations and 2 assistive stations
    - 12 express stations and 1 library research station
    - Public printer and 2 print release stations
    - Scanner stations
- Lockwood 2nd Floor Library (South)
    - Open 8 a.m.-midnight Mon-Thu, 8 a.m.-9 p.m. Fri, 9 a.m.-5 p.m. Sat, Noon-Midnight Sun
    - 37 Cybrary stations and 1 assistive station
    - 12 library research stations
- Lockwood 3rd Floor Library
    - Open 8 a.m.-midnight Mon-Thu, 8 a.m.-9 p.m. Fri, 9 a.m.-5 p.m. Sat, Noon-Midnight Sun
    - 49 Cybrary stations

Server Resources. SENS maintains a server environment comprising the following resources:

- Authentication services for SENS users;
- Home directory server that provides storage for all users on all platforms;
- Class directory server to provide as-needed instructional file storage;
- Several servers for research storage;
- Linux Timeshare services;
- Shared software server and floating license servers;
- Several web servers for departmental, research, and instructional web sites; and
- Servers for print services, infrastructure backups, and other core needs.

UBit provides various server resources, including:

- Authentication and authorization services (Active Directory and Kerberos);
- UBbox, cloud storage;
- Microsoft One Drive cloud storage;
- Central file storage (UBfs) with data backup and restore services;
- Archive File storage (AFS);
- Timeshare services (UBUNIX);
- Centralized email systems for faculty/staff plus Google Mail for students;
- Scheduling and transaction system for students, faculty, and staff (HUB);
- SharePoint and UBLearns (Blackboard) systems;
- Access to remote meeting/collaboration services WebEx, Zoom, Microsoft Teams;
- Panapto video recording service;
- Web services;
- Distributed printing services;

- Central antivirus management;
- Patch management for Microsoft products; and
- Remote software distribution for Microsoft Windows (SCCM) and MACOS (Jamf).

Network Infrastructure. All UB Engineering buildings have wired gigabit Ethernet services, provided and maintained by UBit. Several wireless networks are also available throughout the buildings, including the federated eduroam network for use by students, faculty, and staff, a guest network for use by visitors, and a limited-use network for devices not capable of authentication.

Assistance and Support. Servicing and support of instructional computing for UB Engineering are provided by both SENS and UBit, with SENS being the primary point of contact and initial investigator in most cases. In addition, since the establishment of the Node-based distributed service model in 1997, there is support involvement from other Nodes, as well as support from SENS for technologies useful to other Nodes. These partnerships have benefitted the campus as a whole as well as the constituents served by each Node.

SENS offers walk-in support, phone support, email support, and a ticket tracking system known as SENShelp. Staff are available from 9 a.m. to 5 p.m. Monday-Friday. Staff offices are located on the first floor of Bell Hall, next to the Bell 101 public computing site, and there is an "open door" policy where students, faculty, and staff can ask any appropriate staff member for guidance and support.

UBit's Academic Computing Services offers personal consulting services from 9 a.m. to 5 p.m. weekdays in the Computing Center, with more extended consulting hours in the public computing sites. Services include telephone consultations, provision of reference materials and take home introductory guides, walk-in consultations, and consulting by appointment.

Supported Software. General-purpose software found on SENS and UBit systems include programs for general office applications (spreadsheet, word processing, referencing, presentations, file management, etc.), Internet and media processing (browsers, search engines, visualization), math functions (MATHEMATICA/MAPLE/MATLAB, statistics), and high-level programming (C, C++, FORTRAN, Java, Perl, Python). Available and supported general purpose software packages are listed in Table 7-2, along with specialty engineering software administered by SENS and used by students in the mechanical and aerospace engineering programs.

Table 7-2. Available Software Packages

General purpose packages			
• Adobe Acrobat Reader • Autodesk Products • Zoom • WebEx • Microsoft 365	• EndNote (library tool) • FileZilla • Flash Player plugins • Google Chrome • iTtunes • Microsoft built-in firewall	• Microsoft Office - Enterprise Edition • Microsoft Windows 10 (64 bit) • Microsoft Windows Media Player • Mozilla FireFox	• OS patching client Programming languages • Putty [SSH client] • Sun Java JRE • UBFS Link • WinSCP (sftp)

Specialty Packages administrated by SENS and available to MAE undergraduate students		
Title	**Purpose**	**Class (MAE xxx)**
Arduino IDE	Software to control microcontrollers/sensors/actuators	MAE 334
Autodesk Inventor	3-D CAD software; Dynamic simulation	General use; MAE 477
MATLAB	Introductory programming course; Scientific computation in MAE; Calculations and data analysis; Analysis of experimental data	EAS 230; MAE 376; MAE 334; MAE 338
MATLAB Simulink	Data collection in experiments, drive Quanser Hardware	MAE 334
National Instruments LabVIEW	Data collection in experiments	MAE 334
SOLIDWORKS	Solid modeling and drawings; structural analysis (FEA) and geometric dimensioning and tolerancing (GD&T); modeling part for use in wind tunnel;	MAE 177; MAE 377; MAE 339

C. Guidance

Describe how students in the program are provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories.

The Mechanical and Aerospace Engineering Department leverages several hands-on facilities to meet our educational objectives. These include undergraduate experimental and computer teaching laboratories, and the SEAS Machine Shop. Here we describe the technical and safety-related guidance provided to students on using these facilities.

Undergraduate Teaching Laboratories

The undergraduate laboratories are taught by an instructor supported by teaching assistants, or by teaching assistants alone. The teaching assistants are trained by the instructor on the appropriate safety measures, relevant hazards, and emergency response procedures. The instructor and/or teaching assistants provide this information to the students via an in-class training lecture in conjunction with the laboratory procedures. Topics include protective gear (e.g. eye protection), correct equipment use to minimize risk, emergency procedures, and the use of eye-wash stations. All procedures are routinely reviewed by Environmental Health and Safety on campus.

Technical information is disseminated through in-class lectures, in-lab lectures and training, and written documentation; the methods are course-dependent. In general, the relevant materials such as laboratory manuals are provided ahead of time online.

Courses that include experimental labs are: MAE 334: Mechanical and Aerospace Engineering Lab I, 338: MAE Lab II 385: Engineering Materials Laboratory; 420: Biomechanics of the Musculoskeletal System; 433: Continuous Control Systems; and 476: Mechatronics. For these courses, in addition to the manuals and equipment data sheets supplied online, there are in-lab training sessions performed by the instructor or TAs. These typically include an initial presentation of the overall lab equipment to the students, as well as the relevancy to their coursework and educational goals. Prior to the student groups using a particular lab station, they are given a training demonstration on the specific technical procedures and safety measures.

A Departmental Guidebook has been developed by Prof. Jason Armstrong that standardizes our safety practices across our hardware labs. This guidebook provides instructors and teaching assistants with thorough and consistent information about proper use of the space and the equipment.

Courses utilizing computer labs are: MAE 177: Introduction to Engineering Drawing and CAD, MAE 377: Product Design, MAE 477: Computer-Aided Design Applications. Again, for these the students are typically provided with assignment and specific tutorial documents for each course, as well as lectures describing the software. Furthermore, during class there is generally some time for either the instructor or TAs to aid students on an individual basis. The lab software is provided via site licensing arrangements, and online help and manuals are available to the students.

SEAS Machine Shop

The SEAS Machine Shop supports the department via both functional and educational roles. Students are encouraged to use it for coursework, undergraduate research, and student clubs. To ensure that students are familiar with all of the relevant safety procedures, prior to entering the shop each student must complete an online safety certification course developed by SEAS; available at: http://engineering.buffalo.edu/home/school/explore/facilities/machine-shop.html. Instruction on each machine or tool is provided by a trained machinist on an as-needed basis to ensure safety. Further, each day a machinist is dedicated to supporting student activities.

The SEAS Machine Shop also has a student machine shop area that is open after hours and on weekends. This is run by students who have qualified as supervisors of this space. This space is a smaller portion of the entire Machine Shop and is securely separated from the remainder of the Machine Shop.

D. Maintenance and Upgrading of Facilities

Describe the policies and procedures for maintaining and upgrading the tools, equipment, computing resources, and laboratories used by students and faculty in the program.

Laboratory equipment and computing resources are maintained and updated via a regular process that is administered by the Academic Programs Committee (APC) within the School of Engineering and Applied Sciences. The APC consists of undergraduate Program Directors and Associate and Assistant Deans focused on undergraduate education. The process requires programs to establish a vision for the short- and long-term evolution of their laboratory/computing experiences, develop detailed annual plans that align with guiding principles established by the APC, and execute the approved plan. These guiding principles (see table below) ensure curricular relevance and encourage departments to collaborate where possible. Funds are provided by both the Dean's office and academic departments. The timeline for the process is as follows. The process is supported by an online tool developed by the SEAS Office of Undergraduate Education. More specifically, the tool provides a means to (1) review funding allocations, (2) submit vision documents, detailed update plans, and revision requests, and (3) record and track purchases associated with the laboratory/computing update process.

Date	Action
February 1	Funding allocations set: Departmental funding allocations are set for the next fiscal year. The Dean sets the total level of support provided by the Dean's office and the total "match" provided by departments. The departmental match is approximately 25% of the Dean's contribution. The level of support available to a given department depends on (1) the number of undergraduate academic programs it supports and (2) the fraction of students enrolled in undergraduate programs associated with that department. Historical School-level and department-level support values are provided below.
March 1	Vision documents due: These provide a big picture perspective of how a department aims to improve the undergraduate laboratories. These are typically 1-2 page

Date	Action
	documents. Program Directors from other departments are expected to review these documents, provide feedback, and explore potential collaborations regarding common use of equipment.
April 1	Detailed plans due: Departments submit laboratory update proposals for the next fiscal year. Each proposal includes (1) an overview of the update plan, (2) a description of how the plan aligns with the laboratory support guiding principles, (3) a mapping between proposed expenses and courses, and (4) details regarding where new/repaired equipment will be housed, the nature of the space in which it will be located (e.g., UG teaching lab, research lab), an estimate of the time utilization for undergraduate education (e.g., one week per year, the entire spring semester), and extent to which the equipment may be used for research, if appropriate. The guiding principles are as follows. • **Curricular relevance** (required). The labs should reinforce core concepts addressed within the curriculum. Support for the labs must broadly impact undergraduate students within the major. Given this key guiding principle, the Dean's office generally provides support for laboratories connected to required courses only. • **Collaborative**. Departments are encouraged to work together to develop laboratory experiences that benefit students in multiple undergraduate programs. • **Intrinsic interest**. Students should find the labs interesting to perform. Within this context, interactive "hands-on" experiments are considered particularly attractive. We also find value in laboratory experiments that visitors (e.g., students and parents who attend Open House) are likely to appreciate. • **Practicalities**. Planning for laboratories must consider a variety of constraints related to size, cost, safety, and so on. In this context, laboratory equipment that is modular, space-efficient, cost-effective, sustainable, and provides robust safety features is considered particularly attractive. • **Practical experience**. The labs should give students experience in handling and using a wide variety of equipment and devices employed in engineering practice. • **Data rich**. The labs should provide students with opportunities to apply a variety of data-analysis and statistical-inference methods to real experimental data. The laboratory experiences should also offer an opportunity for students to apply modeling strategies to interpret experimental data. The proposal must adhere to the first guiding principle (Curricular Relevance). Alignment with the remaining guiding principles is highly encouraged.

Date	Action
May 1	Approvals finalized: Laboratory update plans are presented by Program Directors at an APC meeting. Other committee members provide feedback and suggestions, ask questions, and consider the appropriateness of the plan. Following the discussion, a vote is held regarding approval of the plan.
July 1	Execution of the approved update plan: The fiscal year begins July 1, and it is at this point that departments can begin to acquire equipment and supplies and implement the update plan. All purchases associated with the undergraduate laboratories are submitted to a common School-level database for tracking purposes.
July 1 to June 30	Revisions: In some cases, it is not possible to implement the approved plan. The department is then asked to submit a revision request to the Associate Dean for Undergraduate Education. The revised plans are reviewed for alignment with the guiding principles outlined above.
June 30	Completion of update plan: The fiscal year ends June 30, and it is at this point that the update plan is expected to be finalized.

The maintenance and improvement of the lab facilities in MAE is currently governed by a series of 4-year plans; this method was adopted after our 2008 ABET review to ensure the continuity and integrity of the process. Laboratory instructors directly plan the upgrades and implement them for their own courses, with oversight from the UGSC and the SEAS Undergraduate APC process (described earlier). The department agreed on four basic principles to guide and prioritize purchases:

- Required courses must be considered first, ahead of Technical Electives;
- Hands-on experiments are always preferred to passively-observed demonstrations to promote experiential learning;
- Always keep in mind “the greatest good for the greatest number” to prioritize purchases, based on student numbers involved per dollar of expenditure;
- Emphasize instruction, with possible overlap with research or special projects.

It was also agreed that the purchasing process would be transparent; faculty should have open access to purchase orders and information. The process to upgrade a certain lab is as follows:

- We have four primary labs and we cycle through each lab every four years.
- The faculty who teach in a particular lab develop a plan, and make their recommendation for that lab to the UGSC.
- The UGSC discusses and approves the plan, iterating with the faculty as necessary, and then submits it to the SEAS Office of Undergraduate Education (OUE).
- The OUE then discusses and approves the plan, iterating with the UGSC if needed.
- Funds are allocated from MAE and SEAS for purchasing. All purchases are managed by the faculty who teach the lab supported by departmental staff. As mentioned above, purchases are then entered into the SEAS system to keep track of the upgrade spending.

We have now completed two cycles of these upgrades across all of our teaching laboratories and are in the middle of the third cycle. A summary of these upgrades are as follows:

2009-2013

- $356,400 was committed by MAE and SEAS over this time frame.
- Complete revision of the dynamics and systems lab (MAE 334) with 5 new hands-on experiments;
- Five hands-on experiments in fluids and thermal sciences (MAE 338) underwent upgrades or repairs, 3 in fluids and 2 in thermal sciences.

2013-2017

- $364,880 was committed by MAE and SEAS over this time frame.
- Purchased two new hands-on experiments in heat transfer (MAE 338) and 1 in experimental design (MAE 338), and both became active in Fall 2014;
- Three new experiments in materials (MAE 385), 2 hands-on and 1 demonstration; one hands-on experiment bought in 2013-14 (rolling mill);
- Four new hands-on experiments, one revised experiment for experimental design in dynamics and systems (MAE 334); experimental design equipment bought in 2013-14;
- Two new hands-on experiments and two new centralized laboratory facilities in design and manufacturing (project course MAE 494 and proposed non-lab courses MAE 451, 311, 364 and 377)

2018-2022

- $258,600 was committed by MAE and SEAS over this time frame.
- In our fluid/thermal lab (MAE 338), hydrometers were added to provide density measurements, which previously relied on data from literature.
- Two FLIR IR thermal imaging cameras were purchased in the preparation of a new heat transfer experiment (now active) for MAE 338 (ME), giving the students practice with thermal imaging and allowing them to safely perform a complex heat transfer analysis after non-invasively interrogating the thermally-energized system.
- For the 2020–2021 cycle, for MAE 334 there will be PC upgrades, repairs for the Quanser Rotary Servo units, custom experimentation kits (microcontrollers, small motors, basic sensors, and accessory electronic components) that students can take home to work on, and a student assistant to support the kits and aid with developing and fabricating new experiments.
- The 2021–2022 cycle will focus on MAE 338. New fluids and heat transfer experiments, such as an improved heat conduction lab, will be added to broaden the range of experiences students obtain, and to connect better with MAE 335 and 336.

E. Library Services

Describe and evaluate the capability of the library (or libraries) to serve the program including the adequacy of the library's technical collection relative to the needs of the program and the faculty, the adequacy of the process by which faculty may request the library to order books or subscriptions, the library's systems for locating and obtaining electronic information, and any other library services relevant to the needs of the program.

Overview

The University at Buffalo (UB) Libraries is composed of eight units providing access to more than 4.3 million volumes including more than 1.1 million electronic books and more than 180,000 unique journal title subscriptions as well as approximately 1.5 million technical reports. The collections, which are the largest within SUNY system, are used heavily by faculty and students. In 2018-19, there were 3.8 million searches, more than 3.2 million full-text article downloads, and nearly 450,000 downloads from e-books.

Library collections supporting research, teaching, and learning in the School of Engineering & Applied Sciences (SEAS) are housed primarily in Lockwood Library, centrally located on the university's North Campus. The scope of these collections spans the pure and applied sciences and engineering as well as the mathematical sciences. Print collections include books, journals, indices and abstracts, technical reports, standards, theses, and dissertations. In addition to its extensive print collections, the library maintains access to the electronic versions of major bibliographic databases for research in engineering and computer science, including Engineering Village (including Compendex, Inspec, GeoRef, NTIS, and KNOVEL databases), Web of Science, IEEE Xplore, SciFinder-n, ACM Digital Library, SPIE Digital Library, and many others; major electronic journal packages from professional societies including ASCE, ASME, AIAA, IEEE, AIChE, ACS, HFES, and more; and specialized electronic book databases in engineering and computer science, such as KNOVEL, CRCnetBASE, Synthesis from Morgan & Claypool, and *Lecture Notes in Computer Science*, for example. The Library also recently expanded electronic access to standards with a new subscription to ASTM Compass database. Techstreet Enterprise is also available to students with select ISO and ASME standards available to view electronically. Faculty can now request individual standards be added to the TechStreet Enterprise platform for their teaching needs by contacting the Engineering Librarian. In addition, students and faculty in SEAS have access to related print and online collections in architecture and planning, law, management science, and government information. Access to these resources is provided through the UB Libraries' online catalog and website at http://library.buffalo.edu/.

Subject Librarians/Departmental Liaisons

SEAS is supported by two full-time subject specialists in the University Libraries—an Engineering Librarian and a Computer Science Librarian. As subject liaisons to SEAS, the

Engineering and Computer Science Librarians are responsible for addressing department/program needs and requests, including information literacy initiatives, collection development strategies, and implementation of new information technologies. They provide a variety of services, including collection development and management, research consultations, instruction in the use of information resources, curricular support, and purchase requests. In addition, they serve as the conduit of information between the UB Libraries and the School, helping to promote library resources and services to faculty and students and communicating faculty and student needs and concerns back to the UB Libraries. The services and programs offered by the two SEAS subject specialists are complemented and supported by a team of UB Libraries' subject specialists in disciplines including physics, chemistry, geology, math, statistics, biology, bioinformatics, psychology, management science, architecture, and medicine.

These librarians are available to assist with specialized reference queries, multidisciplinary research, emerging technologies, workshops, and classes.

Reference/Research Assistance

Reference/research assistance is provided both in person and by phone and email and is available to assist students and faculty with questions, locate materials, perform literature searches, provide instruction on the use of library materials and tools, and make referrals to other libraries as appropriate. The UB Libraries operate a virtual reference service called Instant Librarian, available 24/7, as well as an email reference service with a one business day response time. In-person research consultations with the Engineering Librarian and Computer Science Librarian are available by appointment. As additional courses are being offered online, the librarians are also available for virtual consultations using Zoom or WebEx.

Collection Development

The Engineering and Computer Science Librarians select materials in consultation with SEAS faculty. Materials are purchased to support the teaching and research needs of the individual departments and faculty. Faculty and students are encouraged to make recommendations, and books requested by them are routinely purchased. Monographs are also selected by the Engineering and Computer Science Librarians in their respective areas. In addition, the UB Libraries are moving rapidly to an on-demand approach to collection building, purchasing books and other materials requested through interlibrary loan based on cost/use ratios and also loading tens of thousands of e-book titles into the catalog for patron discovery and use, with purchase of an e-text triggered after a certain number of multiple uses. Journal titles are added to the collection at the recommendation of faculty and after review by the departments.

Library Instruction/Information Literacy

The Engineering and Computer Science Librarians provide instruction in the use of library and other information resources to SEAS faculty, students, and staff. This includes one-on-one training, hands-on instruction in the classroom and/or lab, invited lectures, seminar presentations, development of course-specific online guides, and integration of information resources into UBLearns (Blackboard), the university's course-management system.

The library plays an active role in the ENG 105 course, which is the first of two required courses in the Communication Literacy sequence of the UB Curriculum. Communication Literacy recognizes that students communicate in a diverse world that is at once textual, digital, and highly visual. ENG 105 establishes strong foundations in writing, rhetoric, and oral and visual communication, while developing strategies to organize, evaluate and manage enormous quantities of information. The team of Education Services Librarians assist with ENG 105 by teaching significant portions of the course. Relevant course outcomes include the ability to:

- Locate, evaluate, synthesize and manage information (text, visuals, media) effectively and ethically.
- Analyze how information is created, disseminated and used in a constantly evolving information environment.

Instructional and outreach programs for SEAS students this past year have included workshops on EndNote (the UB supported citation management software), as well as topics such as patent searching and technical standards. The Engineering Librarian also co-hosted a panel event in the fall 2019 with the UB Blackstone LaunchPad Powered by TechStars which focused on entrepreneurship. The UB IEEE Innovation & Entrepreneurship Panel Seminar was sponsored and created by IEEE; the panel featured speakers from SEAS, the Law School, the UB Technology Transfer Officer, a local alumnus and entrepreneur, and the Engineering Librarian.

In addition, the Engineering Librarian conducts in-person guest lectures for the required SEAS courses: EAS 199 (a freshman seminar course) and EAS 198 (a course for transfer students). The Engineering Librarian also developed library resource instruction modules for the required EAS 360, STEM Communications course. Each of the four modules covers a different resource and is no longer than 12 minutes in length. Resources covered include the UB Libraries Everything Search (which includes the library catalog as well as other e-resources), the Engineering Village database, Applied Science and Technology Source (an EBSCOhost database), and patent searching. EAS 360 students complete an in-class quiz based on the information presented in the modules; the quiz is required and counts toward their overall participation grade in the course. Students have noted they enjoy the library resource instruction modules being available online, so they can readily access them when conducting library research for other assignments or classes.

Document Delivery

The UB Libraries' Delivery+ service allows faculty and students to request any item from any UB library, including our print and electronic collections, and the item will be delivered to them within one business day, with journal articles and book chapters scanned as PDFs and sent electronically and books retrieved and sent either directly via campus mail to faculty or held at the designated library Circulation Desk for students. If the UB Libraries do not own an item, it is requested from one of the thousands of academic libraries with which we have reciprocal borrowing agreements; those items are typically received within three to seven business days, for physical items, and two to three business days for electronic items (i.e. articles or book chapters).

Hours

During the regular academic year, the Science & Engineering Information Center in Lockwood Library is open 88 hours each week (the schedule varies by day, with Monday through Thursday being open from 8am to 12 midnight). Faculty and students also have access to real-time interactive reference assistance via the UB Libraries' 24/7 chat service as well as an email reference service with a 24-hour response time. In-person, individual consultations can also be scheduled at the convenience of the requestor.

Study Space

Lockwood Library (in which the Science & Engineering Information Center is located) has six floors and a total seating capacity of approximately 1,130. The seats are distributed among casual seating, classroom seating, open individual study carrels, group study rooms, and public computer workstations, several floors of individual quiet study area, and a large designated group study area located on another floor from the quiet floors.

In addition, Silverman Library, also located on the North Campus, underwent an extensive renovation in 2016. The completion of Silverman Library is the first milestone of the Heart of the Campus initiative. The $7.2 million renovation transformed the 45,000-square-foot space into a vibrant, state-of-the-art, intellectual hub for the campus. The space has seating to accommodate 880 people including a grand reading room, 17 group study rooms, two classrooms, group study alcoves, one hundred public computing stations, and two video recording studios with media editing stations.

Other Learning Resources

The University Libraries' Map Collection located in the Science & Engineering Information Center in Lockwood Library contains over 450,000 maps; 6,000 aerial photos; and 500 atlases covering all regions of the world, with emphases on Buffalo and Erie County, New York State, the United States, and Canada. Most of the maps in the collection have been cataloged and are included in University Libraries' online catalog. In addition, many maps have been digitized and are available on the Libraries' website. Map-related reference assistance, including online searching and cartographic interpretation, is available. Class instruction and research workshops also are provided upon request. The Map Collection is open during normal Lockwood Library hours.

Student self-reported usage of the library spaces and website is very good, with a noticeable increase in use by undergraduate students (across all disciplines) when comparing a 2013 user survey to the latest 2017 user survey results (see Table 7-3.).

Table 7-3. Undergraduate students indicating "at least weekly use of library spaces or library website"

Undergraduate year	**Year of survey**	
	2013	**2017**
Freshmen	58.3%	86.8%
Sophomore	62.6%	83.5%
Junior	67.3%	87.2%
Senior	64.5%	81.7%

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

Describe the leadership of the program and discuss its adequacy to ensure the quality and continuity of the program and how the leadership is involved in decisions that affect the program.

The MAE Department Chair, Dr. Francine Battaglia, (who took over from Dr. Kemper Lewis on May 1, 2020) is the Chief Administrative and Academic Officer of the Department. Professor Lewis served as Chair of the Department for six years, while Professor Battaglia comes with leadership experience as SEAS Acting Associate Dean for Faculty Affairs. The Department Chair oversees budgets, staff, teaching assistants (TAs) and graders, teaching assignments, space management, and faculty evaluation. The MAE Graduate Programs are under the direction of Dr. David Salac. The Undergraduate Programs are led by separate Directors for the Aerospace (Dr. Matthew J. Ringuette) and Mechanical (Dr. Robert C. Wetherhold) Engineering Programs. Both Directors work with the MAE Undergraduate Studies Committee (UGSC) to articulate policies and procedures, and to oversee student advisement, course development, open houses, documents, manuals, ABET processes, and Program requirements. They also are the interface with the faculty members on Program–related matters. They represent the Department at the School level as members of the SEAS Undergraduate Academic Programs Committee (APC).

The four individuals (i.e., Chair, Director of Undergraduate Studies in Mechanical Engineering, Director of Undergraduate Studies in Aerospace Engineering, Director of Graduate Studies) form the MAE Executive Committee. These are the primary decision makers for the Department and the points of contact to the remainder of the School and University. The Executive Committee also works closely with the MAE Department Advisory Board (DAB), chaired by Robert Harrison (Transmissions Developers, Inc.). The MAE DAB, which consists of outstanding individuals from industry and academia, provides broad insight, advice and advocacy for the Department. The DAB has two meetings per year: a two-hour teleconference strategic overview in the fall semester and one full-day tactical meeting in person in Buffalo, supplemented by occasional conference calls to discuss significant issues. A significant portion of each meeting is devoted toward the continual improvement of our undergraduate programs. The DAB has advocated strongly for reduced student-to-faculty ratios and class size, both of which have been addressed in the past few years. The current DAB membership is displayed in Table 8-1. We count ourselves very fortunate to have the contributions from this accomplished group, all dedicated to enhancing our programs.

Table 8-1. MAE Department Advisory Board

Name	Title	Employer
Dr. Mark Glauser	Professor	Syracuse University
Mr. Robert Harrison	Vice President of Engineering & Construction	Transmission Developers, Inc.
Dr. Daniel Inman	Professor, Aerospace Engineering	University of Michigan
Mr. Glenn Meyers	Vice President	AAR Aircraft Components Services NY
Ms. Allison O'Connor	Business Unit Operations Lead	Moog
Mr. James van Oss	Aerospace and Defense PLM	Moog
Dr. Andreas Polycarpou	Department Head & Meinhard J. Kotzebue Professor	Texas A&M University
Mr. Brian Rothery	Partner	Scully, Scott, Murphy and Presser PC
Mr. Timothy Sopko	Chief Executive Officer	Taylor Devices, Inc.
Mr. John Vanderhoef	Chief Executive Officer	Mechanical Dynamics & Analysis
Dr. Lesley Weitz	Principal Simulation Modeling Engineer	The MITRE Corporation

B. Program Budget and Financial Support

1. *Describe the process used to establish the program's budget and provide evidence of continuity of institutional support for the program. Include the sources of financial support including both permanent (recurring) and temporary (one-time) funds.*
2. *Describe how teaching is supported by the institution in terms of graders, teaching assistants, teaching workshops, etc.*
3. *To the extent not described above, describe how resources are provided to acquire, maintain, and upgrade the infrastructures, facilities, and equipment used in the program.*
4. *Assess the adequacy of the resources described in this section with respect to the students in the program being able to attain the student outcomes.*

Institutional Support for the Program

The University at Buffalo has three primary fiscal agents: New York State, the Research Foundation of the State University of New York (known as RF), and the UB Foundation (known as UBF).

The School of Engineering and Applied Science's base budget, like all units at UB, is based on a set of historical agreements between past Deans and Provosts. In more recent years the units within UB were given more autonomy and if they grew their enrollments, they were able to receive a share of marginal tuition revenues generated from the growth. Tuition rate increases are not directly shared with the units but there is an annual resource planning process where units can ask senior leadership for investments in various initiatives.

Departmental budgets are mostly formulaic, based on the measures of total credit hours taught, and PhDs graduated (three-year average), and are set by the Dean of the School of Engineering and Applied Sciences. In addition to instructional support, units receive 12% of their indirect cost revenues from research. These funds are given at the school level and a portion is allocated to the departments. These funds from the Indirect Cost Recovery or ICR are shared between the Dean's Office and Departments with 1/3 being distributed to departments. Faculty who have grants can earn Income Fund Reimbursable (IFR). IFR are a means by which departments and units charge grant awards for the salary and fringe benefits of University at Buffalo personnel who are: 1.) devoting compensated effort to the grant; 2.) and are paid from either the State appropriated operating budget or income fund reimbursable accounts (IFR). The funds are typically split equally between the faculty member and the department. Funds received from ICR and IFR assist the department in meeting operating costs and start-up commitments.

Departments also receive a share of the summer course revenue (SUTRA), once they have met their historic target for summer course revenue generation. These funds support faculty and TA salaries to support instructional activities during the summer and winter months and are also utilized for lab upgrades and other instructional costs, as needed, during the academic year.

Finally, philanthropic funds are generated that might have a specific donor intention (therefore may live at the Department or Dean's level depending on donor wishes) or are given at the discretion of a Chair or the Dean. Again, this would dictate where these funds go and how they are used.

To provide a current snapshot of departmental funding, sources of support are quantified in Table 8-2 for the past three academic years. The budget model principally allocates resources to the departments in the school based on: a) credit hours taught (65%), and b) PhDs graduated - three-year moving average (35%). This budget model, which is driven by need and incentive, is supportive of the academic programs in the departments in the School.

As our faculty size grew and as senior faculty members retired and were replaced, there has been a major need to secure funds for startup packages. In recent years, these funds have come from multiple sources, including UB2020 initiatives, SUNY High Needs programs, SEAS operating budgets, MAE resources accumulated from allocations provided by the National Science Foundation to compensate for MAE faculty serving as Project Directors, and philanthropic gifts. We have been aggressive in exploring the various possibilities. Such an approach will likely be needed to continue the growth process.

Table 8-2. Summary of Sources of Financial Support

	Academic Year		
Source	**17/18**	**18/19**	**19/20**
State	$73 k	$41 k	$224 k
ICR	$35 k	$33 k	$37 k
Instructional Support	$992 k	$999 k	$944 k
Summer tuition revenue share (SUTRA)	$103 k	$74 k	$133 k
Other UBF IFR	 $35 k $30 k	 $50 k $57 k	 $68 k $166 k
Total	$1268 k	$1254 k	$1572 k

Institutional Support for Teaching

To assist the departments in making PhD level Teaching Assistant offers and hires, the School of Engineering and Applied sciences makes approximately $7.5M available for Teaching Assistant stipends and tuition scholarships. Departments earn a share of this money based on two factors, % of credit hours they teach (both UG and Grad) and the average number of PhDs they graduate as a % of the whole over a three-year term. This money is distributed to the departments and managed locally to provide instructional support in terms of graders, undergraduate and graduate student assistants and teaching assistants.

The MAE budget varies each year, as can be seen from Table 8-3, which categorizes the budget allocations since the previous self-study and also includes the corresponding undergraduate and graduate enrollments for those years. Notice the significant increase in student numbers and the shift in resource allocations from discretionary funds to support for faculty and lecturer salary expenses.

A major portion of the discretionary funds is directed toward supporting Teaching Assistants (TAs) and Graders to assist in our undergraduate programs. The TA appointments are almost exclusively awarded to PhD students in our programs, with a mix of incoming first year doctoral students and others who have successfully completed their Qualifying Exams. In addition to the stipend, all TAs are provided full Tuition Scholarships (TS) from a fund that is provided to the Department as part of our overall budget from the Dean. To further support PhD students who enjoy teaching and are considering a career in academia, MAE developed a PhD Teaching Fellows program for selected PhD students to teach summer courses; the program began in Summer 2015. Due to the increased need to support instructors further, undergraduate students are employed as Undergraduate TAs (UGTAs), and this new opportunity began in Spring 2020. The UGTAs are able to hold office hours and coordinate with the graders, and are proving to be a valuable resource. The TS allocations are included in Table 8-3, as a separate category, because there is no flexibility in how this is spent. The overall number of TA positions and the mix between new and continuing students is decided each year by the MAE Chair in consultation with the Director of Graduate Studies. In this process, the key considerations are the MAE discretionary budget allocation, the number of commitments of TA positions to junior faculty as part of their startup package and the assistance needed to support properly our undergraduate courses. The variability in the rates of acceptance of our TA offers to new students has caused some budget challenges in recent years. However, through this same period, the increased use of Graders has allowed us to maintain the quality of our undergraduate programs.

Resources to Support Facilities and Equipment

The School provides funds to upgrade and maintain departmental undergraduate teaching labs. The total budget is allocated to each department depending on 1) the number of accredited programs offered by the department and 2) the number of students, relative to the total number of undergraduate students in the school. The portion of this commitment relating to computing hardware and software comes directly from the Technology Fee assessed to each undergraduate student. The remainder is supported by the Dean, along with a 20% overall match from the department discretionary budget. Funding amounts for the past 3 years are shown in Table 8-4.

Since the previous ABET review, these funds have allowed us to make significant improvements in our laboratories. The continuation of this dedicated funding will further that trend in providing our students with a quality experiential learning environment. For example, the SEAS Dean was able to secure approximately $45 k for a major upgrade to 1019 Furnas. The department cost shared $5 k for this facility, which is a primary teaching facility for all MAE undergraduate students. The upgrades were a complete rehab of the space including the HVAC system, paint, wiring and projection technologies.

Table 8-3. MAE - Summary of Students and Faculty

Fiscal Year	14-15	15-16	16-17	17-18	18-19	19-20
Undergraduate Students	1073	1069	1057	1122	1234	1399
Graduate Students	258	219	230	210	200	256
Ladder Faculty	29.5	29.5	27.5	31.5	33	32
Full-time Lecturers/Instructors	4	5	5	8	9	9
Full-time Staff	5	5	6	10*	10*	10*
Teaching Assistants	58	60	81	93	99.5	81
PhD Teaching Fellows	3	5	4	2	4	4
Graders	67	98	111	115	113	123

Undergraduate TAs	N/A	N/A	N/A	N/A	N/A	30
Ladder Faculty Salaries	$2860 k	$3460 k	$3185 k	$3450 k	$4052 k	$4105 k
Lecturer/Instructor Salaries	$540 k	$540 k	$540 k	$630 k	$720 k	$720 k

* Includes three additional full-time Engineering Machine Shop staff members

Table 8-4. Summary of Laboratory Spending Budget

	Academic Year		
Source	**17/18**	**18/19**	**19/20**
School	$57,400	$60,100	$45,700
Department match	$15,800	$15,300	$13,700
Total	$73,200	$75,400	$59,400

Resources to Support Student Outcomes

The University also provides support for the five Student Clubs associated with the Department, including AIAA, ASME, SAE, SEDS and UB Robotics. All of these clubs provide an important avenue for our students to enrich their educational experience and to participate in intercollegiate competitions. Each club receives financial support every year from the UB Student Association. Meanwhile, club space is provided by MAE and SEAS, primarily in Jarvis and Bell Halls. Planning is underway for a new engineering building with a focus on undergraduate education. This building is envisioned to provide prime space for all of our student clubs.

With the increasing interest in engineering and the affordability of a UB education, we are challenged constantly to match resources with this demand. However, SUNY2020 legislation has directed increasing resources to UB and, in turn, has provided the opportunity to grow our ladder faculty, to employ full-time lecturers and to add departmental staff, especially to assist with our large undergraduate programs and the UB Finish in Four initiatives. Overall, the resources provided are adequate to support our undergraduate programs and to attain the desired student outcomes.

C. Staffing

Describe the adequacy of the staff (administrative, instructional, and technical) and institutional services provided to the program. Discuss methods used to retain and train staff.

All personnel expenses are managed by the Dean's Office. All faculty and staff salaries are in accounts that are funded and maintained by the Dean. Departments do not manage these funds directly and work with the Dean on hiring and turn over / succession plans.

The MAE Staff members who report to the Department Chair are listed in Table 8-5, along with their primary duties. The full-time administrative staff is also supported by several part-time and work-study students. All staff members are highly capable and work well together. Numerous opportunities are provided throughout the year for training related to various elements of their jobs. In addition, staff members are eligible to take UB courses and are provided flexibility in their schedule to pursue these interests. Several of our MAE administrative staff members do take advantage of these opportunities each semester.

Beginning in early 2014, the engineering Machine Shop personnel now report to MAE and are included in Table 8-5. These individuals report directly to Dr. Joseph Mollendorf, an MAE Professor, who serves as the Supervisor of the newly refurbished Engineering Machine Shop. We also have central technician and machine support for undergraduate laboratories and student projects. One additional lab technician (Mr. Dan Cook) reports directly to the Director of Administration, David Love.

Institutional staff support for Library and Computing Services are quite good and are described in detail under Criterion 7. Erin Rowley, Engineering Librarian, and Jason Lasker, Director, Science and Engineering Node Services, provide the liaison, respectively, from these two service organizations to MAE Faculty, Staff and Students. Both are very supportive of our educational mission.

Table 8-5. MAE Departmental Staff, Position, Source of Funding and Duties

Name	Position	Source of Funding	Duties
David Love	Director of Administration	State	Assists Executive Committee (Chair, Graduate Director, Undergraduate Directors) in day to day operations including personnel matters, budget concerns, and course scheduling. Assists Undergraduate Directors and Graduate Director with student affairs (forced registration, curriculum changes, course approval)
Stephen Hart	Facilities Coordinator	State	Responsible for the oversight of space within MAE. Tracking of keys, setting up department labs for research, teaching and instruction.
Andrew Fogelsonger	Undergraduate Coordinator	State	Provides advisement to undergraduate students. Coordinates the course scheduling and organizes ABET and undergraduate studies committee.
Rosemary Lombardo	Graduate Coordinator	State	Assists Graduate Director in all functions related to the graduate programs from the onset of the application process through the graduation process independently maintains/updates student files, monitors/advises students on filing dates, processes all forms associated with graduate student administration, i.e. assistantships, tuition, fellowships.
Marty Fye	Administrative Assistant	State	Primary contact for faculty affairs including appointment paperwork, summer appointment paperwork. Administers the faculty hiring process in conjunction with the hiring committees.
Marge Hewlett	Senior Staff Assistant	State	Assists the Chair and faculty with clerical support for day to day operations, including paperwork for all budgetary operations involving travel, state, and research reimbursements.
Kelsey Trautwein	Business Analyst	State	Manages Faculty startup and guides new faculty through initial lab set up and student appointment requests. Also assists with department reporting.
Michael Bellotti	Research Analyst	State	Supports faculty with their research awards and provides administrative support for purchasing, hiring and summer salary appointments. Responsible for research student appointments.
Dan Cook	Laboratory Technician	State	Supports instruction and research.
Gary Olson	Laboratory Equipment Designer	State	Supports instruction and research in the Engineering Machine Shop. Reports directly to Dr. Mollendorf, Professor and Director of Engineering Machine Shop.

D. Faculty Hiring and Retention

1. Describe the process for hiring of new faculty.
2. Describe strategies used to retain current qualified faculty.

Over the past six years, MAE has hired ten (ladder) faculty members, plus eight teaching faculty, and expect to add three more hires by the Spring 2021 semester. MAE was fortunate to be in the position to hire when many other universities were not and, as a consequence, has been able to recruit outstanding people, mostly at the Assistant Professor level.

Each Fall, the School notified departments that they have the opportunity to recruit faculty candidates, although the exact number of positions to be filled was not known until later in the academic year. Consequently, our approach has been to create general advertisements covering several of our major thrusts: Computational and Applied Mechanics; Design and Optimization; Dynamics, Control and Mechatronics; Fluid and Thermal Sciences; Materials; and Biomechanics. This has allowed us to identify outstanding candidates across a broad range of disciplines.

The process begins by selecting Search Committee Chairs in each of the areas being addressed and then developing the detailed advertisements for Academic Keys and the UBjobs website. The UBjobs posting must be approved at the department and school level, as well as by UB Human Resources. The composition of each Search Committee is proposed by the Committee Chair, with final approval by the MAE Chair. Typically, we have several hundred applicants, which are parsed to the individual Search Committees, where an initial short list of perhaps eight to ten candidates is recommended for phone interviews. From that pool, three or four are selected for on-campus interviews. At every stage of this selection process, we are cognizant of the importance of identifying qualified candidates that may strengthen the diversity of our faculty.

Each on-campus interviewee must be approved by the MAE Chair and SEAS Dean and thus requires receipt of at least three letters of recommendation. The on-campus interview consists of meetings with the SEAS Dean (or Associate Dean), MAE Chair and Search Committee, along with other interested faculty members and graduate students. The research seminar is, of course, a key piece to the overall interview. However, the individual meetings and breakfast, lunch and dinner gatherings are also important, as an effort is made to involve the entire MAE faculty in the process.

Each Search Committee makes their recommendations at an MAE Faculty meeting and a vote is taken by secret ballot. The MAE Chair then makes a recommendation to the SEAS Dean, who ultimately decides whether or not to make offers, after our hiring proposal is approved by Human Resources. On occasion, an additional recommended candidate may also be offered a position, especially when there is a match with ongoing UB2020 initiatives. In all cases over the past six years, Human Resources and the Dean have approved our hiring recommendations. Afterwards, the negotiation of startup and salary is conducted by the MAE Chair within guidelines established by the Dean. Startup has been funded through various combinations of Department, School and University funds. We have been fortunate to attract nearly all of the selected candidates, including four females, who raise the total women faculty members in MAE to eight, which is 20% of our faculty, well above the national averages for ME and AE programs. Efforts to improve diversity by recruiting faculty from other under-represented groups in engineering remain a challenge.

Spousal accommodation has become increasingly important in the hiring process and for retention. The Office for Faculty Affairs at the Provost level and the SEAS Dean's office do provide a collaborative program to assist with recruiting, when the spouse or significant other is also qualified to become a faculty member, perhaps in a discipline outside of engineering. When this is the situation, usually a good solution can be found. Sometimes, a second faculty position is not necessary, but rather a professional position in the Western New York region. In this situation, we turn to our industry networks including our MAE Department Advisory Board and the Dean's Advisory Council for help.

The more general issue of retention is critical to maintaining quality and continuity of our programs. The new UUP contract that controls faculty across-the-board and discretionary raises has been helpful after not having a contract for a number of years. We currently have mandated 2% salary raises each year with a discretionary pool of funds for additional merit-based raises. This certainly could help with retention. Of course, another way to retain high quality faculty members is to create a proper environment and institutional and departmental culture that encourages outstanding individuals to stay. This is always a work in progress, but with some very positive steps forward in recent years.

E. Support of Faculty Professional Development

Describe the adequacy of support for faculty professional development, how such activities such as sabbaticals, travel, workshops, seminars, etc., are planned and supported.

Faculty and staff are encouraged to participate in professional development throughout the year. The university provides multiple professional development options for staff with Human Resources and all of these are free to staff.

Faculty are supported with sabbaticals if the unit involved can cover the teaching load without that faculty member either for the year or for a semester. SEAS cover the faculty salary at 100% for a semester sabbatical and 50% if the sabbatical is for a year. The faculty member provides a narrative of the work that will be related to their research while on sabbatical, any travel involved, collaborations, and additional salary if applicable. When the faculty member returns they are required to submit a report within six months of returning to the University of how the sabbatical created opportunities of growth and development for the faculty and the unit as a whole.

Non-ladder track faculty have opportunities to apply for internal funding to help support instructional needs they may have including teaching materials, conference attendance, and student opportunities. Tenure track faculty are supported with start-up funding to attend research and/or teaching conferences, pay for society memberships, and travel as necessary for their research.

We encourage faculty development over a broad range of activities, including engagement in federally funded research programs, participation in and organization of international conferences, partaking in career development workshops for our junior faculty members, interaction with industry in projects initiated through The Center for Industrial Effectiveness (TCIE) and through workshop and training sessions provided by the UB Center for Education Innovation (CEI). We provide support for some of these activities, especially for junior faculty members. Faculty members can request Department support for specific purposes, such as research development, travel or participation in local (UB) educational programs, including those offered through CEI.

The Department also organizes the MAE Seminar Series with weekly speakers throughout the academic year including an Engineering Leadership Series where we host department chairs/heads from around the nation. Also, in the past two years, we have conducted over thirty on-campus interviews in total to recruit our new faculty members. These seminars, which are in addition to our weekly MAE Seminar Series, also have allowed us to become better informed on a range of the latest research thrusts across our disciplines and, thus, have also contributed significantly to MAE faculty development, although this was not the primary purpose.

PROGRAM CRITERIA

Describe how the program satisfies any applicable program criteria. If already covered elsewhere in the Self-Study Report, provide appropriate references.

From the *2020-2021 Criteria for Accrediting Engineering Programs*, here are the program criteria:

PROGRAM CRITERIA FOR MECHANICAL AND SIMILARLY NAMED ENGINEERING PROGRAMS

Lead Society: American Society of Mechanical Engineers (ASME)

These program criteria will apply to all engineering programs that include "mechanical" or similar modifiers in their titles.

1. Curriculum

The curriculum must require students (1) to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations);(2) to model, analyze, design, and realize physical systems, components or processes; and (3) prepare students to work professionally in either thermal or mechanical systems while requiring topics in each area.

2. Faculty

The program must demonstrate that faculty members responsible for the upper-level professional program are maintaining currency in their specialty area.

The University at Buffalo's ME program satisfies these program criteria; this has been covered elsewhere in this self-study report, as given below.

1. Curriculum: The following table shows how the three items in the ASME Program Criteria are supported by the required courses in the program.

significant coverage partial coverage

	(1) Apply principles of engineering…	(2) Model, analyze, design…	(3) Prepare students to work professionally…
EAS 199 UB Seminar			
MAE 177 Introduction to CAD			
MAE 204 Thermodynamics I			
MAE 277 Intro. to Mech. Eng. Practice			
MAE 335 Fluid Mechanics			
MAE 340 Dynamic Systems			
MAE 376 Applied Math for MAE			
MAE 381 Eng. Materials			
MAE 311 Machines & Mechanisms			
MAE 334 MAE Lab I			
MAE 336 Heat Transfer			
MAE 364 Manufacturing Processes			
MAE 345 Intermediate Dynamics			
MAE 377 Product Design in a CAE Env.			
MAE 385 Eng. Materials Lab			
MAE 338 MAE Lab II			
MAE 451 Design Process & Methods			
MAE 494 Design Project			

2. Faculty members responsible for the upper-level professional program are maintaining currency in their specialty area. This has been demonstrated elsewhere in this self-study report, as given below.
    a. The faculty vitae found in Appendix B demonstrate the commitment of faculty to continuing research supervision, publications, and presentations.
    b. The breadth of technical electives whose syllabi are given in Appendix A demonstrate the commitment of faculty to offering new material to students.

    c. The level of activity shown by faculty in professional organizations, professional development, and consulting is given in Table 6-1: Faculty Qualifications. This demonstrates that a large number of faculty are making the effort to remain current in their field.

ACCREDITATION POLICIES AND PROCEDURES MANUAL

Describe how instructional and learning environments used by the program (including facilities, tools, and equipment) are safe for their intended purposes. (See the 2020-2021 APPM section I.E.5.b. (1).) Examples of information may include efforts to keep laboratories clean and free of hazards, student training, personal protective equipment used by students, safety policies and procedures, enforcement of safety policies, and routine safety inspections.

Overall Responsibilities: Safety is a high priority for SEAS and the MAE Department, and several actions are taken to ensure this for our students in our teaching laboratories, computer labs, other instructional spaces, and the SEAS machine shop. Regarding teaching laboratory spaces, these are inspected yearly by staff from UB's Environment, Health, and Safety (EH&S) Department. The inspection covers: housekeeping, chemical hygiene, PPE use, hazardous waste management, fire safety and flammable storage, EPA rules related to labeling, etc., mechanical hazards, electrical safety, review of SOPs, door signage and proper hazard ID, and specialty items like fall protection, ladders, 70E, etc. During these inspections, EH&S makes it clear to the lab instructor, aided by the departmental facilities coordinator, that it is their job to keep the labs clean, train TAs and undergraduates as needed, provide PPE, and author SOPs and policies for their labs. The EH&S Dept. will help with that effort and review any of these materials. If problems are discovered, they are addressed within a short time window and compliance is verified by EH&S if necessary; this ensures that hazards are minimized in our instructional labs. Additionally, periodic visits from the local fire marshal occur to ensure compliance with fire safety rules, and the fire extinguishers are inspected regularly. Teaching labs are locked with keys or a swipe-card system to ensure that only authorized personnel have access.

Signage: Outside of the lab doors the appropriate EH&S hazard warning signs are placed, depending on e.g. the chemicals and fire hazards present in the lab. The written safety rules are posted conspicuously in each instructional laboratory space, and include stipulations such as no food or drink and no "horseplay."

General Safety Rules and Precautions: At the start of each lab course, general safety rules are reviewed by the instructor and compliance is required of students or they are not allowed to participate in the lab experiments. All labs are run with at least one instructor or TA present; students do not perform the labs unsupervised. At the beginning of the semester, the TAs are advised of the lab safety protocols by the instructor and told what to do in the event of an issue. The use of personal protective equipment (PPE) such as protective eyewear, gloves, and lab coats is implemented on an as-needed basis for individual experiments; the PPE are available in the lab. For the teaching wind tunnel, used in the MAE 339 Aerodynamics Lab, hearing protection is available for students who would like it.

A chemical spill kit is available in labs where chemicals are used per EH&S policy. In the event of a dangerous spill, students and personnel will be evacuated and the UB emergency number called immediately; EH&S will handle the cleanup in any such situations.

Within each lab or close by in the outer hallway is an accessible eyewash station in the event of an accident; students are alerted to these and shown how to use them at the start of the semester. First aid kits are also present in each lab to handle very minor injuries; for anything beyond this, the UB emergency number is called immediately so that emergency medical care can be provided. Each teaching lab has a fire extinguisher.

Lab-Specific Safety Rules and Precautions: Regarding the safe use of equipment and conducting experiments, first the instructor trains the TAs on the laboratory equipment and stations either prior to the start of the semester or before the start of each lab; safe use and potential hazards are a prime focus. Next, once the semester begins or prior to a given experiment, the students are given a lab manual to first learn about the equipment/experiment at home. In the lab, before using any equipment or performing an experiment, the students receive instruction and often a demonstration from the course professor or TA, telling them about the technical operation and warning them of possible safety issues specific to that experiment and how to avoid them and protect themselves. These actions ensure that students are well-prepared before engaging in any hands-on lab activities.

Other Labs and Spaces: All shared SEAS computer-lab spaces for undergraduate education and use have a “no food or drink” policy.

For SEAS student spaces emphasizing hands-on work, namely the Design Studio (416 Bonner Hall), Digital Manufacturing Laboratory (118 Bonner Hall), and Electronics Tinkering Laboratory (104C Jarvis Hall), no special safety procedures are required. The graduate assistants that oversee the Tinkering Lab have received the EH&S safety training, in the event that an issue arises.

All engineering students who wish to use the SEAS Machine Shop (105 and 111 Jarvis Hall) for research, class projects, or club projects must take and pass the Engineering Machine Shop online safety certification course. Access to the machine shop is restricted to those who have passed the safety certification course and is controlled by swipe access using the student’s UB card. It contains two areas: the main shop and student shop. Once inside, students are required to wear safety glasses at all times. A second swipe is required to access the main shop where there are always qualified technicians on duty. After hours, the main shop is closed; however, at this time the student shop is staffed by trained Student Shop Supervisors.

All spaces mentioned above are regularly cleaned by custodial staff. Additionally, each summer SEAS holds a “clean-out week” for which all spaces can conveniently dispose of many kinds of items and equipment that take up room, are damaged, or obsolete. This yearly process is quite successful at keeping clutter to a minimum which also adds to safety. For teaching laboratory spaces, at the end of each lab session students are instructed to clean up their stations and the TA and instructor have a final pass at cleaning and keeping the environment free of e.g. tripping hazards.

It is anticipated that additional cleaning requirements for teaching and computer labs will be required in the fall due to the COVID-1 pandemic. UB is in the process of establishing rules for cleaning research labs (Summer, 2020).

APPENDIX A – COURSE SYLLABI

MTH 141 College Calculus I

Credit Hours: 4

Contact Hours: Lecture – 3 hours per week; Recitation – 1 hour per week

Coordinator: Prof. Michael Rosas, Dept. of Mathematics

Textbooks and Other Materials:

Required: J. Stewart, Calculus: Early Transcendental Single Variable, 8th custom UB ed.

Catalog Description: Beginning of a three-semester sequence in calculus for students of mathematics, natural sciences, and engineering. Covers differentiation and integration with applications. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade other than W may repeat the course in the summer or winter; or only in the fall or spring semester with a petition to the College of Arts and Sciences Deans' Office. To help students achieve greater success, all new UB students are required to complete the ALEKS math assessment tool. New and continuing UB students seeking to enroll in MTH 141 must complete the ALEKS assessment tool within the last 12 months and achieve a required score of 76 as a prerequisite. (ALEKS is not required in Summer/Winter).

Pre-requisite(s): Trigonometry or Regents Course III Required. Students must score at least 76 on ALEKS to enroll,

Co-requisite(s): None

Role in Curriculum: Required Course (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Define the limit of a function at a point	HW # 1, 2, 3 Midterm 1 Final Exam
2. Evaluate limits using the definition and using algebraic properties of limits	
3. Evaluate limits of functions at infinity and interpret them as horizontal asymptotes	
4. Define continuity and determine whether or not a function is continuous at a point and on an interval	
5. Recognize exponential, logarithmic, and inverse trigonometric functions, sketch their graph and use their basic properties in computations	HW #4, 5 Midterm 1 Final Exam
6. Define derivative and interpret it as the slope of a tangent to the graph of a function	HW #4, 6, 7, 8

7. Compute derivatives of polynomial, exponential, logarithmic, trigonometric, and inverse trigonometric functions	Midterm 2 Final Exam
8. Compute derivatives using derivative rules, including the chain rule and implicit differentiation	
9. Use derivatives to compute linear approximations of functions	HW #8, 9, 10,
10. Find critical points, minima and maxima of a function using its first and second derivatives	11 Midterm 2 Final Exam
11. Use derivatives to solve optimization problems	
12. Use derivatives to sketch graphs of functions	
13. State the mean value theorem and apply it in computations	
14. Apply L'Hospital's rule to compute limits of functions	
15. Use derivatives to solve practical problems involving rectilinear motion	
16. Find the area of a region bounded by a curve and the x-axis using rectangles and limits	HW #11, 12 Final Exam
17. Find the area of a region bounded by a curve and the x-axis using indefinite integrals and the fundamental theorem of calculus	
18. Use integrals to solve practical problems involving rectilinear motion	
19. Choose appropriate methods or models for a given problem, using information from observed or deduced data and knowledge of the system being studied.	HW #1-12 Midterm 1 Midterm 2 Final Exam
20. Employ quantitative methods, mathematical models, statistics, and/or logic to solve real-world problems beyond the level of basic algebra.	
21. Identify common mistakes and/or limitations in empirical and deductive reasoning, and in mathematical, quantitative, and/or logical problem solving.	
22. Interpret mathematical models, formulas, graphs, and/or tables, to draw inferences from them, and explain these inferences.	

Course Topics:

1. Exponential functions
2. Linear approximation and differentials
3. Limit of a function
4. Maxima and minima
5. Chain rule
6. The mean value theorem
7. Definite integral
8. Indefinite integral
9. Fundamental theorem of calculus
10. Continuity
11. Substitution rule
12. Derivative
13. Hyperbolic functions
14. Implicit differentiation
15. L'Hopital's rule
16. Polynomial
17. Precise definition of a limit. infinite limits
18. Distances
19. Areas
20. Calculating limits using limit laws
21. Product rule
22. How derivatives affect the shape of a graph
23. Limits at infinity: horizontal asymptotes
24. Inverse trig functions

MTH 142 College Calculus II

Credit Hours: 4

Contact Hours: Lecture – 3 hours per week; Recitation – 1 hour per week

Coordinator: Prof. Michael Rosas, Dept. of Mathematics

Textbooks and Other Materials:

Required: J. Stewart, Calculus: Early Transcendental Single Variable, 8th custom UB ed.

Catalog Description: Differentiation and integration of transcendental functions; infinite sequences; series and power series; integration methods; additional topics in analytic geometry. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade other than W may repeat the course in the summer or winter; or only in the fall or spring semester with a petition to the College of Arts and Sciences Deans' Office.

Pre-requisite(s): MTH 141

Co-requisite(s): None

Role in Curriculum: Required Course (Math and Science)

<table>
<tr><td>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</td><td>Assessment Tools</td></tr>
<tr><td>1. Interpret the area enclosed between curves as a definite integral and compute its value</td><td rowspan="2">HW #1, 2
Midterm 1
Final Exam</td></tr>
<tr><td>2. Express the area of a surface of revolution as a Riemann sum of rings, convert it to a definite integral form and compute its value</td></tr>
<tr><td>3. Compute indefinite and definite integrals using integration by parts, by substitution (including trigonometric substitutions) and using decomposition of rational expressions into partial fractions</td><td>HW #3, 4
Midterm 1
Final Exam</td></tr>
<tr><td>4. Determine convergence of improper integrals with discontinuities in their domain or with infinite limits of integration and compute their values</td><td rowspan="2">HW #6
Midterm 2
Final Exam</td></tr>
<tr><td>5. Approximate values of definite integrals numerically using the midpoint rule, the trapezoidal rule, and Simpson's rule; compute errors bounds for these approximations</td></tr>
<tr><td>6. Compute the length of a curve segment from its parametric representation</td><td rowspan="2">HW #7, 8, 8
Midterm 2
Final Exam</td></tr>
<tr><td>7. Describe curves and regions of the xy-plane in polar coordinates and use this description to compute lengths and areas</td></tr>
</table>

8. Use the concept of the limit at infinity to determine whether a sequence of real numbers is bounded and whether it converges or diverges	HW #11, 12 Final Exam
9. Interpret the concept of a series as the sum of a sequence, and use the sequence of partial sums to determine convergence of a series	

10. Distinguish between conditional convergence and absolute convergence of infinite series and be aware of the consequences of reordering terms of a conditionally converging infinite series	
11. Decide whether and to what value an infinite geometric series converges	HW #11, 12 Final Exam
12. Use comparison, root, ratio, and integral test to investigate whether a given infinite series is convergent	
13. Decide whether an alternating series converges from the limit and monotonic decrease of the sequence of absolute values of its terms	
14. Interpret a converging power series as a function	Final Exam
15. Compute the derivatives and anti-derivatives of a functions represented by power series	
16. Determine the Taylor series of the nth order and determine an upper bound on its remainder	
17. Manipulate Taylor series by substitution and (anti-)differentiation to obtain expansions for other functions	
18. Choose appropriate methods or models for a given problem, using information from observed or deduced data and knowledge of the system being studied.	HW #1-12 Midterm 1 Midterm 2 Final Exam
19. Employ quantitative methods, mathematical models, statistics, and/or logic to solve real-world problems beyond the level of basic algebra.	
20. Identify common mistakes and/or limitations in empirical and deductive reasoning, and in mathematical, quantitative, and/or logical problem solving.	
21. Interpret mathematical models, formulas, graphs, and/or tables, to draw inferences from them, and explain these inferences.	

Course Topics:

1. Infinite Series
2. Partial fractions in integration
3. Parametric curves
4. Trigonometric integrals
5. Taylor series
6. Plane
7. Average value of a function
8. Integration by parts
9. Probability
10. Areas
11. Power series
12. Integral tables
13. Arc length
14. Volumes
15. Coordinate systems
16. Sequence
17. Improper integral
18. Substitution rule

MTH 241 College Calculus III

Credit Hours: 4

Contact Hours: Lecture – 3 hours per week; Recitation – 1 hour per week

Coordinator: Prof. Michael Rosas, Dept. of Mathematics

Textbooks and Other Materials:

Required: J. Stewart, Calculus: Early Transcendental Multi Variable, 8th custom UB ed.

Catalog Description: Geometry and vectors of n-dimensional space; Green's theorem, Gauss theorem, Stokes theorem; multidimensional differentiation and integration; application to 2- and 3-D space. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade other than W may repeat the course in the summer or winter; or only in the fall or spring semester with a petition to the College of Arts and Sciences Deans' Office.

Pre-requisite(s): MTH 142 or MTH 154

Co-requisite(s): None

Role in Curriculum: Required Course (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Understand vectors in two- and three-dimensional space and their geometric interpretation	HW #1 Midterm 1 Final Exam
2. Add vectors and multiply vectors by scalars	
3. Compute dot product and cross product of two vectors and understand the properties of these operations	
4. Write equations of lines and planes in the three-dimensional space	HW #2 Midterm 1 Final Exam
5. Classify quadratic surfaces based on their equations	
6. Compute derivatives and integrals of vector functions	HW #3 Midterm 1 Final Exam
7. Compute arc length and curvature of a space curve described by a vector function	
8. Understand and compute velocity and acceleration of a particle moving in the three-dimensional space	
9. Compute limit of a function of several variables at a point	HW #4, 5, 6

10. Verify continuity of functions of several variables	Midterm 1 Midterm 2 Final Exam
11. Compute partial derivatives of a function of several variables	
12. Apply the chain rule to compute partial derivatives	
13. Compute directional derivatives and the gradient of a function and understand the meaning of these notions	
14. Write an equation of the tangent plane to the graph of a function of two variables and interpret it as a linear approximation of the function	
15. Compute critical points of a function of two variables	HW #7 Midterm 2 Final Exam
16. Use the second derivative test to classify critical points of a function of two into local minima, local maxima, and saddle points and understand the geometrical interpretation of this classification	
17. Use the method of Lagrange multipliers to solve constrained optimization problems in two and three variables	
18. Compute integrals of functions of two variables over regions of the xy-plane using Cartesian and polar coordinates	HW #8, 9 Midterm 2 Final Exam
19. Apply double integrals to compute moments and centers of mass of lamina, and to compute surface areas	
20. Compute triple integrals using Cartesian, cylindrical, and spherical coordinates	HW #10 Midterm 2 Final Exam
21. Compute line integrals directly, using the fundamental theorem for line integrals, and using Green's theorem	Final Exam
22. Compute curl and divergence of a vector field	
23. Compute surface integrals, directly, using Stokes theorem and using the divergence theorem	

Course Topics:

1. Green's theorem
2. Equations of cylinders and quadric surfaces
3. Multiple integrals
4. Divergence theorem
5. Cross product
6. Disk integration
7. Integrals of vector functions
8. Stokes' theorem
9. Coordinate systems
10. Line integrals
11. Vectors and analytic geometry
12. LaGrange multipliers
13. Multivariable
14. Tangent plane
15. Parametric curves
16. Shell integration
17. Dot product
18. Surface integrals
19. Partial derivative
20. Vector-valued functions
21. Equations of Lines and Planes

MTH 306 Introduction to Differential Equations

Credit Hours: 4

Contact Hours: Lecture – 3 hours per week; Recitation – 1 hour per week

Coordinator: Prof. Michael Rosas, Dept. of Mathematics

Textbooks and Other Materials:
Required: C. Edwards, D. Penney, D. Calvis, *Differential Equations, Computing and Modeling,* 3rd custom UB edition

Catalog Description: Analytic solutions, qualitative behavior of solutions to differential equations. First-order and higher-order ordinary differential equations, including nonlinear equations. Covers analytic, geometric, and numerical perspectives as well as an interplay between methods and model problems. Discusses necessary matrix theory and explores differential equation models of phenomena from various disciplines. Uses a mathematical software system designed to aid in the numerical and qualitative study of solutions, and in the geometric interpretation of solutions. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade other than W may repeat the course in the summer or winter; or only in the fall or spring semester with a petition to the College of Arts and Sciences Deans' Office.

Pre-requisite(s): MTH 142 or MTH 154

Co-requisite(s): None

Role in Curriculum: Required Course (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Understand the concept of existence and uniqueness of solutions of a DE	HW #1 Midterm 1 Final Exam
2. Understand the concept of a general solution, a particular solution and initial conditions	
3. Draw slope fields by hand and also by computer using Maple, Matlab, or Mathematica	
4. Solve 1st order DEs (both nonlinear and linear) using various techniques: integrating factor, separable DE, substitution method, exact DE	HW #2 Midterm 1 Final Exam
5. Understand the equilibrium solutions	HW #3 Midterm 1 Final Exam
6. Draw the phase diagram	
7. Perform the stability analysis: identify stable points, unstable points, saddle points, and bifurcation points	
8. Solve 2nd order constant coefficient homogenous DEs	HW #4

9. Understand the concept of linear independence and determine if functions are linearly independent using Wronskian	Midterm 1 Final Exam
10. Understand that linear combinations of two linearly independent solutions give the general solution	

11. Solve non-homogeneous 2nd order DEs	HW #5 Midterm II Final Exam
12. Use the method of undetermined coefficients to find the particular solution	
13. Understand the resonance phenomena	HW #6 Midterm II Final Exam
14. Understand what the system of equations is	
15. Solve DEs using the method of elimination (convert two DEs into one and vice versa)	
16. Understand the basic notions of linear algebra such as vector, matrix, determinant, and eigenvalue	HW #7 Midterm II Final Exam
17. Rewrite the system of DEs in the matrix form	HW #8 Midterm II Final Exam
18. Compute eigenvectors and eigenvalues for the derived matrix	
19. Solve the system equation using the eigenvalues in three different cases: real distinct roots, repeated roots, and complex roots	
20. Sketch the direction fields and indicate stability on the phase plane	HW #9 Final Exam
21. Perform the stability analysis of a linear system using eigenvalues	
22. Draw slope fields and solution curves using a computer	
23. Predict behavior of solutions of some nonlinear system using analysis of eigenvalues	HW #10 Final Exam
24. Set up a power series and the Taylor series of a function	
25. Compute the radius of convergence of a power series	

Course Topics:

1. Differential equations
2. Mechanical vibrations
3. Forced oscillations and resonance.
4. Solution by Laplace transform
5. Matrices and linear systems
6. Eigenvalue, eigenvector and eigenspace
7. Non-linear systems
8. Laplace transforms

MTH 309 Introduction to Linear Algebra

Credit Hours: 4

Contact Hours: Lecture – 3 hours per week; Recitation – 1 hour per week

Coordinator: Prof. Michael Rosas, Dept. of Mathematics

Textbooks and Other Materials:

Required: D. Lay, S. Lay, J. McDonald Linear Algebra and its Applications, 3nd custom UB edition.

Catalog Description: Linear equations, matrices, determinants, vector spaces, linear mappings, inner products, eigenvalues, eigenvectors.

Pre-requisite(s): MTH 142 or MTH 154

Co-requisite(s): None

Role in Curriculum: Required (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Represent systems of linear equations in vector and matrix form	HW #1, 2 Midterm 1 Final Exam
2. Determine if a system of equations is consistent and whether it has a unique solution	
3. Solve systems of linear equations using Gauss-Jordan elimination	
4. Perform matrix-vector multiplication and understand how this operation defines a linear transformation between Rn and Rm	HW #3 Midterm 1 Final Exam
5. Add, multiply, and transpose matrices	
6. Determine whether a given matrix is invertible and compute its inverse if it exists	
7. State and apply properties of matrix algebra	
8. Recognize which sets of vectors of Rn form a subspace	HW #4 Midterm 1 Final Exam
9. Find a basis of the null space and the column space of a matrix	
10. Compute the rank of a matrix and the dimension of the column space of a matrix	
11. Compute determinants of matrices both by cofactor expansion and by row reduction	HW #5 Midterm 2 Final Exam
12. Use Cramer's rule to solve systems of equations and to compute inverses of matrices	
13. Compute areas of parallelograms and volumes of parallelepipeds using determinants	
14. Understand relationship between the determinant of a matrix and properties of the linear transformation represented by the matrix	

15. Understand the axiomatic definition of a vector space and know some examples of vector spaces other than Rn (vector space of polynomials, vector space of matrices etc.)	HW #6 Midterm 2 Final Exam
16. Recognize if a given function between vector spaces is a linear transformations	
17. Understand the notions of the kernel and the image of a linear transformation and their relationship to the null space and the columns space of a matrix	
18. Compute bases of some simple vector spaces given a basis of a simple vector space	HW #7 Midterm 2 Final Exam
19. Compute coordinates of a vector relative to a basis	
20. Compute the dimension of a vector space in some simple examples	
21. Compute dimensions of various subspaces defines by a matrix using the rank theorem	
22. Compute the characteristic polynomial of a matrix, find eigenvalues and eigenvectors of the matrix	HW #8, 9 Final Exam
23. Determine if a given matrix is diagonalizable and compute its diagonalization	
24. Use diagonalization of a matrix to compute its powers	
25. Compute the inner product of vectors in Rn	HW #10, 11 Final Exam
26. Determine if a set of vectors in Rn is orthogonal	
27. Compute the projection of a vector onto a subspace	
28. Orthogonalize a set of vectors using the Gram-Schmidt process	
29. Solve least square problems	
30. Compute orthogonal diagonalization of symmetric matrix	HW #12 Final Exam
31. Compute the matrix representing a quadratic form	

Course Topics:

1. Matrix operations
2. Systems of linear equations
3. Determinants
4. Eigenvectors and eigenvalues
5. Diagonalization.
6. Least squares problems

CHE 107 General Chemistry for Engineers 1

Credit Hours: 3.5

Contact Hours: Lecture – 3 hours per week; Recitation – 1 hour per week

Coordinator: Mrs. Priscilla Clarke, Laboratory Director

Textbooks and Other Materials:

Required:

1. **Text:** McMurry, Fay, and Robinson, "Chemistry, 7th Ed.", Prentice-Hall, 2015 (with Mastering Chemistry, ISBN 9780133900811; text only, ISBN 9780133886634).
2. Modified Mastering Chemistry, ISBN 9780135214732)

Catalog Description: There is a fee associated with this course. Meets the general chemistry requirement for students wishing to receive an engineering degree. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade other than W may repeat the course in the summer or winter; or only in the fall or spring semester with a petition to the College of Arts and Sciences Deans' Office.

Pre-requisite(s): Intended or Approved Engineering majors only

Co-requisite(s): None

Role in Curriculum: Required Course (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Understand and apply concepts to solve problems using: the Periodic Table of Elements; experimentation and measurement; accuracy, precision, and significant figures in measurement calculations	HW # 1-4 Group works1-2 Quiz 1 Test 1 Lab 1-2 1/3 of credit on final exam
2. Demonstrate atomic structure theory	
3. Quantitate and utilize atomic mass	
4. Identify compounds, mixtures, molecules, ions, and chemical bonds	
5. Name chemical compounds	
6. Utilize chemical symbols, formulas, equations, Avogadro's number and mole theory to recognize, balance and characterize quantities using chemical equations: understand and quantify titrations; determine percent composition and empirical formula; determine molecular masses	
7. Characterize reactions in aqueous solution, including: write aqueous reactions, total ionic and net ionic equations, precipitation reactions and solubility rules	

8. Use the properties of electromagnetic radiation to qualitatively and quantitatively describe: electromagnetic radiation and atomic spectra; wavelike properties of matter using the de Broglie equation	HW # 5-8 Group works 3-4 Quiz 2 Test 2 Lab 3-4 1/3 of credit on final exam
9. Be able to name and use quantum numbers in relation to: Orbital shapes and energy; Quantum Mechanics and Atomic Line Spectra; Electron Spin and the Pauli Exclusion Principle	
10. Write out Electron Configurations for elements on the periodic table	
11. Predict trends for electron configurations and periodic Properties: atomic and ionic radii	
12. Identify Ionic Bonds and Main-Group Chemistry as it refers to: Ions and their Electron Configurations; Ionic Radii; Ionization Energy; Electron Affinity; Lattice Energies of Ionic Solids; Groups of the periodic table	
13. Identify Covalent Bonds and Relate to Molecular Structure in the following ways: Rank strengths of Covalent Bonds; Compare ionic and Covalent Compounds; Draw Electron Dot Structures; Utilize VSEPR Model, Valence Bond Theory, and Molecular Orbital Theory	
14. Utilize thermochemical principles as they relate to chemical energy: Calculate Energy Changes and Enthalpies of Physical and Chemical Change; Quantify heat exchange in Calorimetry; Use Hess's Law	HW # 8-10 Group works 5 Quiz 3 Lab 5 2/3 of credit on final exam
15. Qualitatively and quantitatively relate enthalpy to entropy and free energy	
16. Use the gas laws to quantify gases and their behavior in chemical reactions and in relation to other gases	
17. Identify and rank intermolecular forces	
18. Use phase diagrams	
19. Name unit cells and the packing of spheres in crystalline solids	
20. Know the general properties of metals and solid-state materials	

Course Topics:

1. Formulas, equations, and moles
2. Gases: their properties and behavior
3. Metals and solid-state metals
4. Periodicity and atomic structure
5. Reactions in aqueous solution
6. Covalent bonds and molecular structure
7. Atoms, molecules, and ions
8. Thermochemistry: chemical energy
9. Matter and measurement
10. Ionic bonds and main-group chemistry
11. Liquids, solids, and phase changes

CHE 127 General Chemistry for Engineers Laboratory 1

Credit Hours: 0.5

Contact Hours: Lab – 3 hours per week

Coordinator: Mrs. Priscilla Clarke, Laboratory Director

Textbooks and Other Materials:

Required:

1. **Lab Manual:** "General Chemistry I for Engineers, CHE107Laboratory Manual", Hayden McNeil, 1st Edition. ISBN 978-1-5339-1056-1
2. **Lab Materials:** • CHE 105-106/113-114/127-128 Lab Kit
   • Laboratory Apron
   • Monogoggle Safety Glasses
3. **Proper Protective Clothing:**
   • Long Sleeved Shirt, Long Pants
   • Intact footwear covering the entire upper portion of the foot.

Catalog Description: There is a fee associated with this course. Laboratory to accompany CHE 107, General Chemistry for Engineers 1. Experiments focus upon stoichiometry, reactions in aqueous solutions, thermochemistry, and properties of gases. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade other than W may repeat the course in the summer or winter; or only in the fall or spring semester with a petition to the College of Arts and Sciences Deans' Office.

Pre-requisite(s): None

Co-requisite(s): CHE 107

Role in Curriculum: Required Course (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Understand and apply concepts to solve problems using: • matter and measurement • atoms, molecules and ions • stoichiometry and calculations with chemical formulas and equations • reactions in aqueous solution	Labs 2, 3, 6
2. Describe and calculate quantities for: • thermochemical principles • gas behavior	Labs 9, 11

Course Topics:

1. Separation of a Heterogeneous Mixture (Lab 2)
2. Reactions in Aqueous Solution – Metatheses and Solubilities (Lab 3)
3. Acid-Base Titration (Lab 6)
4. Analysis of an antacid using the Ideal Gas Law (Lab 9)
5. Coffee-cup Calorimetry – Entropy change (Lab 11)

CHE 108 General Chemistry for Engineers 2

Credit Hours:	3.5
Contact Hours:	Lecture – 3 hours per week; Recitation – 1 hour per week
Coordinator:	Mrs. Priscilla Clarke, Laboratory Director

Textbooks and Other Materials:

Required:

1. **Text:** McMurry, Fay, and Robinson, "Chemistry, 7th Ed.", Prentice-Hall, 2015 (with Mastering Chemistry, ISBN 9780133900811; text only, ISBN 9780133886634). Earlier editions may be used**.**
2. **Mastering Chemistry,** (included at a discount in the package with the text ISBN above).
3. **Lab Manual:** Scaife, Beachley, & Allendoerfer, "Chemistry in the Laboratory, University at Buffalo, 11th Ed.", Thomson Custom Publishers 2009 (ISBN 1426633092).
4. **Lab Materials:** CHE 101-2/107-8 Lab Kit, safety glasses with side shields, lab coat, padlock for lab drawer.

Catalog Description: Meets the general chemistry requirement for students wishing to receive an engineering degree in four years. Cannot be used for science distribution credit. There is a fee associated with this class. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade other than W may repeat the course in the summer or winter; or only in the fall or spring semester with a petition to the College of Arts and Sciences Deans' Office.

Pre-requisite(s): CHE 107; Intended or Approved Engineering majors only.

Co-requisite(s): None

Role in Curriculum: Required (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Understand and apply concepts to solve problems using: • Properties of Solutions • Chemical Kinetics • General Chemical Equilibria	Problem sets 1,2 Test 1 Laboratory Experiments 14 and 15 1/4 of credit on the Final Exam
2. Describe and calculate quantities for: • Acid-Base Equilibria • Precipitation Equilibria • Thermodynamic Quantities and Relationships • Properties and Fundamentals of Electrochemical Systems	Problem sets 3-5 Test 2 Laboratory Experiments 18 and 20 1/4 of credit on the Final Exam

3. Understanding the importance and role of the following in society: • Nuclear Chemistry and Radioactivity • Transition metals and coordination chemistry • Organic and Biological Chemistry	Problem sets 6-10 Laboratory Experiment 23 1/2 of Final Exam

Course Topics:

1. Solutions and their properties
2. Chemical kinetics
3. Chemical equilibrium
4. Aqueous Equilibria: acids and bases
5. Applications of aqueous equilibria
6. Thermodynamics: entropy, free energy, and equilibrium
7. Electrochemistry
8. Nuclear chemistry
9. Transition elements and coordination chemistry
10. Organic and biological chemistry

CHE 128 General Chemistry for Engineers Laboratory 2

Credit Hours: 0.5

Contact Hours: laboratory – 3 hours per week;

Coordinator: Mrs Priscilla Clarke, Laboratory Director

Textbooks and Other Materials:

Required:

1. **Lab Manual:** "General Chemistry II for Engineers, CHE128 Laboratory Manual", Hayden McNeil, 1st Edition. ISBN 978-1-5339-1057-8
2. **Lab Materials:** • CHE 105-106/113-114/127-128 Lab Kit
   • Laboratory Apron
   • Monogoggle Safety Glasses
3. **Proper Protective Clothing:**
   • Long Sleeved Shirt, Long Pants
   • Intact footwear covering the entire upper portion of the foot

Catalog Description: Laboratory to accompany CHE 108, General Chemistry for Engineers 2. Experiments focus upon kinetics, chemical equilibria, acid-base chemistry, electrochemistry and coordination chemistry. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade other than W may repeat the course in the summer or winter; or only in the fall or spring semester with a petition to the College of Arts and Sciences Deans' Office.

Pre-requisite(s): None

Co-requisite(s): CHE 108

Role in Curriculum: Required (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Understand and apply concepts to solve problems using: • Chemical Kinetics • Chemical Equilibria	Laboratory Experiments 14, 15
2. Describe and calculate quantities for: • Acid-Base Equilibria, Precipitation Equilibria • Thermodynamic Quantities & Relationships	Laboratory Experiments 18, 20
3. Understanding the importance and role of the following in society: • Transition metals & Coordination Chemistry	Laboratory Experiments 23 B/C

Course Topics:

1. Chemical Kinetics
2. Chemical Equilibria
3. Acid-base Equilibria

4. Precipitation Equilibria
5. Thermodynamics
6. Transition metals

PHY 107 General Physics I

Credit Hours:	4
Contact Hours:	Lecture – 3 hours per week; Recitation – 1 hour per week
Coordinator:	Prof. Priya Banerjee

Textbooks and Other Materials:

Required:	Fundamentals of Physics, 11th edition, extended version with WileyPlus, Halliday, Resnick, Walker

Catalog Description: A calculus-based introductory course primarily for chemistry, engineering, and physics majors. Covers kinematics, Newton's laws, energy, momentum, rotational motion, and oscillations. This course satisfies 4 credits as required by different majors and also 4 credits (out of the mandated 7 credits total) of UB's Science Literacy and Inquiry general education requirement sequence.

Pre-requisite(s):	None
Co-requisite(s):	MTH 141. Enrollment is not allowed in PHY 107 if a student has current enrollment in PHY 101
Role in Curriculum:	Required (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students are expected to master	**Assessment Tools**
1. Measurement of physical quantities, International System of Units, changing units.	HW #1 Quizzes Test 1
2. Vector addition and subtraction, vector components, unit vectors, multiplication of vectors, scalar product, vector product.	
3. Position, displacement, average velocity, instantaneous velocity, acceleration, motion with constant acceleration, free fall.	HW #2 Quizzes Test 1
4. Position vector, displacement vector, velocity vector, acceleration vector. Projectile motion, uniform circular motion. Relative motion.	HW #3 Quizzes Test 1
5. Newton's three laws of motion.	HW #4 Quizzes Test 1
6. Static and kinetic friction. Drag force, terminal velocity. Uniform circular motion.	HW #5 Quizzes Test 2

7. The work-kinetic energy theorem. Power.	HW #6 Quizzes Test 2
8. Potential energy, conservative forces. Potential energy curve. Conservation of energy.	HW #7 Quizzes Test 2
9. System of particles, Center of mass, linear momentum. Collisions, impulse, conservation of linear momentum.	HW #8 Quizzes Test 2
10. Angular velocity, angular acceleration, rotation with constant angular acceleration. Kinetic energy of rotation, rotational inertia, torque.	HW #9 Quizzes Final Exam
11. Rolling, angular momentum. Conservation of angular momentum.	HW #10 Quizzes Final Exam
12. The conditions for equilibrium. Elastic deformation. Stress, strain. Young's modulus, shear modulus, bulk modulus	HW #11 Quizzes Final Exam
13. Gravitational force. Gravitational potential energy. Escape speed. Kepler's laws of planetary motion.	HW #12 Quizzes Final Exam
14. Simple harmonic motion, simple pendulum, physical pendulum. Damped harmonic motion. Forced oscillations, resonance.	HW #13 Quizzes Final Exam

Course Topics:

1. Measurement
2. Motion along a straight line
3. Vectors
4. Motion in two and three dimensions
5. Force and motion
6. Frictional forces
7. Kinetic energy and work
8. Conservation of energy
9. Linear momentum
10. Rotational motion
11. Equilibrium
12. Gravitation
13. Oscillations

PHY 108 General Physics II

Credit Hours:	4
Contact Hours:	Lecture – 3 hours per week; Recitation – 1 hour per week
Coordinator:	Prof. Athos Petrou

Textbooks and Other Materials:

Required:	Fundamentals of Physics, 11th edition, Vol 2 for UB with WileyPLUS, Halliday, Resnick, Walker

Catalog Description: A calculus based introductory course primarily for chemistry, engineering, and physics majors. Covers the electric field, Gauss' law, electric potential, capacitance, DC circuits, RC circuits, magnetic field, Faraday's law, inductance, LR circuits, AC circuits, and Maxwell's equations. This course satisfies 4 credits as required by different majors and also 4 credits (out of the mandated 7 credits total) of UB's Science Literacy and Inquiry general education requirement sequence.

Pre-requisite(s):	PHY 107 or PHY 117
Co-requisite(s):	None
Role in Curriculum:	Required (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Coulomb's law. Electric force between point charges; electric force exerted by a charge distribution on a point charge. Conservation of charge.	HW #1 Quizzes Exam1
2. Electric field created by: i) a point charge, and ii) a charge distribution. Electric field lines. Electric dipoles.	HW #2 Quizzes Exam 1
3. Electric field flux. Gauss' law. Use of Gauss' law to calculate the electric field in various geometries.	HW #3 Quizzes Exam 1
4. Electric potential generated by: i) a point charge and ii) a charge distribution. Electric potential energy of a charge distribution. Equipotential surfaces.	HW #4 Quizzes Exam 1
5. Capacitance between two conductors. Capacitors in series and in parallel, equivalent capacitance. Behavior of a dielectric in an electric field. Energy stored in the electric field.	HW #5 Quizzes Exam 2

6. Electric current, electric current density. Ohm's law. Ohmic and non-Ohmic conductors. Heat dissipation by a resistor.	HW #6 Quizzes Exam 2
7. Kirchhoff's rules. Analysis of simple DC circuits. Equivalent resistance. Ammeters and voltmeters. RC circuits.	HW #7 Quizzes Exam 2
8. Magnetic force on a moving charge. Magnetic force on a wire. Magnetic field lines. Cyclotron motion. Hall effect. Magnetic dipole.	HW #8 Quizzes Exam 2
9. Ampere's law, law of Biot-Savart. Magnetic field generated by a straight wire, a solenoid and a toroid coil.	HW #9 Quizzes Final Exam
10. Faraday's law of induction, Lenz's rule. Energy stored in a magnetic field. Inductance. RL circuits.	HW #10 Quizzes Final Exam
11. Electromagnetic oscillations in an LC circuit. AC circuits. Resonance in an RCL circuit. Transformers, AC power transmission.	HW #11 Quizzes Final Exam
12. Gauss' law for the magnetic field. Complete Ampere's law. Magnetic materials.	HW #12 Quizzes Final Exam

Course Topics:

1. Coulomb’s law
2. Electric field
3. Gauss’ law for the electric field
4. Electric potential
5. Capacitors and dielectrics
6. Electric current and resistance
7. DC circuits
8. Magnetic fields
9. Relation between magnetic field and electric current
10. Induction
11. Electromagnetic oscillations and AC currents
12. Maxwell’s equations, magnetism

PHY 158 General Physics II Lab

Credit Hours: 1

Contact Hours: Laboratory – one 3 hours session per week

Coordinator: Prof. Scott Whitmire

Textbooks and Other Materials:

Required: Mechanics and Electricity Laboratory Manual for Physics 158, 3rd Edition.

Catalog Description: PHY-158 is an introductory Physics lab course. This course covers mechanics, kinematics, forces, vectors, electricity and magnetism. Experiments are used to demonstrate principles discussed in the lecture courses PHY 107 and PHY 108. PHY-158 satisfies the SLI General Education 1-credit laboratory requirement (out of the 7 credits total SLI Gen-Ed requirement).

Pre-requisite(s): PHY 107 or PHY 117

Co-requisite(s): PHY 108 or PHY 118

Role in Curriculum: Required (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Understand the basic laws of physics as discussed in lecture	Lab reports Exams
2. Demonstrate skills used to analyze and present experimentally acquired data.	Lab reports Exams
3. Demonstrate familiarity with the use of spreadsheet programs	Lab reports
4. Predict results of new experimental outcomes	Exams
5. Demonstrate a variety of measurement techniques	Lab reports Exams
6. Conduct an experiment related to error analysis	Lab report
7. Conduct an experiment related to free fall	Lab report
8. Conduct an experiment related to projectile motion	Lab report
9. Conduct an experiment related to Newton's second law of motion	Lab report
10. Conduct an experiment related to simple harmonic motion	Lab report
11. Conduct an experiment related to rotational dynamics	Lab report
12. Conduct an experiment related to electrostatics	Lab report

13. Conduct an experiment related to electric circuits	Lab report
14. Conduct an experiment related to DC circuits with resistors and capacitors	Lab report
15. Conduct an experiment related to Wheatstone bridge	Lab report

Course Topics:

1. Measurement techniques
2. Error analysis
3. Statistics
4. Free fall
5. Projectile motion
6. Electromagnetism
7. Newton's laws of motion
8. Rotational motion
9. Electrostatics
10. Electrical network

PHY 207 General Physics III

Credit Hours: 4

Contact Hours: Lecture – 3 hours per week; Recitation – 1 hour per week

Coordinator: Prof. John Cerne

Textbooks and Other Materials:

Required: Fundamentals of Physics, 10the edition, Vol 3 for UB, Halliday, Resnick, Walker

Catalog Description: Examines sound waves, electromagnetic waves, and geometrical and physical optics. Introduces modern physics, including discovery of the electron, the photon, wave-particle duality, the Bohr model of H-atom, the Schrödinger equation, quantum numbers, the Pauli principle and periodic table, and lasers.

Pre-requisite(s): PHY 108 or PHY 118

Co-requisite(s): None

Role in Curriculum: Required (Math and Science)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**Assessment Tools**
1. Learn how to represent waves mathematically and graphically; understanding of basic wave properties such as frequency, period, wavelength, and wavenumber; understanding of how waves travel on a stretched string, including superposition, interference and standing waves; conceptual understanding of sound waves and how they interfere; understanding of Doppler effect on sound waves and shock waves produced by supersonic sources	HW #1, 2 Exam1 Final Exam
2. Conceptual understanding of traveling electromagnetic waves; understanding of energy transport, Poynting vector and radiation pressure of electromagnetic waves; conceptual understanding of the polarization of electromagnetic waves; understanding of how electromagnetic waves reflect and refract	HW #3 Exam 1 Final Exam
3. Understanding of how lenses and mirrors create images; being able to completely determine the properties of an image both graphically and algebraically for plane mirrors, spherical mirrors, spherical refracting surfaces, and thin lenses; understanding and application of optical instruments such as magnifying lenses, microscopes and telescopes	HW #4 Exam 2 Final Exam

4. Conceptual understanding of how the wave-like nature of light leads to diffraction, double and multiple slit interference, and thin film interference; being able to draw interference patterns and calculate the positions of minima/maxima in those patterns for single/multiple slits as well as circular apertures and diffraction gratings; basic understanding of how x-ray diffraction can be used to study crystals	HW #5, 6 Exam 2 Final Exam
5. Understanding of photons and treating light as particles giving rise to the photoelectric effect, photon momentum; understanding the wave-like nature of particles such as electrons giving rise to the Schroedinger equation, Heisenberg's Uncertainty Principle, and barrier tunneling; using wave-like nature of particles to solve problems involving electrons in 1D, 2D, and 3D traps; understanding the electron energy spectrum in the hydrogen atom using the Bohr model and the Schroedinger equation	HW #7, 8 Final Exam
6. Understanding basic properties of atoms; understanding of electron spin; understanding of angular momenta and magnetic moments of electrons trapped in atoms; applying Pauli Exclusion Principle to determine how electrons occupy states in multi-electron traps and atoms; understanding of how lasers work; understanding of electrical properties of solids from a quantum mechanical perspective; understanding of semiconductors and how they are used to make diodes, transistors, and solid-state lasers	HW #, 10 Final Exam

Course Topics:

1. Mechanical Waves
2. Electromagnetic waves
3. Images
4. Interference and Diffraction
5. Photons and matter waves
6. Atoms and solids

EAS 198 UB Seminar

Credit Hours:	1
Contact Hours:	Lecture– one 1 hour session per week
Coordinator:	Prof. Jennifer Zirnheld

Textbooks and Other Materials:

Materials for laboratory projects

Catalog Description: The one credit UB Seminar is focused on a big idea or challenging issue to engage students with questions of significance in a field of study and, ultimately, to connect their studies with issues of consequence in the wider world. Essential to the UB Curriculum, the Seminar helps transition to UB through an early connection to UB faculty and the undergraduate experience at a comprehensive, research university. This course is equivalent to any 198 offered in any subject. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade of F or R may not be able to repeat the course during the fall or spring semester.

Pre-requisite(s):	Students with <45 transfer credits upon matriculation to UB AND have already earned credit for an EAS 140 equivalent will be allowed to take EAS 198 instead of EAS 199.
Co-requisite(s):	None
Role in Curriculum:	UB Seminar Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Describe the unique character of higher learning in a university, such as deep domain knowledge, the role of research, and value of experiential learning.	3, 7	E-Portfolio, two experiential learning reflections, resume,
2. Articulate the components of the UB General Education program and the integration of multiple disciplines.	3, 7	Academic plan, academic analysis reflection, pathways, career aspirations reflections
3. Understand their chosen major or other fields of study and the key concepts that will be explored in those disciplines.	3, 7	Resume, academic plan, academic analysis reflection, Career fair plan, career aspirations reflections
4. Understand the necessity for writing/communication in university and professional settings.	3	Two experiential learning reflections, resume, career aspirations reflection, academic analysis reflection, about me reflection, Peer assessment

5. Initiate use of the E-portfolio and select a thematic framework for the UB General Education program using articulated transfer and UB coursework.	3, 7	Midterm E- portfolio, Final E-portfolio, two experiential learning reflections, pathways worksheet, Career aspirations reflection

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
		2				2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Resume
2. Career Fair Plan
3. Academic Plan
4. Digital citizenship/ePortfolio
5. Experiential learning
6. Academic analysis

EAS 199 UB Seminar

Credit Hours: 3

Contact Hours: Lecture – 2 hours per week; Laboratory – 2-hours per week

Instructor: William Wild

Textbooks and Other Materials:

Required: Materials for laboratory projects

Catalog Description: The three credit UB Seminar is focused on a big idea or challenging issue to engage students with questions of significance in a field of study and, ultimately, to connect their studies with issues of consequence in the wider world. Essential to the UB Curriculum, the Seminar helps students with common learning outcomes focused on fundamental expectations for critical thinking, ethical reasoning, and oral communication, and learning at a university, all within topic focused subject matter. The Seminars provide students with an early connection to UB faculty and the undergraduate experience at a comprehensive, research university. This course is equivalent to any 199 offered in any subject. This course is a controlled enrollment (impacted) course. Students who have previously attempted the course and received a grade of F or R may not be able to repeat the course during the fall or spring semester.

Pre-requisite(s): Students who have already successfully completed the first year seminar course may not repeat this course. If you have any questions regarding enrollment for this course, please contact your academic advisor.

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Method**
Describe an engineering process for approaching “real-world” problems: problems that are ill-structured (e.g., characterized by uncertainties in definition, constraints, data, solution paths, etc.), open-ended (e.g., “no one right answer”), and comprised of a range of components both technical and non-technical (e.g., environmental, social, cost, ethical).	1	Alternative Fuels Project Report, Renewable Electric Project Report
Develop a conceptual model of a real world situation	7	Conceptual Model: Alt Fuels, Renewable Electric
Develop quantitative metrics, and a decision matrix to facilitate comparison of alternatives	1	Decision Matrix; Alt Fuels, Renewable Electric, in- class quizzes, in-class exercises
Design a quantitative model based on a conceptual model (identify key variables, identify relationships between variables, identify needed data, and perform necessary calculations)	1	Quantitative Model; Alt Fuels, Renewable Electric, in-class quizzes

Represent a quantitative model, analysis, and results, in an ethically transparent manner	4	Quantitative Model: Alt Fuels, Renewable Electric
Employ sensitivity and scenario analysis to characterize system dynamics and performance via a quantitative model	1	Computer simulation assignments: off-grid electric systems
Develop an evidence-based engineering recommendation in the context of multiple-criteria decision-making under uncertainty	1,4	Engineering Recommendation written reports: Alt Fuels, Renewable Electric
Demonstrate ability to apply an engineering design process for a physical mechanism	2,7	Design Project written report, oral presentation
Apply a controlled experimental design regimen to assess the performance of alternative mechanism configurations	6	Design Project written report, oral presentation
Demonstrate skills related to effective functioning on a project team: knowledge of attributes of high/low functioning teams, create work breakdown structure, team task allocation for efficiency and individual accountability, produce acceptable quality results within designated deadlines, collaborative and inclusive inquiry and decision-making	5	Gantt Chart assignments, Student Self and Peer Evaluations, Course staff observation
Develop and present PowerPoint briefings to peer and professional audiences	3	In-lab presentations, Design Project oral presentation

Relationship of EAS 199 to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
1	1	1	1	1	1	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Engineering Modelling
2. Decision Matrices
3. Renewable Energy
4. Experimental Design
5. Computer Simulation
6. Teamwork
7. Technical Report Writing
8. Oral Presentation
9. Ethics
10. Professional Responsibility
11. Technical Literature

EAS 200 Electrical Engineering Concepts for Non-Majors

Credit Hours: 3

Contact Hours: Lecture – Three hours per week

Coordinator: Prof Presentacion Rivera

Textbooks and Other Materials:

Required: Introductory Circuit Analysis, 13th ed., Robert L. Boylestad

Catalog Description: Introduces aspects of electrical engineering useful to all the engineering disciplines. Course material includes basic circuit analysis and networks, fundamentals of electromagnetics, energy conversion and transmission. Not intended for electrical or engineering physics majors. Students may not receive credit for this course and EE 202.

Pre-requisite(s): MTH 141. Approved and Intended Engineering Majors Only

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Methods**
1. Analyze simple dc circuits using Ohm's and Kirchhoff's laws	1, 7	Exam 1, Final Exam, HW #1, 2, 3
2. Analyze dc circuits using node-voltage, mesh-current, Thevenin equivalent circuits and superposition	1, 7	Exam 1, Exam 2, Final Exam, HW # 4, 5, 6
3. Analyze RC and RL transient circuits	1, 2, 7	Exam 2, Final Exam, HW #7, 8
4. Analyze simple ac circuits using phasor analysis and determine the steady-state response of ac circuits	1, 7	Final Exam, HW # 9, 10, 11
5. Perform power calculations in single-phase ac circuits	1, 2, 4, 7	Final Exam, HW #12
6. Be familiar with logic circuits	1, 7	Final Exam, HW #13

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
2	1		1			2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. DV Voltage, Current and Resistance

2. Ohm’s Law, Power, Energy and Efficiency
3. Series DC circuits
4. Parallel and Combination DC Circuits
5. Methods of Analysis
6. Network Theorems
7. Capacitors
8. Inductors
9. Sinusoidal Alternating Waveforms
10. Basic Elements and Phasors
11. Series and Parallel AC Circuits
12. Power (AC)
13. Introduction to Logic Circuit

EAS 202 Engineering Impact on Society

Credit Hours: 1

Contact Hours: Lecture – 1hour per week

Instructor: William Wild

Textbooks and Other Materials:

Required: None

Catalog Description: EAS 202 is a one credit freshman seminar course aimed at broadening students' vision of engineering problem solving, and elucidating how engineers can make a difference in meeting key societal needs. The course focus is the National Academy of Engineering's 'Grand Challenges' for the future. It includes a series of interactive presentations by engineering faculty who are experts in these areas, offering an understanding both of these problems and engineering approaches to solving them. Students also explore a self-selected area of personal interest as a step toward identifying possible niches for their own career path.

Pre-requisite(s): 1st Term Freshmen Engineering

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Describe problems in which engineers can be involved related to the National Academy of Engineering's "Grand Challenges" for the future	1, 7	Reflection
2. Cite approaches that engineers employ in addressing the above problems	1, 7	Reflection
3. Generate a project proposal, or a structured research analysis, to address a self-selected problem that impacts the welfare of people and/or the environment	3, 7	Project proposal
4. Establish personal contact with an SEAS faculty mentor		

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
2		1				2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. NAE Grand Challenge Themes
2. Technical report writing
3. Mentoring

EAS 207 Statics

Credit Hours: 3

Contact Hours: Lecture – 3 hours per week; Recitations – 1 hour per week

Instructor: Prof. Shahid Ahmad

Textbooks and Other Materials:

Required:

1. Engineering Mechanics -Statics, by Hibbeler, 14^{th} Edition , 2016
2. Mastering Engineering 14E (Online resource and tutorials)

Catalog Description: Applies mechanics to studying static equilibrium of rigid and elastic bodies. Topics include composition and resolution of forces, moments and couple, equivalent force systems, free-body diagrams, equilibrium of particles and rigid bodies, forces in trusses and beams, friction forces, first and second moments of area, moments and product of inertia, and methods of virtual work and total potential energy.

Pre-requisite(s): PHY 107 or PHY 117; MTH 142 College Calculus 2. Approved and Intended Engineering Majors only.

Co-requisite(s): MTH 241 (recommended) College Calculus 3

Role in Curriculum: Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Calculate the resultant forces and moments in 2D and 3D systems;	1	Homework and Exams
2. Draw free-body diagrams for particles and rigid bodies;	1	Homework and Exams
3. Solve particle and rigid body problems using the principle of static equilibrium;	1	Homework and Exams
4. Analyze 2D and 3D trusses using methods of joints and sections;	1	Homework and Exams
5. Calculate internal forces in a beam and plot shear-force and bending-moment diagrams;	1	Homework and Exams
6. Solve problems related to sliding objects using Coulomb's dry friction theory;	1	Homework and Exams
7. Locate the center of gravity and the centroid of a given shape/volume;	1	Homework and Exams

8. Calculate moment of inertia for an area/volume.	1	Homework and Exams

Contribution of EAS 207 towards fulfillment of Student Outcomes:

1. *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*

EAS 207 is an engineering problem solving course that builds upon the students' background in mathematics and physics to form a linkage between abstract concepts and physical problems common to engineering practice.

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
1						

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Composition and Resolution Of Forces
2. Moments and Couples
3. Equivalent Force Systems
4. Free-Body Diagrams
5. Equilibrium of Particles and Rigid Bodies
6. Forces in Trusses and Beams
7. Frictional Forces
8. First and Second Moments of Area
9. Moments and Products of Inertia
10. Methods of Virtual Work and Total Potential Energy

EAS 208 Dynamics

Credit Hours: 3

Contact Hours: Lecture – 3 hours per week; Recitations – 1 hour per week

Coordinator: Prof. Mostafa Nouh

Textbooks and Other Materials:

Required: R.C. Hibbeler, Engineering Mechanics: Dynamics, 14th Edition, Pearson, Prentice Hall, NJ, 2016

Catalog Description: Applies mechanics to studying the motion of particles and rigid bodies. Topics include kinematics and kinetics of particles, relative motion, work-energy methods, impulse-momentum methods, kinematics and kinetics of rigid bodies, and simple vibration.

Pre-requisite(s): EAS 207 and (MTH 241 or MTH 251)

Co-requisite(s): MTH 306 (Recommended). Approved and Intended Engineering Majors Only

Role in Curriculum: Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Understand the basic physical concepts of dynamics	1	Exams, Assignments, In-class quizzes
2. Understand and be able to relate the kinematics of particles and rigid bodies to the solution of dynamics problems in straight line and curvilinear motion	1,2	Exams, Assignments, In-class quizzes
3. Be able to apply Newton's Laws to particles and rigid bodies to solve problems related to dynamic behavior	1,6,7	Exams, Assignments, In-class quizzes
4. Apply the methods of work, momentum and energy to particles and bodies associated with dynamic behavior	1,2	Exams, Assignments, In-class quizzes

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
2	1				1	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Kinematics of a Particle
2. Kinetics of a Particle: Force and Acceleration
3. Kinetics of a Particle: Work and Energy
4. Kinetics of a Particle: Impulse and Momentum
5. Planar Kinematics of a Rigid Body
6. Planar Kinetics of a Rigid Body: Force and Acceleration
7. Planar Kinetics of a Rigid Body: Work and Energy

EAS 209 Mechanics of Solids

Credit Hours: 3

Contact Hours: Lecture – 3 hours per week; Recitations – 1 hour per week

Coordinator: Prof. Shahid Ahmad

Textbooks and Other Materials:

Required: *Mechanics of Materials* by T. A. Philpot, 4th Edition, John Wiley & Sons (with online resources: *Wiley*PLUS and *MecMovies*), ISBN **9781119344865**

Catalog Description: Studies the mechanical behavior of solid bodies under various types of loading. Topics include stresses and strain, stress-strain relationships, plane stress and plane strain; shear and bending moments in beams, stresses in beams; deflection of beams, torsion of shafts, buckling of columns, energy methods, and failure criteria.

Pre-requisite(s): EAS 207 Statics. Approved and Intended Engineering Majors Only

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Apply basic understanding of stress-strain behavior of engineering materials to solution of engineering problems;	1	Homework, Exams
2. Analyze members subjected to axial loading, shear, torsion, bending to determine the state of stress and resulting deformation;	1	Homework, Exams
3. Design simple members to withstand prescribed loads based on strength and serviceability considerations;	2	Homework, Exams
4. Apply the concepts of equilibrium and compatibility to analyze statically indeterminate members;	1	Homework, Exams
5. Calculate principal stresses and strains and transform states of stress/strain to different orientations;	1	Homework, Exams
6. Draw shear-force and bending-moment diagrams for beams;	1	Homework, Exams
7. Calculate beam deflections;	1	Homework, Exams
8. Calculate the critical buckling load for columns.	1	Homework, Exams

Contribution of EAS 209 towards fulfillment of Student Outcomes:

1. *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*

EAS 209 is an engineering problem solving course that builds upon the students' background in mathematics and physics to form a linkage between abstract concepts and physical problems common to engineering practice.

2. *An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors*

Design of simple structural elements is introduced. Students consider safety and serviceability.

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
2	1					

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Stresses and Strain
2. Stress-Strain Relationships
3. Plane Stress and Plane Strain
4. Shear and Bending Moments in Beams
5. Stresses in Beams
6. Deflection of Beams
7. Torsion of Shafts
8. Buckling of Columns
9. Energy Methods and Failure Criteria

EAS 230 Engineering Computations

Credit Hours: 3

Contact Hours: Lecture – Two one-hour lectures per week;

Lab. – One-hour computer lab per week

Coordinator: Prof. Alaa Hassan Ali

Textbooks and Other Materials:

Required: The zyBook (EAS230: Engineering Computations) will be used by students for pre-reading and preparation ahead of the class time and for assignments.

Recommended:

- S. J. Chapman, *Essentials of MATLAB Programming*, Second Edition, Cengage Learning, 2008, ISBN: 978-0-495-29568-6.
- J. DeFranza and D. Gagliardi, *Introduction to Linear Algebra with Applications*, Waveland Press Inc., 1st Edition. ISBN: 978-1478627777.
- *MATLAB*, The MathWorks, Inc., Full or Student Version, R2010b or later.

Catalog Description: This is a first course in computer programming that develops programming concepts using MATLAB with application to engineering problems. Topics include data structures, arithmetic expressions, I/O, plotting, branching and loop structures, debugging, and user-defined functions. These concepts will be illustrated and emphasized through applications in chemical process mass balances, transport processes, truss structures, data fitting, principal component analysis in fluid and solid mechanics, and modal analysis in dynamics.

Pre-requisite(s): MTH 141. Approved and Intended Engineering Majors Only

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Understand the fundamental constructs used in procedural programming, including variables, data types, arrays, loops, conditionals, functions, data input/output.	1	HW, Quizzes, lab work, Exams
2. Understand the fundamentals of linear algebra including vector, matrices, determinants, matrix inverse, linear combinations, linear dependence, rank, span and linear system consistency	1	HW, Quizzes, Exams

3. Construct and solve linear systems of equations, for relevant engineering problems, both by hand and in MATLAB	1	HW, Quizzes, Exams
4. Write and test a computer program to solve engineering problems	1	HW, lab work, midterm, programming project
5. Read, interpret, and understand the operation of an algorithm written by others	1	HW, lab, exams
6. Work in a team to write, revise, and test a computer program for solving engineering problems	1, 5	Programming project

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
2				1		

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. MATLAB getting started, built-in functions, creating variables
2. Computer architecture
3. Creating and addressing arrays
4. Mathematical operation with arrays
5. Managing data in MATLAB
6. Branching
7. Looping
8. Two dimensional plots
9. Solving linear systems of equations
10. Determinant properties
11. LU factorization
12. Linear dependence/independence
13. Eigenvalues, eigenvectors and diagonalization
14. MS Excel
15. MATLAB

EAS 305 Applied Probability

Credit Hours: 3

Contact Hours: Lecture – Two one-hour 20 minute lectures per week

Instructor: Prof Jee Eun Kang

Textbooks and Other Materials:

Required: Textbook: Probability and Statistics for Engineering and the Sciences, 9th Edition. Author: Devore Jay; Publisher: Cengage Learning, 2016. ISBN-13: 978-1305251809
Textbook Companion Website: WebAssign (https://www.webassign.net/)

Catalog Description: Introduces probability and its application to engineering problems. Examines sample space, random variables, expected values, limiting theorems, error analysis, and provides introduction to random processes. Students may not receive credit for this course and CIE 308.

Pre-requisite(s): None

Co-requisite(s): MTH 241 or MTH 251. Approved and Intended Engineering Majors Only

Role in Curriculum: Required (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Use statistical methodology and tools in the engineering problem-solving process	1	Exam 1, 3; HW # 1, 9, 10
2. Compute and interpret descriptive statistics using numerical and graphical technique	1	Exam 1, HW #1
3. Understand the basic concepts of probability, random variables, probability distributions, and joint probability distributions	1	Exam 2, HW # 2 -6
4. Compute point estimation of parameters, explain sampling distributions, and understand the central limit theorem	1	Exam 3, HW # 7-8
5. Construct confidence intervals on parameters for a single sample	1, 4	Exam 3, HW # 9
6. Test hypothesis about population parameters based on sample data	4, 6	Exam 3, HW # 10

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
2			1		2	

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Descriptive statistics
2. Probability
3. Discrete random variables and probability distributions
4. Continuous random variables and probability distributions
5. Joint probability distributions and random variables
6. Point estimation
7. Statistical intervals based on a single sample
8. Test of hypotheses based on a single sample
9. Test of hypotheses based on two samples

EAS 330 Ethics in Engineering and Computing

Credit Hours: 3

Contact Hours: Lecture – Two one-hour 20 minute lectures per week

Instructor: Prof Amy Baird

Textbooks and Other Materials:

Required: *Engineering Ethics: Concepts and Cases*, 6th Edition
Charles E. Harris, Jr., Michael S. Pritchard, Michael J. Rabins, Ray W. James, P.E., Elaine E. Englehardt

The Poisoned City: Flint's Water and the American Urban Tragedy by Anna Clark, any edition

Catalog Description: Engineers and computer scientists can impact thousands of lives and are often put in difficult situations, such as those involving internal pressures and constraints surrounding deadlines and budgets. This is why it's essential for them to develop a habit of considering the ethical implications of their choices, as even seemingly small, everyday decisions can have unintended consequences. This course will introduce students to engineering and computing ethics by teaching them to identify ethical issues in engineering and computer science practice and acquire ways to think about them. Students will become familiar with ethical theories, professional ethics, and the ethical codes of their particular field. Through analyzing and discussing case studies, they will develop skills in critical thinking, communication, and reflection. This course is the same as PHI 330.

Pre-requisite(s): Approved Engineering Students Only

Co-requisite(s): None

Role in Curriculum: Selective Elective (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Describe major ethical theories	4	Reading responses; case study analysis
2. Recognize ethically complex situations.	3, 4, 5, 7	Case study analysis; group project; reading responses; journal entries
3. Describe and evaluate multiple solutions to an ethical problem, including demonstrated knowledge of the major canons of the code of ethics.	3, 4, 5, 7	Case study analysis; group project

4. Describe the ethical implications of an action.	4, 5, 7	Case study analysis; group project
5. Practice moral imagination to understand multiple perspectives, including perspectives of non-engineers.	3, 4, 5	Case study analysis; group project; reading responses, journal entries
6. Demonstrate listening skills to understand the perspectives of diverse publics affected by engineering decisions.	4	Reading responses, journal entries
7. Develop a deeper understanding of their personal ethics, and describe how these may compete with or be supported by professional ethics.	4	Personal Ethics Narrative; journal entries

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
		2	3	2		2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Personal versus professional ethics
2. History of engineering and computer ethics
3. Ethical theories
4. Legal versus Moral
5. Standard of Care
6. Codes of ethics
7. Case Study: Flint water crisis
8. Organizational culture; whistleblowing
9. Risk and safety
10. Honesty; conflict of interest
11. Trust and reliability
12. Engineering and the environment
13. Global context
14. Research and ethics
15. Ethics and technology
16. Diversity in STEM

EAS 360 STEM Communications

Credit Hours: 3

Contact Hours: Lecture – Three one-hour lectures per week

Coordinator: Prof Amy Baird,

Textbooks and Other Materials:

Required:

1. Tebeaux, E. & Dragga, S. *The Essentials of Technical Communication*. 4th ed. NY, New York: Oxford University Press. (3rd ed. acceptable – page numbers referenced may be different though)

2. Supplementary readings in support of this course will be provided via UBlearns (**https://ublearns.buffalo.edu/**)]

Catalog Description: Prepares students to successfully communicate, across a range of professional genres and media, to technical, professional, and public audiences; to produce communications individually and as part of a team; and to produce communications which are consistent with ethical engineering practice.

Pre-requisite(s): Completion of Communication Literacy 1. UB Curriculum Students Only

Co-requisite(s): MTH 241 or MTH 251. Approved and Intended Engineering Majors Only

Role in Curriculum: Required (Other)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Methods**
1. Recognize and produce professional communication in a range of relevant genres, including use of appropriate rhetorical strategies and formal elements.	3	HW, Tests, Individual Project, Team Project
2. Communicate successfully to a variety of audiences including professional (peers, management) and public audiences, using style and tone appropriate for those audiences.	3	HW, Tests, Individual Project, Team Project
3. Use appropriate qualities of professional writing style, including sentence conciseness, readability, clarity, accuracy, honesty, avoidance of wordiness or ambiguity, previewing, using direct order organization, objectivity, unbiased analyzing, summarizing, coherence, and transitional devices	3	HW, Tests, Individual Project, Team Project
4. Present information through live presentations in a logical sequence and with appropriate use of verbal and visual cues so that audience can understand the structure and organization of the talk	3	Individual Project, Team Project

5. Organize and adjust content to meet time constraints without rushing, and use eye contact, examples, and directed, animated speech to engage audience	3	HW, Tests, Individual Project, Team Project
6. Use non-textual elements (graphs, charts, equations, figures, photos) that are necessary for clarity, are complete, are appropriately labeled, and are referred to and explained appropriately	3	HW, Tests, Individual Project, Team Project
7. Recognize and practice professional formatting across all media, including print, html, multi-media, visual aids for oral presentations (posters, slides, etc.)	3	HW, Tests, Individual Project, Team Project
8. Compose individually and in collaboration with peers, and utilize appropriate technologies and practices which support collaborative writing	3,5	Tests, Team Project
9. Meet criteria for ethical communication in engineering practice including citing information sources and recognizing the contributions of others (including funding sources); providing legitimate interpretation of data; avoiding the use of selective results in order manipulate the reader; and explicitly acknowledging the data, assumptions, and limitations which challenge the stated conclusions	4	HW, Tests, Individual Project
10. Locate via literature search and read scientific and technical documents produced by others closely and critically	7	Tests, Team Project

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
		2	2	2		2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Written Communication
2. Oral Communication
3. Procedure Manual
4. Web Page
5. Resume
6. Cover Letter
7. Graphs and Charts
8. Technical Reports
9. Help Files
10. Collaborative Writing
11. Graphic Design Slides
12. Presentation Delivery

EAS 496 ENGINEERING CO-OP

Credit Hours: 1 to 3

Contact Hours: 3 to 9 hours of Internship work per week

Instructor: Prof Andrew Olewnik

Textbooks and Other Materials:

Required: None

Catalog Description: Up to three work periods of engineering-related employment. Co-op students are employed in technical assignments in industry, with emphasis on practical application of engineering coursework. Students are registered for 1-3 credit hours, but are afforded full-time status at the University if at least 2-credits are taken. This protects the student's insurance, loan deferment and possible immigration status. The course goal is to provide valuable experience for students, while making a positive contribution to the employer. Completion of the course assignments is intended to help students understand the relationship between technical and professional competencies and the transition from theory to practice.

Pre-requisite(s): Permission of instructor. Approved Engineering Majors Only

Co-requisite(s): None

Role in Curriculum: Selective Elective (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	Student Outcomes	Assessment Methods
1. Describe their role and contribution to the development of solutions to engineering/applied sciences-related problem(s)	1, 2, 3	Co-op Overview, Interim Journal
2. Demonstrate their ability to contribute to the development of solutions to engineering/applied sciences-related problem(s)	1, 2	Employer Evaluation, Final Presentation
3. Describe and assess their level of achievement in applying specific technical competencies in contributing to the development of solutions to engineering/applied sciences-related problem(s)	1, 2, 7	Interim Journal, Summative Reflection
4. Describe and assess their level of achievement in applying specific professional competencies in contributing to the development of solutions to engineering/applied sciences-related problem(s)	3, 4, 5	Interim Journal, Summative Reflection
5. Describe specific professional competencies like teamwork, written/oral communication, problem solving/critical thinking, initiative, and leadership and their relevance in execution of project activities and individual roles/responsibilities	3, 4, 5	Summative Reflection, Final Presentation

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
2	2	2	2	2		2

Contribution Level: 3 = Mastery, 2 = Reinforcement, and 1 = Introduction

Course Topics:

Provides a field experience by means of working on a Mechanical Engineering project in a practical setting (design or consulting, governmental agency office, etc.) under the joint guidance of a practicing engineer and a faculty advisor. Projects are selected that integrate the material learned in academic courses at UB. A written report and an oral presentation are required.

EE 202 Circuit Analysis

Credit Hours: 4

Contact Hours: Lecture – Two 80 min lectures per week; Recitation – One-50 min per week

Instructor: Farah Vandrevala

Textbooks and Other Materials:

Required: Engineering Circuit Analysis - 9th Edition by William Hayt, Jack Kemmerly, and Steven Durbin, McGraw-Hill Science.

Catalog Description: Systematic development of network analysis methods. Topics include resistive circuits, Kirchhoff's laws, equivalent subcircuits; dependent sources; loop and nodal analysis; energy-storage elements; transient analysis of first-order and second-order circuits; sinusoidal steady-state analysis; passive filters.

Pre-requisite(s): MTH 141, Recommended: MTH 142, MTH 306, PHY 107, PHY 108

Role in Curriculum: Selective Elective (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	Student Outcomes	Assessment Methods
1. Be able to describe the electrical characteristics of voltage sources, current sources, resistors, inductors, and capacitors.	1	Homework and exams
2. Be able to use Ohm's law to solve DC and AC circuits appropriately.	1	Homework and exams
3. Be able to apply Kirchhoff's circuit laws for DC and AC circuits and be able to explain how KCL and KVL lead to appropriate standard circuit analysis techniques.	1,2	Homework and exams
4. Be able to apply standard circuit analysis techniques to DC circuits including the methods of: node-voltages, mesh currents, source transformations, Thevenin and Norton conversions, maximum power transfer, superposition	1,2	Homework and exams
5. Be able to identify and analyze first order RL and RC circuits including: series and parallel circuits, the natural response (non-driven), the step response (DC source driven)	1	Homework and exams
6. Be able to analyze sinusoidal stead-state analysis of RLC circuits	1	Homework and exams

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
2	1					

Contribution Level: 3 = Mastery, 2 = Reinforcement, and 1 = Introductory

Course Topics:

1. Introduction to Circuit Analysis
2. Basic components and electric circuits
3. Voltage and current laws
4. Basic nodal and mesh analysis
5. Useful circuit analysis techniques
6. Capacitors and inductors
7. Basic RL and RC circuits
8. The LC circuit
9. Sinusoidal steady-state analysis

IE 320 Engineering Economy

Credit Hours: 3

Contact Hours: Lecture – 3 hours per week

Coordinator: Sabrina Casucci

Textbooks and Other Materials:

Required: Park, Chan S., *Contemporary Engineering Economics*, 6th Ed., Prentice Hall (2015)
Top Hat Subscription

Catalog Description: Applied concepts of economic decision making, including present worth analysis, cash-flow equivalence, replacement analysis, equipment selection. Open to students in any discipline.

Pre-requisite(s): MTH 141

Co-requisite(s): None

Role in Curriculum: Selective Elective (Engineering Topic)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	Student Outcomes	Assessment Methods
1. Evaluate the investment worthiness of individual engineering projects by applying time value of money concepts	1	Homework, Exams, Self-assessment, Participation
2. Describe how commercial loans and mortgages are structured and calculate interest and principal payments for each	1	Homework, Exams, Self-assessment, Participation
3. Compare the investment worthiness of multiple mutually exclusive engineering projects using NPW, AE, and ROR methods	1	Homework, Exams, Self-assessment, Participation
4. Understand the role of cost data in short term and production related decision making	1	Homework, Exams, Self-assessment, Participation
5. Quantify the impact of depreciation and taxes on engineering projects and business operations	1, 4	Homework, Exams, Self-assessment, Participation

6. Prepare cash flow statements for engineering projects to facilitate investment worthiness evaluation	1, 4	Homework, Exams, Self-assessment, Participation
7. Describe the complexities of economic analysis in evaluation of service sector and health care related projects.	1, 2	Homework, Exams, Self-assessment, Participation

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
2	2		2			

Contribution Level: 3 = Mastery, 2 = Reinforcement, and 1 = Introduction

Course Topics:

1. Economic equivalence & time value of money
2. Nominal and effective interest rate
3. Debt financing
4. New present worth analysis
5. Annual equivalent worth analysis
6. Rate of return analysis
7. Operational costs and short-term decisions
8. Depreciation
9. Taxes
10. Developing financial statements
11. Economic analysis in the private sector

MAE 177 Introduction to Computer-Aided Design (CAD)

Credit Hours: 1

Contact Hours: Online course

Instructor: Prof. Jason Armstrong or Prof. Ardeshir Raihanian

Textbooks and Other Materials:

Required: None

Required software: SOLIDWORKS 2018

Catalog Description: The purpose of this course is to familiarize students with a 3D modeling CAD software platform, like Creo Parametric. Students will learn basic 3D modelling functions such as extrude, revolve, pattern, sweep, etc. The course will cover integration of individual parts into assemblies. Documenting CAD models through the use of engineering drawings will also be covered.

Pre-requisite(s): Approved and Intended Engineering Majors Only

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Understand and interpret engineering graphics	1, 2, 3, 7	Assignments and Final Project
2. Utilize SOLIDWORKS to create solid models and engineering drawings.	1, 2, 3, 7	Assignments and Final Project

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
1	1	1	0	0	0	2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:
1. Basic 3D modelling functions
2. Integration of individual parts into assemblies
3. Documenting CAD models through the use of engineering drawings

MAE 204 Thermodynamics 1

Credit Hours: 3

Contact Hours: Lecture – Two one-hour and twenty-minute lectures per week

Recitation: One fifty-minute recitation per week

Instructor: Prof. Jobaidur Khan, Prof. Alaa Eldeen A. Hassan Ali, Prof. David Salac

Textbooks and Other Materials:

Required: Thermodynamics: An Engineering Approach by Cengal and Boles, 8th Edition

Catalog Description: Analysis of the laws of thermodynamics that involve mass, energy, and entropy. Students will gain knowledge of thermodynamic properties, processes, and cycles. They will be able to apply the governing laws to open and closed systems, along with steady and unsteady processes. Students will also understand the behavior of pure compressible substances as well as idealized substance models and will be able to characterize the performance and efficiency of power cycles.

Pre-requisite(s): MTH 142

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. To teach students the basic principles of classical thermodynamics.	1	Homework, Quizzes, Project
2. To train students to identify, formulate, and solve engineering problems in classical thermodynamics involving closed and open systems for both steady state and transient processes.	1, 7	Homework, Quizzes, Project
3. To train students in the application of a second law analysis to a thermodynamic system.	1, 7	Homework, Quizzes, Project
4. To train students to analyze the performance of power, refrigeration, and heat pump cycles.	1, 2, 3, 5, 7	Homework, Quizzes, Project

5. To teach students the basic principles of classical thermodynamics.	1	Homework, Quizzes, Project
6. To train students to identify, formulate, and solve engineering problems in classical thermodynamics involving closed and open systems for both steady state and transient processes.	1, 7	Homework, Quizzes, Project

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	1	1	0	2	0	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:
1. Laws of thermodynamics involving mass, energy, and entropy
2. Thermodynamic properties, processes, and cycles
3. Application of governing laws to open and closed systems
4. Steady and unsteady processes
5. Compressible substances and idealized substance models
6. Performance and efficiency of power and refrigeration cycles

MAE 277 Introduction to Mechanical Engineering Practice

Credit Hours: 3

Contact Hours: Lecture – Three fifty-minute lectures per week

Instructor: Prof. Zachary Ball

Textbooks and Other Materials:

Required: Jonathan Wickert and Kemper Lewis, An Introduction to Mechanical Engineering, 4th Edition, Cengage Learning, 2017

Catalog Description: An overview of engineering in industry; introduces engineering design concepts, reverse engineering, case studies including a hands-on product dissection project, basics of manufacturing processes, elementary modeling of engineering systems, and technical communications.

Pre-requisite(s): Approved and Intended Mechanical Engineering Majors Only

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Understand the role of mechanical engineers in industry and society, and their impact on a global level	1, 2	Homework, Quizzes, Exams
2. Create appropriate models for engineering systems given the desired outcome	1, 2, 6	Homework, Project
3. Effectively estimate and evaluate analytical results in a technically rigorous manner, lever- aging the appropriate information for the desired outcome	1, 7	Homework, Exams, Project
4. Make and justify engineering decisions considering technical, global, societal, economic, and environmental factors	2, 3, 4	Project
5. Effectively communicate your findings across disciplines, including but not limited to business, engineering, manufacturing, legal, etc.	3	Project

6. Understand and demonstrate the characteristics of professional behavior	4, 5	Homework, Project

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	3	2	3	3	3	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Mechanical engineering profession
2. Engineering analysis and estimation
3. Design process and design concepts
4. Manufacturing processes
5. Problem solving and communication skills
6. Materials selection
7. Professionalism and ethics

MAE 315 Analysis of Structures

Credit Hours: 3

Contact Hours: Lecture – Three fifty-minute lectures per week/Two one-hour and twenty-minute lectures

Instructor: Prof. Bradley Darrall or Prof. Robert Wetherhold

Textbooks and Other Materials:

Required: Ugural and Fenster (2012), *Advanced Mechanics of Material and Applied Elasticity*, Fifth Edition, Prentice Hall.

Additional Resources: MATLAB, The MathWorks, Inc., Full or Student version, R2007b or later.

Catalog Description: Examines the theory of elastic structural components including elastic stress analysis; equilibrium, strain displacement and compatibility; yield criteria; energy methods; finite element analysis and numerical methods.

Pre-requisite(s): EAS 209

Co-requisite(s): MAE 376; Approved ASE and ME majors only

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Gain fundamental knowledge of structural elements and stress analysis	1	Series of "active" handouts, HW's
2. Learn how to design structural elements based on failure and other criteria	2	HW's, Take-home exam problems
3. Develop an understanding of how basic programming and numerical methods can be used in structural analysis	7	HW's, Take-home exam problems, FE project

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	1	0	0	0	0	2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Analysis of stress
2. Strain and Material Properties
3. Problems in Elasticity
4. Failure Criteria
5. Axisymmetrically loaded members
6. Bending of beams
7. Application of energy methods
8. Numerical solutions

MAE 316 Aerospace Structures

Credit Hours: 3

Contact Hours: Lecture – Three fifty-minute lectures per week

Instructor: Prof. Robert Wetherhold or Prof. Gary Dargush

Textbooks and Other Materials:

Required: T.H.G. Megson, Intro to Aircraft Structural Analysis 3rd ed, B-H Pub, 2018, ISBN 978-0081020760

Catalog Description: Explores the theory of light structures including beam bending, shear stress, shear center, and composite beams; shear flow, warping stresses, and secondary warping; torsion of thin-walled single and multi-cell tubes; deformation of struts, plates, frames, and trusses; stress analysis of connections; composite structures and sandwich construction. Also covers computer implementation with applications to aircraft and aerospace structures.

Pre-requisite(s): MAE 315

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Formulate and solve aircraft structure problems using analytical and numerical methods	1	All HW's and tests
2. Design aspects	2	HW and test problems involving uncertainty, "factors of safety"
3. Develop an understanding of how basic programming and numerical methods can be used in structural analysis. Application of numerical tools acquired in MAE 376.	7	HW and take home test problems

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	1	0	0	0	0	2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Materials
2. Structural Components
3. Airworthiness, Airframe loads
4. Bending, shear, and torsion of beams
5. Combined open and closed section beams
6. Wing spars, box beams, fuselages, fuselage frames, wings, wing ribs
7. Structural instability, vibration of beams
8. Laminated and composite structures

MAE 334 MAE Lab 1

Credit Hours: 3

Contact Hours: Lecture – Three fifty-minute lectures per week

Instructor: Prof. Aaron Estes or Prof. Ardeshir Raihanian

Textbooks and Other Materials:

Required: None

Catalog Description: Introduces digital data acquisition systems. A/D convertors, and amplifiers. Error analysis. Transducers for mechanical and electrical measurements. Static and dynamic response of electrical and mechanical elements and systems. Modifying dynamic response using feedback control.

Pre-requisite(s): MAE 340, EAS 209

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1	Workshops, In-class exercises
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	2	Final Project
3. Communicate effectively with a range of audiences	3	Final Project Report and Oral Presentation
4. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	5	Lab Reports, Final Projects
5. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	6	Final Project
6. Acquire and apply new knowledge as needed, using appropriate learning strategies	7	Final Project

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
2	1	3	0	3	3	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Analog and Digital Signal Sampling Theory and Practice
2. Identification of System Parameters
3. Analysis of Sampled Data
4. Uncertainty Analysis and Error Propagation
5. Measurement Tools and Sensors
6. Experimental Design to Capture Desired Data
7. Sending and Receiving Data with a Microcontroller (Arduino)

MAE 335 Fluid Mechanics

Credit Hours: 3

Contact Hours: Lecture – Three fifty-minute lectures per week
Recitation – One fifty-minute recitation per week

Instructor: Prof. Matthew Burge or Professor Craig Snoeyink

Textbooks and Other Materials:

Required: Munson, Young and Okiishi's *Fundamentals of Fluid Mechanics*, 8th editions, John Wiley and Sons, Inc.

Additional:

- WileyPlus to access course on-line course materials
- Smits, A. J. A Physical Introduction to Fluid Mechanics A.J. Smits 2015 (PDF available on UBLearns)

Catalog Description: Fluid statics; substantial derivatives; Reynolds transport equation; control volume approach for conservation of mass, linear momentum, moment of momentum, and the first law of thermodynamics; dimensional analysis and similitude; laminar and turbulent pipe flow of liquids; boundary-layer theory; one-dimensional, compressible flow; potential flow.

Pre-requisite(s): EAS 209

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Determine pressure changes within manometers	1	Homework, Exam 1
2. Analyze steady, one-dimensional inviscid flows through the application of Bernoulli's equation; predict of static and dynamic pressure variations throughout a flowing system	1	Homework, Exam 1, Final exam
3. Perform dimensional analyses on general fluid flow systems and apply the concepts of similitude to such systems, including the application of similitude to laboratory modeling, and scale effects, as well as the correlation of experimental data	1, 7	Homework, Quiz, Exam 2, Final exam
4. Implement the concept of the control volume and apply conservation of mass and linear momentum principles in modeling and analyzing steady open systems	1	Homework, Quiz, Exam 2, Final exam
5. Analyze the flow of viscous fluids through pipes and simple piping systems for both laminar and turbulent flows, including minor losses	1, 7	Homework, Quiz, Final exam

6. Analyze the effects of flow on immersed bodies including the application of the concepts of boundary layers, and lift and drag	1, 7	Homework, Quiz, Final exam

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	0	0	0	0	0	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Drag on falling spheres
2. Dye-flow visualization
3. Uncertainty analysis
4. Lift and drag on airfoils
5. Calibration of flow meters
6. Latex Report Generation
7. Measuring drag coefficients
8. Reynolds number calculations

MAE 336 Heat Transfer

Credit Hours: 3

Contact Hours: Lecture – Three fifty-minute lectures per week

Instructor: Prof. Matthew Burge or Prof. Joseph Mollendorf

Textbooks and Other Materials:

Required: Elements of Propulsion, Gas Turbines and Rockets, Second Edition by Jack D. Mattingly and Keith M. Boyer

Catalog Description: Introduces the transport of heat by conduction, convection, and radiation. Topics include transient and steady-state, one- and multidimensional heat conduction (treated both analytically and numerically); single-phase, laminar and turbulent, and forced and natural convection both within ducts and on external surfaces (dimensional analysis and empirical correlations); two-phase transport (boiling and condensation); radiative properties of materials and analysis of radiative heat transfer in enclosures; and analysis of heat exchangers.

Pre-requisite(s): MAE 204

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Determine the temperature distribution and heat transfer rate in a system	1	Homework, Exams 1 – 3
2. Solve first order differential equations by applying boundary conditions	1, 7	Homework, Exams 1 – 3
3. Perform energy balances on control surfaces using multiple modes of heat transfer including conduction, convection and radiation	1	Homework, Exams 1 – 3
4. Perform finite difference heat transfer analysis	1	Homework, Exam 1
5. Determine heat transfer coefficients for radiation and convection	1, 7	Homework, Exams 2 – 3
6. Investigate enhancing heat transfer through geometric configurations	1, 7	Homework, Exams 1 – 3

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	0	0	0	0	0	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Heat diffusion
2. Shape factor
3. Natural convection
4. Conduction
5. Transient heat transfer
6. Heat exchangers
7. Thermal Resistance
8. Forced convection
9. Radiation

MAE 338 MAE Lab II

Credit Hours: 2

Contact Hours: Lab – One two-hour and fifty-minute lab per week

Instructor: Prof. Jobaidur Khan or Prof. Jude Sabato

Textbooks and Other Materials:

Required: None

Catalog Description: Testing the behavior and response of fluid and thermal systems; dimensionless groups, flow metering; measurement of properties such as viscosity, friction losses, thermal conductivity; heat exchangers, thermodynamic cycles.

Pre-requisite(s): MAE 335, MAE 336

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Work in a team as a team member to create a collaborative environment to achieve goals	5	In all experiments
2. Validate drag coefficient by comparing between the one obtained in experiment and theoretical ones	3, 6	Drag on a sphere experiment
3. Find the viscosity of different fluids and compare with actual values	3, 6	Viscosity measurement experiment
4. Use different instruments, e.g. manometer, orifice meter, venture meter, turbine meter, float meter for flow measurement	6	Flow meter calibration experiment
5. Use modern data acquisition system to collect data for heat exchanger and interpret the data	3, 6	Heat exchanger experiment
6. Calculate the heat conduction parameters from data obtained from experiments	6	Transient heat conduction experiment
7. Solve Uncertainty problem in assignment and in different experiments	1	Uncertainty homework and Drag, Viscosity, and Flowmeter experiments

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
1	0	3	0	1	3	0

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Fluid Viscosity Measurement
2. Drag on a Sphere
3. Concentric-Tube Heat Exchanger
4. Plate Heat Exchanger
5. Flow Meter Calibration

MAE 339 AE Lab II

Credit Hours: 2

Contact Hours: Lab – One two-hour and fifty-minute lab per week

Instructor: Prof. Matthew Burge

Textbooks and Other Materials:

Required: None

Catalog Description: Students will conduct a series of hands-on experiments in fluid mechanics, heat transfer, and aerodynamics in small groups. They will post-process and analyze the experimental data and compare them with available theories. Communication of the objectives, results, and conclusions is critical in any engineering position; therefore students will present their findings in both textual and graphical form in professional-style reports. Uncertainty analysis is an essential part of analyzing and presenting experimental data, and is incorporated into the labs. Finally, the design of experiments, i.e. what experiment will be conducted, and how and why it will be done, is incorporated heavily into one of the labs and as design problems in the others.

Pre-requisite(s): MAE 335, MAE 336, MAE 424

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Apply theoretical concepts from fluid mechanics, heat transfer, and aerodynamics to study the performance of real-world engineering experiments, including airfoil tests	1	Lab experiences and reports
2. Select test cases for an experiment and approach new experimental design problems based on previous experience	2	Lab experiences and reports
3. Communicate the results and conclusions clearly and effectively, both written and graphically, in a well-organized and thorough technical report	3	Lab experiences and reports
4. Select test cases for an experiment and approach new experimental design problems based on previous experience	5	Lab experiences and reports
5. Interpret the physical meaning of the results and draw conclusions on setup performance; perform an uncertainty analysis, and understand the results and limitations in this context	6	Lab experiences and reports

6. Use fundamental tools of experimental investigation in the field, such as electronic data acquisition, thermocouples, flow meters, manometers, and micrometers, to obtain data; analyze the acquired data using theory couple with appropriate software (e.g. Excel)	7	Lab experiences and reports

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
1	1	3	0	2	3	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Drag on falling spheres
2. Dye-flow visualization
3. Uncertainty analysis
4. Lift and drag on airfoils
5. Calibration of flow meters
6. Latex Report Generation
7. Measuring drag coefficients
8. Reynolds number calculations

MAE 340 Dynamic Systems

Credit Hours: 3

Contact Hours: Lecture – Three fifty-minute lectures per week

Instructor: Prof. D. Joseph Mook or Prof. Minghui Zheng

Textbooks and Other Materials:

Required: None

Catalog Description: Modeling and analysis of lumped physical systems; static and dynamic response of electrical, mechanical, thermal and hydraulic elements, systems and transducers; Laplace transforms, transfer functions, frequency response; mixed systems; use of state space and matrix methods in systems modeling and analysis; introduction to feedback control.

Pre-requisite(s): EAS 208, Mechanical or Aerospace Engineer Majors Only

Co-requisite(s): MAE 376

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Create mathematical models of practical engineering systems that may include mechanical elements, electrical circuits, hydraulic systems, and or thermal/components, as well as the interfaces between these subsystems	1, 2, 6, 7	HW's, quizzes, tests, and/or final exam
2. Solve and/or otherwise analyze mathematical models of practical engineering systems for critical engineering design and evaluation purposes, including stability, performance, time-domain behavior, frequency-domain behavior	1, 2, 3, 4, 6, 7	HW's, quizzes, tests, and/or final exam

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	2	1	1	0	1	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:
1. Time Domain Analysis
2. Laplace Domain Analysis
3. Frequency Domain Analysis
4. Modeling of physical systems

MAE 345 Intermediate Dynamics

Credit Hours: 3

Contact Hours: Lecture – Two one-hour and twenty-minute lectures per week

Recitation – One fifty-minute recitation per week

Instructor: Prof. Bradley Darrall or Prof. Gary Dargush

Textbooks and Other Materials:

Required: H. Schaub, J. Junkins (2014), Analytical Mechanics of Space Systems, 3rd or 4th Edition, AIAA. (Required)

MATLAB, The MathWorks, Inc., Full or Student version, R2007b or later. (Required)

Catalog Description: Intermediate dynamics is a preliminary course in modeling dynamical systems for mechanical and aerospace engineering students. Fundamentals methods of kinematics and kinetics for a system of particles are presented with applications to physical systems. This discussion is followed by the development of equations of motion of a rigid body, including the study of torque free motion and conservation principles. Constrained motion is discussed briefly along with a short study of impulsive motion. The concept of equilibrium points for dynamical systems is introduced and methods of linear analysis are discussed in conjunction with linearization about the equilibrium point. The course concludes with an exposition of vibration theory and its relationship to Eigenvalue problems.

Pre-requisite(s): EAS208

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Understand advanced analytical dynamics concepts	1, 5	Tests, assignments
2. Understand and be able to relate the kinematics of particles and rigid bodies to the solution of dynamics problems in general 2- and 3-d curvilinear motion	1	Tests, assignments
3. Understand the various attitude coordinates, that are used to describe the 3d orientation of a rigid body, and how these coordinates are related to each other	1, 5, 7	Tests, assignments

4. Apply Newton's Laws and Euler's equations to solve problems involving the dynamic response of particles and rigid bodies, subject to foces and moments	1	Tests, assignments
5. Understand how Lagrangian mechanics can be used as an alternative method to solve complex 3-d dynamics problems	1, 7	Tests, assignments
6. Implement numerical methods to solve the non-linear equations that come up in analysis of dynamic components	1, 5, 7	Tests, assignments

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	0	0	0	1	0	2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Intro: Vectors / Vibration
2. Particle Kinematics
3. Particle Kinetics
4. Rigid Body Kinematics
5. Eulerian Mechanics
6. Lagrangian Mechanics

MAE 364 Manufacturing Processes

Credit Hours: 3

Contact Hours: Lecture – Three fifty-minute lectures per week

Instructor: Prof. Jennifer Stamm

Textbooks and Other Materials:

Required: None

Suggested: *Manufacturing Processes for Engineering Materials,* 6th edition (5th addition is also acceptable), Serope Kalpakjian and Steven R. Schmid

Catalog Description: Examines manufacturing processes including casting, forming, cutting, joining, and molding of various engineering materials (metals and non-metals). Also studies manufacturing considerations in design including material and process selection, tooling, product quality, and properties/processing tradeoffs. Includes quality control and automation issues.

Pre-requisite(s): MAE 381

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Identify the various capabilities and limitations of the many manufacturing processes	1	Assignments, Quizzes, Exams, Projects
2. Describe various manufacturing techniques and distinguish the appropriate process for given scenarios	1	Assignments, Quizzes, Exams, Projects
3. Propose design modifications considering the various capabilities and limitations of the manufacturing processes	2, 4, 5, 7	Projects
4. Evaluate and justify which manufacturing methods are suitable for fabricating a given product	1, 4, 7	Assignments, Quizzes, Exams, Projects
5. Design a unique product that considers their ethical responsibilities and realistic constraints	2, 4, 5	Projects

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
2	2	0	1	2	0	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Properties of metals
2. Casting process
3. Bulk deformation
4. Machining
5. Additive manufacturing

MAE 377 Product Design in a CAE Environment

Credit Hours: 3

Contact Hours: Lecture – One fifty-minute lecture per week

Lab – One one-hour and fifty-minute lab per week

Instructor: Prof. Jason Armstrong

Textbooks and Other Materials:

Required: None

Software Used: Creo Parametric & Creo Simulate

Catalog Description: This course examines detailed mechanical design of functional, pragmatic products, including topics in computer-aided-design (CAD), finite element analysis (FEA), and geometric dimensioning & tolerancing (GD&T). The lab portion of the course will focus on learning CAE software for modeling, analysis, documentation.

Pre-requisite(s): MAE 177 (or EAS 999TR177)

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Understand and apply Geometric Dimensioning & Tolerancing (GD&T) in accordance with ASME standards	1, 2, 3, 7	Assignments, quizzes, and projects
2. Utilize commercial Finite Element Analysis (FEA) software to perform structural analysis on components and assemblies	1, 2, 3, 7	Assignments, quizzes, and projects

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
1	3	1	0	0	0	2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:
1. Solid Modeling
2. Finite Element Analysis
3. Geometric Dimensions and Tolerancing (GD&T)

MAE 381 Engineering Materials

Credit Hours: 3

Contact Hours: Lecture – Two one-hour and twenty-minute lectures per week

Instructor: Prof. Jason Armstrong or Prof. Robert Wetherhold or Prof. Deborah Chung

Textbooks and Other Materials:

Required: Materials Science and Engineering: An Introduction, Callister and Rethwisch, 10th Ed., Wiley, 2018.

Catalog Description: Introduces the physics and chemistry of engineering materials including metals, ceramics, polymers, and composites. Covers the relationships among the processing, internal structure, material properties, and applications. Internal structure includes crystal structure, imperfections, and phases. Processing includes annealing, precipitation hardening, and heat treatment of steel. Properties include mechanical properties and corrosion behavior. Also considers current industrial needs.

Pre-requisite(s): CHE 101 or CHE 105 or CHE107

Co-requisite(s): None

Role in Curriculum: Required (2 credits Engineering Topics, 1 credit Math & Basic Sciences)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Understand the internal structure of a material and how it impacts the behavior of the material	1	Exams
2. Understand how the internal structure of a material can be controlled by processing to alter the material properties	1	Exams
3. Perform a literature survey on an advanced material topic and disseminate the results in a term paper	3, 7	Term paper

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
23	0	1	0	0	0	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Physics and chemistry of engineering materials including metals, ceramics, polymers, and composites
2. Relationship among the processing, internal structure, material properties, and applications.

3. Internal structure includes crystal structure, imperfections, and phases.
4. Material processing, including annealing, precipitation hardening, and heat treatment of steel.
5. Material properties, including mechanical properties and corrosion behavior.

MAE 385 Materials Lab

Credit Hours: 1

Contact Hours: Lab – One two-hour and fifty-minute lab per week

Instructor: Prof. Jason Armstrong

Textbooks and Other Materials:

Required: Materials Science and Engineering: An Introduction, Callister and Rethwisch, 10th Ed., Wiley, 2018.

Catalog Description: Involves experiments designed to illustrate the relationships among the processing, internal structure and properties of engineering materials, emphasizing metals and their heat treatment, microstructure and mechanical properties. Provides hands-on experience in metallography, heat treatment and mechanical testing. Includes laboratory report writing and work in groups.

Pre-requisite(s): MAE 381

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Perform standardized tests to determine material properties	6, 7	Labs 1 & 2
2. Understand how a material's property can be adjusted via processing, such as: cold work, hot work, heat treatment, adjusting cooling rate, etc.	1	Labs 3, 5, & 6
3. Use metallographic techniques of polishing, etching, and quantitative microscopy to evaluate the microstructure to gain fundamental understanding of the reasons for the changes in measured mechanical properties.	6	Lab 4
4. Communicate, clearly and concisely, and according to the established professional norms, the results of the measurements of material properties and the experimental procedures, including limitations and sources of errors, by writing a Lab report.	3	Labs 1 – 6
5. Be aware that a mechanical engineer, when using a material property from an Atlas or a Handbook, must know how this property was measured, along with the conditions and limitations of these measurements.	1	Labs 1 – 6

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
1	0	2	0	0	2	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Tensile Testing and Mechanical Properties
2. Mechanical Properties and Testing: Shear, Bending, and Hardness
3. Plastic Deformation, Recovery, Recrystallization, and Grain Growth.
4. Metallographic Examination of Metals and Alloys.
5. Hardened and Tempered Steel.
6. Precipitation Hardening of Aerospace-related Aluminum Alloys

MAE 422 Gas Dynamics

Credit Hours: 3

Contact Hours: Lecture – Two one-hour twenty-minute lectures per week

Instructor: Prof. James Chen

Textbooks and Other Materials:

Required: J. D. Anderson Modern Compressible Flow with HistoricalPerspective, McGraw-Hill

Catalog Description: Explores fundamentals of gas dynamics and compressible aerodynamics including one-dimensional isentropic flow; one-dimensional flow with friction and with heating or cooling; normal shock relations; oblique shocks and expansion waves; the method of characteristics; quasi-one-dimensional flow; nozzles and diffusers; shock tubes; and small perturbation theory.

Pre-requisite(s): MAE 335

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Describe assumptions, physical meaning of terms and to utilize key relationship for compressible flow, speed of sound, isentropic and non-isentropic flows and potential and rotational flows	1, 2	Homework, Midterm
2. Calculate the effect of area change, shaft work, heat addition, mass addition and friction on flow states in a compressible channel flow	1, 6	Homework
3. Characterize quantitatively the behavior of velocity and density non-uniformities in an unsteady compressible flow including their evolution in fluid system components	7	Homework, Midterm, Final
4. Estimate the lift and drag for basic aerodynamic shapes in compressible, inviscid flows	6, 7	Homework, Final

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	1	0	0	0	2	2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Brief review of fluid mechanics and thermodynamics
2. Review of steady, one-dimensional gas dynamics
3. Unsteady, one-dimensional gas dynamics
4. Steady, two-dimensional gas dynamics
5. Viscous effects
6. Hypersonic and nonequilibrium flows

MAE 423 Introduction to Propulsion

Credit Hours: 3

Contact Hours: Lecture – Two one-hour twenty-minute lectures per week

Instructor: Prof. Paul DesJardin

Textbooks and Other Materials:

Required: Elements of Propulsion, Gas Turbines and Rockets, Second Edition by Jack D. Mattingly and Keith M. Boyer

Catalog Description: Reviews combustion thermodynamics; flow in nozzle, diffuser, and constant area duct with shock; analysis and performance of air breathing and chemical rocket propulsion systems; performance of single and multi-staged rocket vehicles; and space missions.

Pre-requisite(s): MAE 335

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1	Homework, Exam
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	2	Final Project
3. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	4	Final Project
4. Acquire and apply new knowledge as needed, using appropriate learning strategies	7	Homework

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	3	0	3	0	0	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Reacting thermodynamics and compressible flows
2. Analysis of air-breathing engines
3. Analysis of non-air-breathing engines
4. Design considerations including constraints and topics related to SOs 2 and 4

MAE 424 Aerodynamics

Credit Hours: 3

Contact Hours: Lecture – Two one-hour and twenty-minute lectures per week

Instructor: Prof. Matthew Ringuette

Textbooks and Other Materials:

Required: Anderson, J. D., Fundamentals of Aerodynamics, 6th Edition, McGraw-Hill, NY (2016).

Catalog Description: Explores flow over airfoils and wings; ideal flow theory; singularity solutions; superposition; source; and vortex panel methods; method of source panels; 2-D airfoil theory; pressure distributions and lift; effects of compressibility; Prandtl's lifting-line theory; boundary-layer theory; and friction drag. Includes an aerodynamics laboratory experience, considering airfoil characteristics, and boundary-layer measurements.

Pre-requisite(s): MAE 335

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Understand the physical mechanisms underlying the aerodynamics of airfoils and wings	1	Homework, Exams, Projects
2. Apply the appropriate governing equations and assumptions to analyze airfoils and wings, and obtain aerodynamic forces and moments	1	Homework, Exams, Projects
3. Identify the effects of parameters such as airfoil shape, wing aspect ratio, and compressibility on performance	1	Homework, Exams, Projects
4. Incorporate aspects such as fuel efficiency and cost into performance calculations, to consider environmental and economic factors	2, 4	Projects
5. Have an introductory knowledge of the experimental facilities and methods used to measure airfoil characteristics	1	Homework, Exams
6. Have an introductory understanding of the computational methods used to analyze airfoils and wings	1	Projects
7. Produce an aerodynamic design to meet specified requirements and constraints, including environmental and economic considerations, using the skills identified above	2, 4	Projects

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	3	0	1	0	0	0

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Aerodynamic forces and moments
2. Center of pressure
3. Streamlines
4. Vorticity
5. Circulation
6. Stream function
7. Potential flow
8. D'Alembert's paradox
9. Kutta-Joukowski theorem and the generation of lift
10. Airfoil characteristics, vortex sheets
11. Kutta condition
12. Kelvin's circulation theorem
13. Thin airfoil theory
14. Cambered airfoils
15. Panel methods
16. Modern low-speed airfoils
17. Flow fields around finite wings
18. Biot-Savart law
19. Helmholtz's vortex theorems
20. Prandtl's lifting-line theory
21. Introduction to compressible flow
22. Velocity potential equation
23. The linearized velocity potential equation
24. Prandtl-Glauert compressibility correction
25. Brief viscous-flow boundary-layer and turbulence concepts

MAE 425 Spacecraft Dynamics & Control

Credit Hours: 3

Contact Hours: Lecture – One one-hour and twenty-minute lecture per week

Instructor: Prof. John Crassidis

Textbooks and Other Materials:

Required: Schaub, H., and Junkins, J.L., Analytical Mechanics of Space Systems 4th Edition, AIAA Educational Series, Reston, VA 2018.

Catalog Description: Introduces the concepts of spacecraft orbital mechanics and attitude dynamics. Orbital mechanics is the study of the positional motion, while attitude dynamics describes the orientation of the spacecraft. Topics include: review of rotational kinematics and dynamics, orbital mechanics, gravity turn and trajectory optimization, orbit lifetimes, three-body problem, orbit perturbations, orbit determination, spacecraft dynamics, spinning and three-axis stabilized spacecraft, and attitude determination.

Pre-requisite(s): MAE 345, MAE 376

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Apply orbital and attitude equations of motion to formulate practical spacecraft mission requirements	1	Project 1 and 2
2. Draw conclusions on the usefulness of orbital dynamics and coordinate frames to interpret solutions	6	Home 3, 4, and 6
3. Understand and apply knowledge of the theory behind orbital and attitude equations of motion to solve new problems	7	Test 1 and 2

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
3	0	0	0	0	1	2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Introduction and Vectors
2. Introduction to Orbital Dynamics
3. Ellipses, Kepler and Newton
4. Angular Momentum & Newton’s Law
5. The Two-Body Problem
6. Kepler’s Equation
7. Orbital Coordinate Systems
8. Lagrange/Gibbs F and G Solution
9. Spacecraft Formation Flying
10. Orbit Determination
11. Earth-Satellite Operations
12. Transport Theorem
13. Newtonian Mechanics
14. Angular Momentum & Kinetic Energy
15. Attitude Matrix, representations, and kinematics
16. Rotational Dynamics
17. Inertia and Kinetic Energy
18. Euler’s Rotational Equations
19. Energy/Momentum Integrals and Attitude Control
20. Attitude Determination and Feedback Attitude Control
21. Application of energy methods
22. Numerical solutions

MAE 436 Flight Dynamics

Credit Hours: 3

Contact Hours: Lecture – Two one-hour and twenty-minute lectures per week
Recitation – One fifty-minute recitation per week

Instructor: Prof. Francis Lagor

Textbooks and Other Materials:

Required:

[1] Nelson, R. C., Flight Stability and Automatic Control. 2nd Edition, McGraw-Hill, 1998.
[2] Stevens, B. L., and Lewis, F. L., Aircraft Control and Simulation. 2nd Edition, Wiley, 2003.
[3] Stengel, R. F., Flight Dynamics. Princeton University Press, 2004.

Catalog Description: Reviews practical aerodynamics of wings and bodies, as well as performance of aircraft and missiles in the atmosphere. Topics include longitudinal, lateral, and directional static stability; control effectiveness; control forces; basic equations of motion of flight vehicles; aerodynamics, thrust and gravity forces; and stability derivatives. Analyzes aircraft and missile dynamic stability, as well as typical model responses to control inputs. Further studies autopilots, stability augmentation, and analysis of the pilot as a control-system element.

Pre-requisite(s): MAE 340, MAE 345, MAE 424

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Derive the nonlinear equations of motion for an aircraft through application of New- ton's Laws and the analysis of forces and moments from thrust, aerodynamic interactions, and gravity.	1	HW 1, HW 2 Test 1, Final
2. Describe aircraft attitude in terms of Euler angles and quaternions.	1	HW 2, HW 3, Test 1, Final
3. Linearize the equations of motion of an aircraft about a reference flight condition and solve for the aircraft response to atmospheric disturbances and control inputs.	1	HW 4, Test 2, Final Exam

4. Use Matlab to solve numerically for aircraft response and analyze the motion of the aircraft using numerical tools.	1, 7	HW 1, HW 3, HW 5, HW 6, HW 7, HW 8, Test 1, Test 2, Final Exam
5. Perform stability analysis for an aircraft design about a reference flight condition.	2, 4	HW 4, Test 2, Final Exam
6. Analyze the longitudinal and lateral dynamics (stick-fixed) for an aircraft.	1	HW 5, HW 6, Test 2, Final Exam
7. Evaluate flight stability coefficients and understand their connection to aircraft design variables.	2, 6	HW 5, HW 6, HW 7, Test 2,Final Exam
8. Implement a flight stability augmentation and control augmentation systems.	2, 3	HW 7, HW 8, Test 2, Final Exam

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
3	2	1	1	0	1	1

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Project research and formulation
2. Project management of time and costs
3. Engineering analysis
4. Technical communication skills

MAE 451 Design Process & Methods

Credit Hours: 3

Contact Hours: Lecture – Three one-hour lectures per week

Instructor: Prof. Rahul Rai and Prof. Ardeshir Raihanian

Textbooks and Other Materials:

Required: None

Recommended:

1. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.H., Engineering Design: A Systematic Approach, Third ed., Springer Verlag, London, 2007.

2. Dieter and Schmidt, Engineering Design Process, 4th Edition, McGraw Hill

3. Otto, K. N., and Wood, K. L., Product Design: Techniques in Reverse Engineering, Systematic Design, and New Product Development, Prentice-Hall, NY, 2001.

4. Arora, J.S., Introduction to Optimum Design, 4th Edition, Academic Press, 2016.

Catalog Description: Discusses the fundamental concepts and activities of design processes. Investigates domain-independent topics of design processes. These topics include idea conception, teamwork, quality, experimental design, optimization, and technical communication. In addition, discusses fundamental methods of design, including decision making, conceptual design, cost evaluation, ethics issues, and intellectual property issues, which are investigated through interactive lectures and individual and group exercises.

Pre-requisite(s): Approved Aerospace and Mechanical Engineering Majors Only

Co-requisite(s): MAE 338 or MAE 339

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Formulate an engineering problem that specifies performance requirements and design constraints cognizant of various aspects such as public health, safety, and welfare, as well as global, cultural, social,	1, 2, 4	Memos/Exam 1/HW 1

environmental, and economic factors by converting the customer needs to design specifications.		
2. Present a design solution that satisfies the defined requirements and constrains by developing a step-by-step plan that includes concept generation, concept evaluation and concept development with proper considerations related to design for manufacturability and design for assembly.	2	Memos
3. Evaluate the design solution in terms of how well it performs within the design requirements and constraints. Describe how engineering and economic analyses was used to help understand the feasibility of the design solution.	2	HW 2, 3, 4/Exam 2
4. Communicate intermediate and final designs clearly and effectively in written and oral formats	3	Oral presentations/Memos
5. To teach students the basic principles of classical thermodynamics.	1	Homework, Quizzes, Project
6. Understand the characteristics of successful design teams. Use some scheduling and planning tools, principles, and behaviors that promote the effectiveness of a team.	5	Memos

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
1	3	3	3	2	1	0

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Establishing Engineering Specification: QFD Matrix
2. Prototyping and Detailed Design
3. Design for variation/Six Sigma
4. Engineering Economics
5. Design Optimization

MAE 494 Design Project

Credit Hours: 3

Contact Hours: Lecture – One two-hour and fifty-minute lecture per week

Instructor: Prof. Ardeshir Raihanian

Textbooks and Other Materials:

Required: None

Catalog Description: Students working in teams of two or three under the supervision of a faculty member complete an original engineering design, which in some cases results in hardware. Design problems are drawn from industry and initiated by faculty. Where practical, two or more teams compete to solve the same problem. Teams meet individually with faculty on a weekly basis to discuss their projects.

Pre-requisite(s): Approved Aerospace and Mechanical Engineering Majors Only

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Work with a diverse group to complete a unified project	5	Progress reports
2. Present technical work through oral and written communications	3	Design reviews, proposal/final report/Elevator pitch video
3. Provide project updates and resolve technical issues using a web- based communication platform	6, 7	Progress reports
4. Perform an engineering development project that is cognizant of health, safety, and welfare as well as global, cultural, social, environmental, and economic factors	2, 4	Final report
5. An understanding of professional and ethical responsibility	4	Progress reports/final report
6. Identify, formulate and solve problems related to an engineering project	1	Proposal/final report
7. Apply mathematics, science and engineering skills to a real-world problem	1	Final report
8. Use experimental, numerical and analytical techniques to conceive solutions to engineering problems	1, 7	Final report

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	2	3	4	5	6	7
3	3	3	3	3	1	2

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:

1. Project research and formulation
2. Project management of time and costs
3. Engineering analysis
4. Technical communication skills

UBC 399 Capstone

Credit Hours: 1

Contact Hours: Online

Instructor: Jeffrey Kohler

Textbooks and Other Materials:

Required: *Portfolio* Keeping (3rd Edition), by Nedra Reynolds and Elizabeth Davis (Boston: Bedford/St. Martin's 2014)

Catalog Description: The UB Capstone is the culminating experience of the UB Curriculum. The Capstone is not a seated class, but rather a digital space set aside for thinking, reflecting, and integrating elements of the program through the creation of a Capstone ePortfolio: a multi-media, web-based platform where students will gather and integrate their learning experiences at UB into a meaningful whole, demonstrating their growth and development as learners. Students will be able to keep (and modify) this ePortfolio as they transition into the job market, graduate study, or other endeavors.

Pre-requisite(s): Students may enroll in the Capstone course upon completion of all UB curriculum courses – or – during the same semester a student is completing the last of these requirements.

Co-requisite(s): None

Role in Curriculum: Required (Other)

Course Learning Outcomes: Upon successful completion of the course, students will be able to:	**SOs**	**Assessment Tools**
1. Articulate connections across different academic disciplines and perspectives		ePortfolio
2. Adapt and apply skills, abilities, theories or methodologies acquired in one situation to new situations.	7	ePortfolio
3. Connect relevant experiences and academic knowledge.		ePortfolio
4. Demonstrate an evolving sense of self as learner.	7	Final ePortfolio
5. Integrate different forms of communication to enhance meaning (prose, sound, visual media)	3	ePortfolio

6. Apply your understanding of digital citizenship to create an academic capstone portfolio.	3	ePortfolio

Relationship of Course to Student Outcomes (Course Assessment Matrix):

1	**2**	**3**	**4**	**5**	**6**	**7**
		3				3

Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery

Course Topics:
1. ePortfolio
2. Digital citizenship and ethics
3. Peer review
4. Reflection

APPENDIX B – FACULTY VITAE

1. Name: Alaa Eldeen A. Hassan Ali

2. Education
   - Ph.D., Mechanical Engineering, University of Wisconsin–Madison, 2000
   - M.Sc., Mechanical Engineering, University of Wisconsin–Madison, 1998
   - M.Sc., Mechanical Engineering, Alexandria University, 1992
   - B.Sc., Mechanical Engineering, Alexandria University, 1985

3. Academic Experience
   - University at Buffalo, Mechanical and Aerospace Engineering Department, Assistant Professor of Teaching, 2016-Present, full-time
   - University of Texas at San Antonio, Senior Lecturer, 2015-2016, full-time
   - McMaster University, Research Engineer, 2010-2014, full-time
   - McMaster University, Post Doctoral Fellow, 2006-2009, full-time
   - McMaster University, Sessional Lecturer, 2007-2014, part-time
   - Mohawk College, Sessional Lecturer, 20012-2013, part-time
   - Alexandria University, Assistant Professor, 2000-2006, full-time
   - Alexandria University, Teaching Assistant, 1987-1995, full-time
   - Arab Academy for Science and Technology, Adjunct Professor, 2003-2004, part-time
   - Alexandria Higher Institute of Engineering and Technology, Adjunct Professor, 2004-2005, part-time

4. Non-academic experience
   - Spira Ltd., CFD specialist, performing CFD modeling and simulation for VAWT., 2007-2007, part-time
   - Lanxess Inc., Thermofluid specialist, performing thermofluid modelling and software development of butyl rubber chemical reactor, 2012-2013, part-time.

5. Certifications or professional registrations
   - Fully Licensed Professional Engineer, 2011-Present

6. Current membership in professional organizations
   - Professional Engineers Ontario, 2011-Present
   - The Egyptian Syndicate for Engineers, 1985-Present
   - The Egyptian Society of Water and Energy, 2005-Present

7. Honors and awards

- Alexandria University, Outstanding Educational Award, 1980-1985
- Alexandria University, Degree of Honor, 1985
- Mech. Eng. Award for the Highest Rank in Thermal Engineering, 1985

8. Service activities
   - Member of the MAE committee for undergraduate studies, UB, 2018-present.

9. Briefly list the most important publications and presentations from the past five years
   - Hassan, A. A. and Hamed, M. S., "Modeling Effective Thermal Conductivity of Randomly Distributed Loads of Mono-Sized Parts of Arbitrary Geometry," Materials Performance and Characterization, Vol. 5, No. 1, 2016, pp. 7-22, http://dx.doi.org/10.1520/MPC20150031. ISSN 2165-3992.
   - Hassan, A. A., Baraich, H. S., Hamed M. S., and Abdel-Hady, A., "Effect of Surface Condition on Pool Boiling of Nanofluids on Horizontal Flat Surfaces," presented at the 8th International Conference on Boiling and Condensation Heat Transfer, June 3-7, 2012, Lausanne, Switzerland.
   - Hassan, A. A., and Hamed M. S., "Model-Based Optimization of the Heat Treatment of Randomly Packed Load in Mesh Belt Multi-Zone Continuous Furnaces," Materials Science Forum Vols. 706-709 (2012) pp 289-294. Presented at THERMEC'2011 the 7th International Conference on Processing and Manufacturing of Advanced Materials, Québec, Canada.
   - Hassan, A. A., and Hamed M. S., "Towards the Achievement of 2020 Vision Goals of the Heat Treating Industry," JOM Journal of the Minerals, Metals and Materials Society, 62-9 (2010) 55-59.
   - Takrouri, K., Luxat, J., Hassan, A. A., and Hamed, M. S., "Heat Transfer and Two-Phase Flow Behavior during Quench of Hot Horizontal Cylindrical Tubes", Proceedings of the Fourth International Conference on Thermal Engineering Theory and Applications, Abu Dhabi, UAE, January 12-14, 2009.

10. Briefly list the most recent professional development activities
    - Badged for CEI Designing Experiences Academy: Issued from the University at Buffalo, Continuing and Professional Education, 2018
    - Badged for CEI Teaching Effectively Academy: Issued from the University at Buffalo, Continuing and Professional Education, 2019
    - Institutional Standards of Conduct Training: Completed at University of Texas at San Antonio, 2016.

1. Name: **Jason N. Armstrong**

2. Education
- B.S. Mechanical Engineering, University at Buffalo, State University of New York, Buffalo, NY, 2004
- B.S. Aerospace Engineering, University at Buffalo, State University of New York, Buffalo, NY, 2004
- Ph.D. Mechanical Engineering, University at Buffalo, State University of New York, Buffalo, NY, 2010
- Postdoctoral Associate, University at Buffalo, State University of New York, Buffalo, NY, 2010-2012

3. Academic Experience
- University at Buffalo, State University of New York, Buffalo, NY Department of Mechanical& Aerospace Engineering, Teaching Associate Professor, 2018-present, full-time
- University at Buffalo, State University of New York, Buffalo, NY Department of Mechanical& Aerospace Engineering, Director, MAE Materials Teaching Lab, 2016-present, full-time
- University at Buffalo, State University of New York, Buffalo, NY Department of Mechanical& Aerospace Engineering, Teaching Assistant Professor, 2012-2017, full-time
- University at Buffalo, State University of New York, Buffalo, NY Department of Mechanical& Aerospace Engineering, Postdoctoral Associate, 2010- 2012, full-time
- University at Buffalo, State University of New York, Buffalo, NY Department of Mechanical& Aerospace Engineering, Lecturer, 2010- 2012, part-time

4. Non-academic experience
   None

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- American Society for Engineering Education (ASEE)
- Materials Research Society (MRS)
- American Society of Mechanical Engineers (ASME)
- SAE International (previously Society of Automotive Engineers)

7. Honors and awards
- 2019 UB Teaching Innovation Award - For new teaching methods and approaches to enhance student learning outcomes.
- 2018 Best Teaching Faculty of the Year Award - For outstanding educational contributions to the School of Engineering and Applied Sciences.

- 2018 Vanderhoef Award - For taking the extra effort to coach, mentor, and provide support for students in Mechanical and Aerospace Engineering.
- 2014-2015 Milton Plesur Teaching Award - For excellence in teaching; awarded by the Student Association at the University at Buffalo.

8. Service activities (within and outside of the institution)

- MAE Undergraduate Studies Committee
- MAE Student Excellence and Diversity Committee
- SAE (UB Motorsports) Faculty Advisor
- EAS202 Faculty Mentor

9. Briefly list the most important publications and presentations from the past five years

- Feng Hu, Lu An, Aditya Chivate, Zipeng Guo, Saurabh Khuje, Yulong Huang, Yong Hu, Jason Armstrong, Chi Zhou and Shenqiang Ren, Flexible and printable dielectric polymer composite with tunable permittivity and thermal stability, Chemical Communications, Advance Article (2020). https://doi.org/10.1039/C9CC08648J
- Ruizhe Yang, Feng Hu, Lu An, Jason Armstrong, Yong Hu, Changning Li, Yulong Huang, and Shenqiang Ren, A Hierarchical Mesoporous Insulation Ceramic, Nano Letters, Article ASAP (2019). https://doi.org/10.1021/acs.nanolett.9b04411
- Jun Wang, Rahul Rai, and Jason Armstrong, Investigation of compressive deformation behaviors of cubic periodic cellular structural cubes through 3D printed parts and FE simulations, Rapid Prototyping Journal, Vol. ahead-of-print No. ahead-of-print. (2019). https://doi.org/10.1108/RPJ-03- 2019-0069
- Yulong Huang, Yong Hu, Feng Hu, Ruizhe Yang, Changning Li, Jason N. Armstrong and Shenqiang Ren, Correlation at Two-Dimensional Charge-Transfer FeSe Interface, Chemical Communications, 55, 12643-12646 (2019). https://doi.org/10.1039/C9CC06163K
- Yong Hu, Guohua Zhong, Ying-Shi Guan, Jason N. Armstrong, Changning Li, Changjiang Liu, Alpha N'Diaye, Anand Bhattacharya, and Shenqiang Ren, Strongly Correlated Aromatic Molecular Conductor, Small, 1900299 (2019). https://doi.org/10.1002/smll.201900299

10. Briefly list the most recent professional development activities
    None

1. Name: **Francine Battaglia**

2. Education - degree, discipline, institution, year
– Ph.D., Mechanical Engineering, Pennsylvania State University, 1997
– M.S., Aerospace Engineering, State University of New York at Buffalo, 1992
– B.S., Mechanical Engineering, State University of New York at Buffalo, 1991

3. Academic Experience
– University at Buffalo, Buffalo, NY, Acting Associate Dean for Faculty Affairs, SEAS, 2019 – present, full-time
– University at Buffalo, Buffalo, NY, Professor of Mechanical and Aerospace Engineering, 2017-present, full-time
– Virginia Tech, Blacksburg, VA, Professor of Mechanical Engineering, 2012 – 2017, full-time
– Virginia Tech, Blacksburg, VA, Associate Professor of Mechanical Engineering, 2007–2012, full-time
– Iowa State University, Ames, IA, Associate Professor of Mechanical Engineering, 2005–2007, full-time
– Iowa State University, Ames, IA, Assistant Professor of Mechanical Engineering, 1999–2005, full-time

4. Non-academic experience
National Institute of Standards and Technology, Postdoctoral Fellow, 1997-1999, full-time

5. Certifications or professional registrations
None

6. Current membership in professional organizations
– American Institute of Aeronautics and Astronautics (Lifetime Senior Member)
– American Society of Mechanical Engineers (Fellow)
– American Society of Thermal and Fluids Engineers (Fellow)
– Sigma Xi, The Scientific Research Society (Full Member)

7. Honors and awards
– ASME Board of Governors for Service as IMECE Conference Chair, November 2017
– ASME Dedicated Service Award, 2016
– College of Engineering Dean's Award for Teaching Excellence, Virginia Tech, May 2016

8. Service activities (within and outside of the institution)
– Group Leader, Thermal-Fluid Systems, Graduate Student Committee, UB, 2017-present

- Editor, ASME Journal of Fluids Engineering, November 2017-present
- Vice President/Treasurer, American Society of Thermal and Fluids Engineers, August 2014-present (co-founder of this new organization established in July 2014)
- ASME Congress Steering Committee, 2014-2019
- Member, Faculty Search Committee, UB, September 2017-April 2018
- Co-chair, ME Mentoring Program, Virginia Tech, August 2014-July 2017

9. Briefly list the most important publications and presentations from the past five years

- Matta, A., Pendar, H., Battaglia, F., Bayandor, J., Impact of caudal fin shape on thrust production of a thunniform swimmer, Journal of Bioionic Engineering, Accepted Feb 2020.
- Yin, P., Pate, M., Battaglia, F., In-field Performance Evaluation and Economic Analysis of Residential Ground Source Heat Pumps in Heating Operation, J. Build Energy, 26(11), 100932, pp. 1-10, 2019.
- Matta, A., Bayandor, J., Battaglia, F., Pendar, H., Effects of fish caudal fin sweep angle and kinematics on thrust production during low-speed thunniform swimming, Biology Open, 8(7), 2019.
- Strasser, W., Battaglia, F., "Pulsating Slurry Atomization, Film Thickness, and Azimuthal Instabilities". Atomization and Sprays, 28(7), pp.643-672, 2018.
- Wang, J., Zhang, T., Wang, S., Battaglia, F., "Numerical investigation of single-sided natural ventilation driven by buoyancy and wind through variable window configurations", Energy and Buildings, 168(1), pp. 147-164, 2018.
- Feaster, J., Bayandor, J., Battaglia, F., "A computational study on the influence of insect wing geometry on bee flight mechanics", Biology Open, 6, pp. 1784-1795, 2017.
- Kanholy, S.K., Estejab, B., Battaglia, F., "Modeling Multiple Gas Jet Interactions during Fluidization in a Pseudo-2D Bed", Chem. Eng. J., 328(11), pp. 1009-1021, 2017.
- Estejab, B., Nyendu, G., Agblevor, F., Battaglia, F., "Coal-biomass mixing characteristics in a bubbling fluidized bed of Geldart A particles". Chem. Eng. Res. Desg., 120(4), 2017.
- Chen, L., Battaglia, F., "The Effects of Inlet Turbulence Intensity and Computational Domain on a Non-premixed Bluff-body Flame". ASME J. Energy Res. Tech., 139(2), 2017.
- Strasser, W., Battaglia, F., "The Effects of Pulsation and Retraction on Non-Newtonian Flows in Three-Stream Injector Atomization Systems". Chem. Eng. J., 309(2), 2017.
- Strasser, W., Battaglia, F., "Identification of Pulsation Mechanism in a Transonic Three-Stream Airblast Injector", ASME J. Fluids Eng., 138(11), p. 111303 (15pp), 2016.
- Dadashi, S., Feaster, J., Bayandor, J., Battaglia, F., Kurdila, A.J., "Identification and Adaptive Control of History Dependent Unsteady Aerodynamics for a Flapping Insect Wing", Nonlinear Dyn, 85(3), pp. 1405-1421, 2016.
- Chen, L., Battaglia, F., "The Effects of Fuel Mixtures in Non-premixed Combustion for a Bluff-body Flame". ASME J. Energy Resour. Technol., 138(3):022204, pp. 1-9, 2016.

10. Briefly list the most recent professional development activities

MAC Academic Leadership Development Program Fellow, 2019-2020

1. Name: **Javid Bayandor**

2. Education

- Ph.D., Aerospace Engineering, The Royal Melbourne Institute of Technology, 2000

3. Academic experience

- University at Buffalo, Associate Professor of Mechanical and Aerospace Engineering, 2017-present, full-time
- Virginia Tech, Associate Professor of Mechanical Engineering, 2009-2017, full-time
- Massachusetts Institute of Technology, Invited Visiting Associate Professor of Aerospace Structures, 2008-2009, full-time
- Royal Melbourne Institute of Technology, Associate Professor of Aerospace Structures, Group Leader Aerospace Structures, 2008-2009, full-time
- Royal Melbourne Institute of Technology, Senior Lecturer Aerospace Engineering, Group Leader Aerospace Structures, 2005-2008, full-time
- Royal Melbourne Institute of Tech., Lecturer Aerospace Eng., 2001-2005, full-time

4. Non-academic experience

- NASA Glenn Research Center, NASA Faculty Fellow, aerospace research, varied periods 2012-2016, full-time
- Simulation Technology and Advanced Research Corporation, Principal Research Scientist, aerospace research, 2007, full-time (on assignment)
- German Aerospace Center, Senior Scientist, aerospace research and development, 2005-2006, full-time (on assignment)
- The Sir Lawrence Wackett Aerospace Center, Principal Research Engineer, 2005- 2009, part-time (joint appointment)
- Airbus, Research Scientist, aerospace research and development, 2002, full time (on assignment)
- Cooperative Research Center for Advanced Composite Structures, Research Eng., aerospace research and development, 2001-2002, part-time (joint appointment)

5. Certifications or professional registrations None

6. Current membership in professional organizations

- International Council of the Aeronautical Sciences (Invited National Representative)
- Royal Aeronautical Society (Fellow)
- American Society of Mechanical Engineers (Fellow)
- International Energy Foundation (Fellow)
- American Institute of Aeronautics and Astronautics (Associate Fellow)

7. Honors and awards

- Theodore von Kármán Fellow, July 2019
- NASA Innovative Advanced Concepts Program Lifetime Fellow, April 2019
- Honorary Professorship, Tampere University, Finland, March 2018
- NASA Recognition Plaque, Research Directorate, NASA Glenn Research Center, Aug. 2012, 2013 and 2016
- Inventor of the Month, Virginia Tech Office of the Vice President for Research May 2016
- Research Appreciation Note, Executive Office of the President of the United State at The White House, Jan. 2016

8. Service activities (within and outside of the institution)

- Member at Large, Engineering Sciences Segment, American Society of Mechanical Engineers, 2018-present.
- Chair, Executive Committee, Fluids Engineering Division, American Society of Mechanical Engineers, 2017-2018
- Chair, Fluids Engineering Summer Conference (FEDSM 2017), 2017

9. Briefly list the most important publications and presentations from the past five years

- Matta, A., Pendar, H., Battaglia, F., and Bayandor, J., "Impact of caudal fin shape on thrust production of a thunniform swimmer," Bionic Engineering-to appear, Vol. 17, No. 2, 2020.
- Horton, B., *Song, Y., Jegley, D., Collier, F., and Bayandor, J., “Predictive analysis of stitched aerospace structures for advanced aircraft,” The Aeronautical Journal, Vol. 124, No. 1271, 2020, pp. 44-54.
- Song, Y., *Horton, B., *Perino, S., *Thurber, A., and Bayandor, J., “A contribution to full-scale high fidelity aircraft progressive dynamic damage modeling for certification by analysis,” Int. J. Crashworthiness, Vol. 24, No. 3, 2019, pp. 243-256.
- Schroeder, K., Samareh, J., and Bayandor, J., “TANDEM: Tension Adjustable Network for Deploying Entry Membrane,” J. Spacecraft and Rockets, Vol. 55, No. 6, 2018, pp. 1379-1392.
- Song, Y., *Horton, B., *Feaster, J., and Bayandor, J. “Benchmarking of computational fluid methodologies in resolving shear driven flow fields,” J. Fluids Engineering, Vol. 139, No. 11, 2017, pp. 111402-111414.
- Perino, S., Bayandor, J., Samareh, J., Armand, S., “Contemporary impact analysis methodology for planetary sample return missions,” J. Spacecraft and Rockets, Vol. 52, No. 4, 2015, pp. 1217-1227.

10. Briefly list the most recent professional development activities

- American Institute of Aeronautics and Astronautics SciTech 2020, Jan. 2020

1. Name: **Eleonora M. Botta**

2. Education

– Ph.D., Mechanical Engineering, McGill University, Montreal, Canada, 2013 - 2017
– M. Eng., Space Engineering, Politecnico di Milano, Milano, Italy, 2010 – 2013
– M. Eng., Aerospace Engineering, Politecnico di Milano, Milano, Italy, 2010- 2013
– B. Eng., Aerospace Engineering, Politecnico di Milano, Milano, Italy, 2007 - 2010

3. Academic Experience

– University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor, 2019 – present, full-time
– McGill University / GlobVision, Department of Mechanical Engineering, Postdoctoral Fellow, 2018, full-time
– McGill University, Department of Mechanical Engineering, Research Assistant, 2013 – 2017, full-time
– McGill University, Department of Mechanical Engineering, Research Assistant, 2014, part-time.

4. Non-academic experience

– McGill University / GlobVision, Department of Mechanical Engineering, Postdoctoral Fellow, 2018, full-time

5. Certifications or professional registrations
None

6. Current membership in professional organizations

– American Institute of Aeronautics and Astronautics, AIAA, 2019-present
– Member of Space Tethers Technical Committee
– American Astronautical Society, AAS, 2016-present

7. Honors and awards

– Outstanding Teaching Assistant Award. Faculty of Engineering, McGill University, 2018
– Amelia Earhart Fellowship. Zonta International, 2015
– McGill Engineering Doctoral Award (MEDA). Faculty of Engineering, McGill University, 2013 - 2016
– Werner Graupe International Fellowship in Engineering. Antje Graupe Pryor Foundation, 2013–2016
– Giovanni Zampese Award. Banca di Credito Cooperativo Cantù, 2010, 2013

8. Service activities (within and outside of the institution)

– DC Faculty hiring committee (2019-2020).

- SEAS Faculty-Freshman Mentor (Spring 2019, Spring 2020).
- Judge for UB MAE Poster Competition (2019, 2020).
- Science is Elementary Mentor (2019 – Present).
- Editorial Board Member, International Journal of Space Science and Engineering

9. Briefly list the most important publications and presentations from the past five years
- C. Barnes, E.M. Botta. An Improved Quality Index for Net-Based Capture of Space Debris. Acta Astronautica. Submitted.
- E.M. Botta, C. Miles, and I. Sharf. Simulation and Tension Control of a Tether-Actuated Closing Mechanism for Net-Based Capture of Space Debris. Acta Astronautica. Under review.
- C. Barnes, E.M. Botta. An Improved Quality Index for Net-Based Capture of Space Debris. 2nd IAA Conference on Space Situational Awareness (ICSSA). Arlington, VA. January 2020.
- R. Gold, E.M. Botta. Validation of a Simulation Tool for Net-Based Capture of Debris with Parabolic Flight Experiment Data. 2019 AAS/AIAA Astrodynamics Specialist Conference. Portland, ME. August 2019.
- E.M. Botta, I. Sharf, and A.K. Misra. Simulation of Tether-Nets for Capture of Space Debris and Small Asteroids. Acta Astronautica. Vol. 155 (2019), pp. 448-461.
- E.M. Botta, I. Sharf, and A.K. Misra. Contact Dynamics Modeling and Simulation of Tether Nets for Space-Debris Capture. Journal of Guidance, Control, and Dynamics. Vol. 40, No. 1 (2017), pp. 110-123.
- E.M. Botta. Deployment and Capture Dynamics of Tether-Nets for Active Space Debris Removal. Ph.D. Thesis, McGill University, 2017. Department of Mechanical Engineering.
- E.M. Botta, I. Sharf, M. Teichmann, and A.K. Misra. On the Simulation of Tether-Nets for Space Debris Capture with Vortex Dynamics. Acta Astronautica. Vol. 123 (2016), pp. 91-102.

10. Briefly list the most recent professional development activities
- Designing Experiences Academy. UB Center for Educational Innovation (CEI), 2019
- Making an Effective Syllabus. UB Center for Educational Innovation (CEI), 2019
- New Faculty Academy: writing/publishing. UB University Libraries, Spring 2019
- Supervising the UB way. UB Organizational Development and Training, 2019
- Research Fundamentals Workshop. UB Office of Research Advancement, 2019
- Teaching Techniques for Instructors Workshop. McGill T-PULSE, 2017
- Graduate Teaching Development Workshop. McGill T-PULSE, 2017
- AGSEM Teaching Assistant Training. SKILLSETS – McGill University, 2014

1. Name: **Matthew Burge**

2. Education
- Ph.D. Fluid/Thermal Sciences, University at Buffalo, Buffalo, New York, 2017
- M.A. Teaching Physics, Stony Brook University, Stony Brook, New York, 2012
- M.S. Mechanical Engineering, University at Buffalo, Buffalo, New York, 2011
- B.S. Applied Physics, SUNY Geneseo, Geneseo, New York, 2007
- B.A. Mathematics, SUNY Geneseo, Geneseo, New York, 2007

3. Academic Experience
- University at Buffalo, Assistant Professor of Teaching, 2016 – present, full-time
- University at Buffalo, Undergraduate Course Instructor, 2013 – 2016, part-time
- University at Buffalo, Teaching Assistant, 2013 – 2014, full-time
- Walt Whitman High School, Student Teacher in Honors and AP Physics, 2012, full-time
- Brentwood South Middle School Student Teacher in General Science, 2012, full-time
- Stony Brook University, Teaching Assistant, 2011 – 2012, full-time

4. Non-academic experience
   None

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
   None

7. Honors and awards
- MAE Ph.D. Teaching Fellow 2014 (Course taught: MAE 336, Summer 2014)

8. Service activities (within and outside of the institution)
- 'Impossible Engineering' Rocket Car Demonstration, September 2018
- MAE Student Mentor, 2017 – 2019
- MAE Freshman Orientation, June 2018
- Laboratory Upgrade Committee, 2017 – 2019
- MAE Open House Tour of the Aerospace Engineering Lab, 2017 – 2019
- WiSE Tour of MAE Teaching Labs, March, 2018
- Student Excellence and Diversity Committee, 2016 – 2019
- Science is Elementary, 2018
- WiSE and TechPREP Mentor Program, 2012

- Bay Scallop Bowl, 2012
- Science Olympiad, 2012

9. Briefly list the most important publications and presentations from the past five years

- Burge, M. and Ringuette, M.J. “The Effect of Pitch Phase and Rate on the Three- Dimensional Vortex Structure of a Flapping Wing in Hover.” Experiments in Fluids
- Burge, M. and Ringuette, M.J. “The Effect of Pitching Phase on the Vortex Circulation for a Flapping Wing During Stroke Reversal” 70th APS Division of Fluid Dynamics, Denver CO, 19-21 November 2017
- Burge, M. and Ringuette, M.J. “Circulation Produced by a Flapping Wing During Stroke Reversal” 69th APS Division of Fluid Dynamics, Portland OR, 20-22 November 2016

10. Briefly list the most recent professional development activities

    None

1. Name: **James M. Chen**

2. Education
– Ph.D., Mechanical and Aerospace Engineering (Major in Solid Mechanics (Continuum Physics), Minor in Fluid Mechanics and Applied Mathematics), The George Washington University, Washington, DC, 2011
– M.S., Applied Mechanics, National Taiwan University, Taipei, Taiwan, 2007
– B.S., Mechanical Engineering, National Chung-Hsing University, Taichung, Taiwan, 2005

3. Academic Experience
– University at Buffalo, Associate Professor of Mechanical & Aerospace Engineering, 2020–Present, full-time
– University at Buffalo Assistant Professor of Mechanical & Aerospace Engineering, 2018 –2020, full-time
– Kansas State University, Assistant Professor of Mechanical Engineering, 2015 – 2018, full-time
– Pennsylvania State University, Graduate Faculty of Materials Sciences and Engineering, University Park, 2013 – 2015, full-time
– Pennsylvania State University, University Park, Materials Research Institute, Affiliated Faculty, 2012 – 2015, full-time

4. Non-academic experience
None

5. Certifications or professional registrations
None

6. Current membership in professional organizations
– Honorary Fellow, Australian Institute of High Energetic Materials, 2015-Present
– Honorary Member, Pi Tau Sigma, International Mechanical Engineering Honor Society, 2010-Present
– Member, American Society of Mechanical Engineering, 2010-Present
– Member, Sigma Xi, The Scientific Research Society 2010-Present
– Member, American Physical Society, 2008-Present
– Senior Member, American Institute of Aeronautics and Astronautics, 2015-Present

7. Honors and awards
– UB Exceptional Scholar - Young Investigator Award, 2019
– Outstanding Young Engineer Award, Wichita Council of Engineering Societies (nominated by AIAA), 2018
– Steve Hsu Keystone Research Faculty Scholar (Endowed Scholarship), 2017-2018

- U.S. Air Force Office of Scientific Research Young Investigator Award, 2017
- Research Collaboration Fellowship Award, Penn State Materials Research Institute (MRI), 2014

8. Service activities (within and outside of the institution)

- Strategic Planning Committee - MAE Department, University at Buffalo, 2019 - Present
- Undergraduate Studies Committee - MAE Department, University at Buffalo, 2018 - Present
- 5th CDSE Day 2019, Organizing Committee - University at Buffalo, 2019
- Lab Committee - MNE Department, Kansas State University, 2016-2018
- Faculty Search Committee - MNE Department, Kansas State University, 2017
- Liaison Committee to Physics - MNE Department, Kansas State University, 2016-2018

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

- M. I. Cheikh, J. Chen and M. Wei, "Small-scale Energy Cascade in Homogeneous Isotropic Turbulence," *Physical Review Fluids*, 4, 104610, 2019
- J. Liu, M. I. Cheikh, R. Bao, H. Peng, F. Liu, Z. Li, J. Jiang, J. Chen and T. Thundat, "Tribo-tunneling direct-current generator with carbon aerogel/silicon multi-nanocontacts," *Advanced Electronic Materials*, 1900464, 2019
- L. B. Wonnell and J. Chen, "First-order Approximation to the Boltzmann-Curtiss Equation for Flows with Local Spin," *Journal of Engineering Mathematics*, 114, 43-64, 2019
- K. M. Abdelaziz, J. Chen, T. J. Hieber and Z. C. Leseman, "Atomistic Field Theory for Contact Electrofication of Dielectrics," *Journal of Electrostatics*, 96, 10-15, 2018
- L. B. Wonnell, M. I. Cheikh, and J. Chen, "A Morphing Continuum Simulation of Transonic Flow over an Axisymmetric Hill," *AIAA Journal*, 56, 4321-4330, 2018
- J. Chen, "Morphing Continuum Theory for Turbulence: Theory, Computation and Visualization," *Physical Review E*, 96, 043108, 2017

10. Briefly list the most recent professional development activities
    None

1. Name: **Souma Chowdhury**

2. Education
– Ph.D., Mechanical Engineering, Rensselaer Polytechnic Institute, 2012
– M.S., Mechanical Engineering, Florida International Institute, 2008
– B.Tech., Mechanical Engineering, Indian Institute of Technology, 2007

3. Academic Experience
– University at Buffalo, Mechanical and Aerospace Engineering, Assistant Professor, 2016–present, full-time
– Mississippi State University, Aerospace Engineering, Assistant Research Professor, 2013-2016, full-time
– Syracuse University, Mechanical and Aerospace Engineering, Research Assistant Professor, 2012-2013, full-time

4. Non-academic experience
None

5. Certifications or professional registrations
None

6. Current membership in professional organizations
– American Society of Mechanical Engineers (ASME) – Professional Member
– American Institute of Aeronautics and Astronautics (AIAA) – Senior Member
Member (selected) of the AIAA MDO Technical Committee (*MDO-TC*)
– Institute of Electrical and Electronics Engineers (IEEE) – Professional Member

7. Honors and awards
– School of Engineering and Applied Sciences, Early Career Researcher of the Year 2019, University at Buffalo
– Best student paper, 3rd place prize, Payam Ghassemi (Advisor and Co-Author: Souma Chowdhury), AIAA Aviation 2019 Conference, Dallas, TX.
– Renewable Energy Top Paper Award, Elsevier, 2015
– 3rd place in the ASME Innovation Showcase Competition, Montreal, Canada, 2012

8. Service activities (within and outside of the institution)
– Review Panelist for NSF; also ad hoc reviewer; (CBET & CISE)
– Reviewer for 20 Journals in the areas of Design, Optimization, Energy, Robotics, and AI.
– MAE Graduate Studies Committee (GSC), 2018-present

9. Briefly list the most important publications and presentations from the past five years

PEER-REVIEWED JOURNAL ARTICLES:

- Ghassemi, P., and Chowdhury, S., *An Extended Bayesian Optimization Approach to Decentralized Swarm Robotic Search*, Journal of Computing and Information Science in Engineering. March 2020. https://doi.org/10.1115/1.4046587.
- Zeng, C., Abnous, R., Gabani, K., Chowdhury, S. and Maldonado, V., *A new tilt-arm transitioning unmanned aerial vehicle: Introduction and conceptual design*, Aerospace Science and Technology, Vol. 99, pp.105755.
- Behjat, A., Paul, S., and Chowdhury, S., *Learning reciprocal actions for cooperative collision avoidance in quadrotor unmanned aerial vehicles*, Robotics and Autonomous Systems, Vol 121, 103270, 2019.
- Mu, D., Ge, Y., Sha, M., Paul, S., Ravichandra, N. and Chowdhury, S., *Robust Optimal Selection of Radio Type and Transmission Power for Internet of Things*, ACM Transactions on Sensor Networks, Vol. 15, No. 4, 2019.
- Odonkor, P., Ball, Z., and Chowdhury, S., *Distributed Operation of Collaborating Unmanned Aerial Vehicles for Time-Sensitive Oil Spill Mapping*, Swarm and Evolutionary Computation, Vol 46, pp. 52-68, May 2019.
- Mehmani, A., Chowdhury, S., Meinrenken, C. J., and Messac, A., *Concurrent Surrogate Model Selection (COSMOS): Optimizing Model Type, Kernel Function, and Hyper-parameters*, Structural and Multidisciplinary Optimization, Vol. 57, No. 3, pp. 1093-1114, 2018.

FULL-LENGTH CONFERENCE ARTICLES:

- Ghassemi, P. and Chowdhury, S., Informative Path Planning with Local Penalization for Decentralized and Asynchronous Swarm Robotic Search. In *IEEE 2nd International Symposium on Multi-Robot and Multi-Agent Systems (MRS)*, 8 2019.
- Ghassemi, P., Lulekar, S., and Chowdhury S., Adaptive Model Refinement with Batch Bayesian Sampling for Optimization of Bio-inspired Flow Tailoring, *AIAA Aviation and Aeronautics Forum and Exposition*, Dallas, Texas, June 17-21, 2019. (Won 3rd place in Student Paper Competition)
- Behjat, A., Chidambaran, S. and Chowdhury, S., *Adaptive Genomic Evolution of Neural Network Topologies (AGENT) for State-to-Action Mapping in Autonomous Agents*, 2019 International Conference on Robotics and Automation (ICRA), Montreal, Canada, May 2019.

INVITED SEMINAR TALKS

- OSPR/Chevron Oil Spill Response Technology Workshop, California Department of Fish and Wildlife, *Oil Spill Monitoring and Disaster Response with Drone Swarms*, San Ramon, Feb 2019.

10. Briefly list the most recent professional development activities

- Lead Organizer of the MDO Student Paper Competition at the AIAA Aviation conference.
- Co-Organizer of the Multifidelity Modeling Workshop at the AIAA Aviation 2019 Conference.
- Organizer of Symposiums in ASME IDETC for the following topics: AI and Machine Learning, Data-driven Design, Sustainable Systems and Computational Synthesis.

1. Name: **Deborah D.L. Chung**

2. Education

- Ph.D., Materials Science, Massachusetts of Technology, Cambridge, MA, 1977
- S. M., Materials Science, Massachusetts of Technology, Cambridge, MA, 1975
- M.S., Engineering Science, California Institute of Technology, Pasadena, CA, 1973
- B.S., Engineering and Applied Science, California Institute of Technology, Pasadena, CA, 1973

3. Academic Experience

- University at Buffalo, Professor of Mechanical and Aerospace Engineering, 1986 – present; Niagara Mohawk Power Corp. Endowed Chair Professor, 1991-2008. (Full-time)
- Carnegie-Mellon University, Associate Professor of Metallurgical Engineering and Materials Science, 1982 – 1986 (Full-time)
- Carnegie-Mellon University, Assistant Professor of Metallurgical Engineering and Materials Science and Electrical Engineering, 1977 – 1982 (Full-time)

4. Non-academic experience

- Consultant to National Power PLC, UK, 1995-96. (Part-time)
- Consultant to the Division of Materials Science, Research and Development Center, Westinghouse Electric Corporation, 1978. (Part-time)
- Consultant to Semiconductor Research, Research and Development Center, Westinghouse Electric Corporation, 1983. (Part-time)
- Consultant to the International Advisory Panel and The Chinese Review Commission of the Chinese Ministry of Education, People's Republic of China, 1984. (Part-time)
- Consultant to the General Technology Division, IBM, 1984. (Part-time)
- Consultant to the Electro-Physics Section, NASA Lewis Research Center, 1985. (Part-time)

5. Certifications or professional registrations

   None

6. Current membership in professional organizations

- Fellow, American Carbon Society, 2001-present; Member, 1979-present; Advisory Board member, 1999-2005.
- Fellow, ASM International, 1998-present; Member, 1986-present; Director of Buffalo Chapter, 1987-1994; Member of Superconductor Materials Committee, 1989-1993.
- Member, Society for the Advancement of Material and Process Engineering, 2007-present. Member, Materials Research Society, 1981-present.
- Member, The Minerals, Metals & Materials Society (TMS), 1977-present. Executive Committee Member of the Three-Rivers Section of TMS-AIME, 1986.Member of the Membership Development Committee (national) of TMS-AIME, 1986-1988.

7. Honors and awards

- Charles E. Pettinos Award, The American Carbon Society, 2004.
- Honorary Doctorate Degree, University of Alicante, Alicante, Spain, 2011.
- Chancellor's Award for Excellence in Scholarship and Creative Activities, Academic Year 2002-2003, The State University of New York.
- Outstanding Inventor, State University of New York, 2002.
- Top Reviewer in 2008, the journal Carbon, Elsevier Pub., 2009.
- Fellow, American Carbon Society, conferred in 2001.
- Fellow, ASM International, conferred in 1998.

8. Service activities (within and outside of the institution)

- Member, Panel on Review of In-house Laboratory Independent Research in Materials Sciences at the Army's Research, Development, and Engineering Centers, The National Academies, 2018-19.
- Member, Committee on Materials for High Density Electronic Packaging, National Materials Advisory Board, Commission on Engineering and Technical Systems, National Research Council, 1987-1990.
- Associate Editor, Journal of Electronic Materials, 2008-present.

9. Briefly list the most important publications and presentations from the past five years

- D.D.L. Chung, Carbon Fiber Composites, 1st Ed., Butterworth-Heinemann, 1994; Carbon Composites: Composites with Carbon Fibers, Nanofibers and Nanotubes, 2nd Ed., Elsevier, 2017, 706 pages.
- D.D.L. Chung, Book series titled Engineering Materials for Technological Needs, Vol. 3, Carbon Materials: Science and Applications, World Scientific, 2018, 382 pages.
- D.D.L. Chung and Xiang Xi. Electric poling of carbon fiber with and without nickel coating. Carbon 162, 25-35 (2020).
- Kairong Shi and D.D.L. Chung. Piezoelectricity-based self-sensing of compressive and flexural stress in cement-based materials without any admixture requirement and without poling. Smart Mater. Struct. 27(10), 105011 (20 pp) (2018).
- D.D.L. Chung. A review of multifunctional polymer-matrix structural composites. Composites, Part B, 160, 644-660 (2019).
- D.D.L. Chung. Development, design and applications of structural capacitors. Applied Energy 231, 89-101 (2018).
- Hongtao Guan and D.D.L. Chung. Radio-wave electrical conductivity and absorption-dominant interaction with radio wave of exfoliated-graphite-based flexible graphite, with relevance to electromagnetic shielding and antennas. Carbon 157, 549-562 (2020).

10. Briefly list the most recent professional development activities

- None

1. Name: **John L. Crassidis**

2. Education
– Ph.D., Mechanical Engineering, State University of New York at Buffalo, 1993
– M.S., Mechanical Engineering, State University of New York at Buffalo, 1991
– B.S., Mechanical Engineering, State University of New York at Buffalo, 1989

3. Academic Experience
– University at Buffalo, SUNY Distinguished Professor, Department of Mech. & Aero. Engineering, 2019 – present, full-time
– University at Buffalo, Samuel P. Capen Chair Professor of the Department of Mech. & Aero. Engineering, 2018 – present, full-time
– University at Buffalo, CUBRC Professor in Space Situational Awareness in the Department of Mech. & Aero. Engineering, 2013 – 2017, full-time
– University at Buffalo, Professor of the Department of Mech. & Aero. Engineering, 2007-present, full-time
– University at Buffalo, Director for the Center for Multisource Information Fusion (CMIF), 2014 – present, full-time, full-time
– University at Buffalo, Founder and Director of the University at Buffalo Nanosatellite Laboratory (UBNL), 2010 – present
– University at Buffalo, Associate Director of the Center for Multisource Information Fusion (CMIF), 2007 – 2013, full-time
– University at Buffalo, Associate Chair of the Department of Mech. & Aero. Engineering, 2012–present, full-time

4. Non-academic experience
– XAnalytix Systems, LLC, President, 2013 – present, part time

5. Certifications or professional registrations
None

6. Current membership in professional organizations
– Fellow – American Institute of Aeronautics and Astronautics
– Fellow – American Astronautical Society
– Member – American Society of Mechanical Engineers
– Member – American Society for Engineering Education
– Member – Society of Automotive Engineers

7. Honors and awards
– SUNY Distiguished Professor, '19

– Samuel P. Capen Chair Professor, '18
– UB President Emeritus and Mrs. Meyerson Award for Distinguished Undergraduate Teaching and Mentoring, '17
– NASA iTech Semifinalist, '17
– Collegiate Science Technology Program (CSTEP) Research Mentor Award, '17

8. Service activities (within and outside of the institution)
– Member, International Academy of Astronautics, Strategy and Feasibility Assessment of Collision Protection from Asteroids and Comets: Concept, Technology, and Prospect Group,'17-present
– Deputy Director, AIAA Region 1 Honors and Awards, '15-'19
– Member, Air Force Space Command Astrodynamics (AFSPC) Innovation Committee, also MEMBER of the Transparency, Openness, and Collaboration Working Group within AFSPC, '13-'17
– Guest Editor, AIAA Journal of Guidance, Control, and Dynamics, Special Issue on the Kalman Filter and its Aerospace Applications, Vol. 40, No. 9, Sept. 2017.
– Book Series Co-Editor (with Dr. Mark Balas and Dr. Florian Holzapfel), Dynamics and Control of Electromechanical Systems, '14-'17
– Deputy Editor, AIAA Journal of Guidance, Control, and Dynamics, '17-present Associate Editor, AIAA Journal of Guidance, Control, and Dynamics, '05-'17

9. Briefly list the most important publications and presentations from the past five years
– Attarzadeh, M.A., Maleki, S., Crassidis, J.L., and Nouh, M., "Non-Reciprocal Wave Phenomena in Energy Self-Reliant Gyric Metamaterials," *The Journal of the Acoustical Society of America*, Vol. 146, No. 1, July 2019, pp. 789-801.
– Crassidis, J.L., and Cheng, Y., "Maximum Likelihood Analysis of the Total Least Squares Problem with Correlated Errors," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 42, No. 6, June 2019, pp. 1204-1217.
– Crassidis, J.L., and Cheng, Y., "Generalized Attitude Determination with One Dominant Vector Observation," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 42, No. 4, March 2019, pp. 885-893.
– Hao, W., Chen, L., Jin, Z., and Crassidis, J.L., "Adaptive Momentum Distribution Jitter Control for a Micro-Satellite," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 42, No. 3, March 2019, pp. 632-641.
– Baghdadi, A., Cavuoto, L., and Crassidis, J.L., "Hip and Trunk Kinematics Estimation in Gait through Kalman Filter Using IMU Data at the Ankle," *IEEE Sensors Journal*, Vol. 18, No. 10, 2018, pp. 4253-4260.

10. Briefly list the most recent professional development activities
– The National Science Foundation Regional Grants Conference, 3/98

1. Name: **Gary F. Dargush**

2. Education
- Ph.D., Civil Engineering (Computational Mechanics), University at Buffalo, 1987
- M.S., Civil Engineering (Computational Mechanics), University at Buffalo, 1977
- B.S., Civil Engineering (Structures), Rensselaer Polytechnic Institute, 1974

3. Academic experience
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Professor, 2005-present
- University at Buffalo, School of Engineering and Applied Sciences, Associate Dean for Research and Graduate Education, 2014-2017
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Chair, 2008-2014
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Associate Chair, 2007-2008
- University at Buffalo, Department of Civil, Structural and Environmental Engineering, Professor, 2002-2005; Associate Professor, 1998-2002; Assistant Professor, 1996-1998; Research Associate Professor, 1990-1996; Research Assistant Professor, 1987-1990

4. Non-academic experience
- General Motors Corporation, Harrison Radiator Division, Senior Engineer, 1982-1986
- General Motors Corporation, Harrison Radiator Division, Project Engineer 1980-1982
- Ford Motor Company, Structural Analysis Department, Research Engineer B, 1978-1980
- Ford Motor Company, Structural Analysis Department, Research Engineer C, 1977-1978

5. Certifications or professional registrations
- None

6. Current membership in professional organizations
- United States Association for Computational Mechanics
- American Society of Mechanical Engineers
- American Society of Civil Engineers

7. Honors and awards
- State University of New York Chancellor's Award for Excellence in Teaching, 2014
- University at Buffalo President's Circle support for Active Learning Experiments in Dynamics, 2014

8. Service activities
- SEAS Dean Search Committee, University at Buffalo, 2019-2020

- Faculty Senate Academic Planning Committee, University at Buffalo, 2001-2015
- Faculty Senate Executive Committee, University at Buffalo, 2007
- Faculty Senate, University at Buffalo, 2005-2007, 2008-2010, 2018-2021
- Graduate School Executive Committee, University at Buffalo, 2003-2004, 2014-2017
- Associate Deans Graduate Council, 2015-2017
- SEAS Faculty Personnel Committee, University at Buffalo, 1999-2002, Alternate 2017-2020
- SEAS Assistant Dean for Graduate Education Search, University at Buffalo, Chair, 2015

9. Briefly list the most important publications and presentations from the past five years (total of 30 archival journal papers published in last five years)

- Damiano, R.J., Tutino, V.M., Lamooki, S.R., Paliwal, N., Davies, J.M., Siddiqui, A.H., Dargush, G.F., Meng, H., Improving Accuracy for Finite Element Modeling of Endovascular Coiling of Intracranial Aneurysm, PLoS ONE, **14**, e0226421 (2020).
- Guarín-Zapata, N., Gomez, J., Valencia, C., Dargush, G.F., Hadjesfandiari, A.R., Finite Element Modeling of Micropolar-based Phononic Crystals, Wave Motion, **92** 102406 (2019).
- Hadjesfandiari, A.R., Furlani, E.P., Hajesfandiari, A., Dargush, G.F. Size-effects in Vibrating Silicon Crystal Micro-beams, J. Engrg. Mech., ASCE, **145**, 04018136 (2019).
- Wetherhold, R.C., Dargush, G.F., Mhatre, T., Effects of Free-edge Interface Angle on Bi-material Shear Strength, Int. J. Mech. Sci., **144**, 262–273 (2018).
- Chakravarty, S., Das, S., Hadjesfandiari, A.R., Dargush, G.F., Variational Inequalities for Heterogeneous Microstructures based on Couple-Stress Theory, Int. J. Multiscale Comp. Engrg., **16**, 119-137 (2018).
- Apostolakis, G., Dargush, G.F., Mixed Lagrangian Formalism for Temperature-Dependent Dynamic Thermoplasticity, J. Engrg. Mech., ASCE, **143**, 04017094, 1-10 (2017).
- Deng, G., Dargush, G.F., Mixed Lagrangian Formulation for Size-dependent Couple Stress Elastodynamic and Natural Frequency Analyses, Int. J. Numer. Meth. Engrg., **109**, 809-836 (2017).
- Dargush, G.F., Apostolakis, G., Darrall, B.T., Kim, J., Mixed Convolved Action Variational Principles in Heat Diffusion, Int. J. Heat Mass Trans., **100**, 790-799 (2016).
- Dargush, G.F., Soom, A., Contact Modeling in Boundary Element Analysis Including the Simulation of Thermomechanical Wear, Tribo. Intl., **100**, 360-370 (2016).
- Hajesfandiari, A., Hadjesfandiari, A.R., Dargush, G.F., Boundary Element Formulation for Plane Problems in Size-dependent Piezoelectricity, Int. J. Numer. Meth. Engrg., **108**, 667-694 (2016).
- Dargush, G.F., Darrall, B.T., Kim, J., Apostolakis, G., Mixed Convolved Action Principles in Linear Continuum Dynamics, Acta Mech., **226**, 4111–4137 (2015).

10. Briefly list the most recent professional development activities

- SEAS Search Committee Training, 2019
- Negotiation Skills for Organizational Leadership, 2016

1. Name: **Bradley Darrall**

2. Education

– Ph.D., Mechanical Engineering, University at Buffalo, 2016
– M.S., Mechanical Engineering, University at Buffalo, 2015
– B.S., Mechanical Engineering, University at Buffalo, 2011

3. Academic Experience

– University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor of Teaching, 2016 – present, full-time
– University at Buffalo Department of Mechanical and Aerospace Engineering, Instructor, 2014-2016, full-time
– University at Buffalo Department of Mechanical and Aerospace Engineering, Teaching Assistant, 2013-2016, part-time
– University at Buffalo Department of Mechanical and Aerospace Engineering, NSF Research Fellow, 2011-2016, part-time

4. Non-academic experience

– Sprung Brett RDI, research consultant, 2012 (part time)

5. Certifications or professional registrations

None

6. Current membership in professional organizations

None

7. Honors and awards

– Tau Beta Pi "Professor of the Year" (2017)
– SUNY Chancellor's Award Nominee (2016)
– National Science Foundation Graduate Research Fellowship (2011-2015)
– UB Presidential Fellowship (2011-2015)

8. Service activities (within and outside of the institution)

– SEAS Graduation Marshall (2019)
– MAE Undergraduate Studies Committee (2018-Present)
– MAE Undergraduate Lab Upgrades Committee (2017-Present)
– Teaching Faculty Search Committee (2017)
– EAS Undergraduate Mentor Program (2017-Present)

9. Briefly list the most important publications and presentations from the past five years

- Darrall, B.T., Dargush, G.F. “Variational principle and time-space finite element method for dynamic thermoelasticity based on mixed convolved action”. Eur. J. Mech. A-Solids, 71, 351-364 (2018).
- Darrall, B.T., Dargush, G.F. “Mixed convolved action variational methods for poroelasticity”, ASME J. App. Mech, 83, 091011 (2016).
- Dargush, G.F., Apostolakis, G., Darrall, B.T., Kim, J. “Mixed convolved action variational principles in heat diffusion”, Int. J. Heat & Mass Transfer, 100, 790-799 (2016).
- Dargush, G.F., Darrall, B.T., Kim, J., Apostolakis, G. “Mixed convolved action principles in linear continuum dynamics”, Acta Mech., 226, 4111-4137 (2015).
- Darrall, B.T., Hadjesfandiari, A.R., Dargush, G.F. “Size-dependent piezoelectricity: A 2D finite element formulation for electric field-mean curvature coupling in dielectrics”, Eur. J. Mech. A-Solids, 49, 308-320 (2015).
- Darrall, B.T., Dargush, G.F., Hadjesfandiari, A.R. “Finite element Lagrange multiplier formulation for size-dependent skew-symmetric couple-stress planar elasticity”, Acta Mech., 225, 195-212 (2014).

10. Briefly list the most recent professional development activities

- CEI Online course building sessions

1. Name: **Paul E. DesJardin**

2. Education
- Doctor of Philosophy, Mechanical Engineering, Purdue University, 1998
- Master of Science, Mechanical Engineering, Purdue University, 1995
- Bachelor of Science, Mechanical Engineering, University at Buffalo, 1993

3. Academic Experience
- University at Buffalo, Professor, 2012 – present, full-time
- University at Buffalo, Associate Professor, 2007 – 2012, full-time
- University at Buffalo, Assistant Professor, 2002 – 2007, full-time
- Sandia National Laboratories, Senior Member of the Technical Staff (SMTS), 1998 – 2002, full-time

4. Non-academic experience
   None

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- Associate Fellow, American Institute of Aeronautics and Astronautics (2016-present)
- Senior Member, American Institute of Aeronautics and Astronautics (2011-2016)
- Technical Chair Member, Propellants and Combustion
- Committee, American Institute of Aeronautics and Astronautics (2000-2007)
- Technical Chair Member, K-11 Fire and Combustion Committee, American Society of Mechanical Engineers (2000-2008)

7. Honors and awards
- UB Exceptional Scholar Award – Sustained Achievement (2019)
- UB School of Engineering and Applied Science Senior Researcher of the Year (2018) Associate Fellow of AIAA (2016)
- SUNY Chancellor's Award for Excellence in Teaching (2009) –highest teaching award from the State University of New York system
- Featured in CASC (Coalition for Academic Scientific Computations) brochure that is distributed to members of congress and major research funding agencies (NSF, NIH, etc.), December, 2008

8. Service activities (within and outside of the institution)
- Faculty Advisor, SEDS – Students for Exploration and Development of Space, 2007-present
- Director of Undergraduate Aerospace Studies, 2011-2014

- Chair, SEAS Qualified Rank Committee, 2019-2020
- Member, Engineering Education Faculty Search Committee, 2018-2019
- Chair, SEAS Teaching Faculty Personnel Committee, 2017-2018

9. Briefly list the most important publications and presentations from the past five years

- Budzinski, K.L., Aphale, S. S., Katz-Ismael, E., Surina, G. and DesJardin, P.E., “Radiation Heat Transfer in Ablating Boundary Layer Combustion Theory used for Hybrid Rocket Motor Analysis,” (accepted) *Combustion and Flame*, (2020).
- Aphale, S.S. and DesJardin, P.E., “Development of a non-intrusive radiative heat flux measurement for upward flame spread using DSLR camera based two-color pyrometry,” Combustion and Flame, 210, pp. 262-278, (2019)
- Richter, J.P., Weisberger, J.M., Bojko, B. T., Mollendorf, J.C., DesJardin, P.E.,“Numerical Modeling of Homogeneous Gas and Heterogeneous Char Combustion for a Wood-Fired Hydronic Heater,” Renewable Energy, 131, pp. 890-899, (2019).
- Weisberger, J.M., Richter, J.P., DesJardin, P.E., “Direct Absorption Spectroscopy Baseline Fitting for Blended Features,” Applied Optics, 57, pp. 9086-9095 (2018).
- Bojko, B. T. and DesJardin, P.E., “On the development and application of a droplet flamelet-generated manifold for use in two-phase turbulent combustion simulations,” Combustion and Flame, 183, pp. 50-65 (2017).
- Richter, J.P., Weisberger, J.M., Mollendorf, J.C., DesJardin, P.E., “Emissions from a domestic two-stage wood-fired hydronic heater: effects of non-homogeneous fuel decomposition,” Renewable Energy, 112, pp. 187-196 (2017).
- DesJardin, P.E., Bojko, B.T. and McGurn, M.T., “Initialization of High-Order Accuracy Immersed Interface Based CFD Solver using Complex CAD Geometry,” J. Num. Methods Eng., 109(4), pp. 487-513 (2017).
- Richter, J.P., Mollendorf, J.C. and DesJardin, P.E., “Absolute and Relative Emissions Analysis in Practical Combustion Systems – Effect of Water Vapor Condensation,” Measurement Science and Technology, 27(11), pp. 117002 (2016).
- Bojko, B.T. and DesJardin, P.E., “Formulation and Assessment of Flamelet-Generated Manifolds for Reacting Interfaces,” Combustion and Flame, 173, pp. 296-306 (2016).
- Richter, J. P., Bojko, B. T., Mollendorf, J. C. and DesJardin, P.E., “Characterization of Fuel Burn Rate, Emissions and Thermal Efficiency of a Two-Stage Wood-Fired Hydronic Heater,” Renewable Energy, 96, pp. 400-409 (2016).

10. Briefly list the most recent professional development activities

- Invited talk: “Flamelet Generated Manifold Modeling of Ablating Reacting Surfaces,” Modeling and Simulation of Turbulent Mixing and Reaction: For Power, Energy and Flight, Buffalo, NY, April (2019)
- Invited talk: “Modeling of Ablating Reacting Surfaces using Flamelet Generated Manifolds,” AFOSR/ARO/NSF Basic Combustion Research Review, Arlington, VA, August 30, (2018)

1. Name: **Ehsan T. Esfahani**

2. Education
- Doctor of Philosophy, Mechanical Engineering, University of California, Riverside, CA, 2012
- Master of Science, Electrical Engineering, University of California, Riverside, CA, 2012
- Master of Science in Mechanical Engineering, University of Toledo, Toledo, OH, 2007
- Bachelor of Science in Mechanical Engineering–Manufacturing, Isfahan University of Technology, Isfahan, Iran, 2004

3. Academic Experience
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Associate Professor, 2018– present, full-time
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor, 2012 – 2018, full-time
- Roswell Park Cancer Institute, Adjunct Assistant Professor, Department of Oncology and Robotic Surgery, 2013 – 2016, full-time

4. Non-academic experience
- General Motors, Project Engineer, Electrical and Control Integration Lab, 2008, full-time
- Isfahan Science and Technology Town, Robotic Engineer, DRobotics Center, 2004-2006, full-time

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- Member, American Society for Mechanical Engineers (ASME)
- Senior Member, Institute of Electrical and Electronics Engineers (IEEE)
- Member, Association for Advancement of Artificial Intelligence (AAAI).

7. Honors and awards
- American Power Public Associations DEED Scholarship, Jan 2012.
- Dissertation Year Fellowship Award, UC Riverside, 2011-2012.
- Lung-Wen Tsai Memorial Scholarship in Mechanical Design, UC Riverside, April 2010.

8. Service activities (within and outside of the institution)
- Served on National Science Foundation Review Panel, 2019, 2020
- Guest Editor, Journal of Computer Aided Design, 2014
- Associate Editor, IEEE International Conference on Robotic and Automation, 2014

- Conference Chair, ASME Frontiers in Biomedical Device Conference, 2016, 2017
- Local Organizing Chair, ASME International Design Engineering Technical Conference, 2014
- Served as an Advisory Board Member, Department of Mechanical Engineering, University of California Riverside, 2015 – present
- Served on IMPACT Physical and Engineering Review Panel, February 2016.
- Human-in-loop Systems Workshop, Computational and Data-Enabled Science and Engineering Day, March 2016
- Member of MAE Strategic Planning Committee, Fall 2018 – present.
- Member of MAE Graduate Studies Committee, Fall 2013 –Fall 2018.

9. Briefly list the most important publications and presentations from the past five years

- Memar, AH. and Esfahani, ET., "Objective Assessment of Human Workload in Physical Human-Robot Cooperation using Brain Monitoring." ACM Transactions on Human-Robot Interaction, Vol. 9,No. 2, Pp. 13:1–13:21, 2020.
- Memar, AH. and Esfahani, ET., "A Robot Gripper with Variable Stiffness Actuation for Enhancing Collision Safety", IEEE Transactions on Industrial Electronics, Accepted, 2019.
- Baghdadi, A., Cavuoto, LA., Jones-Farmer, A., Rigdon, SE., Esfahani, ET., and Megahed, FM., "Monitoring Worker Fatigue Using Wearable Devices: A Case Study to Detect Changes in Gait Parameters." Journal of Quality Technology, Accepted, 2019.
- Younespour, M., Atighehchian, A, Kianfar, K., and Esfahani, ET., "Using Mixed Integer Programming and Constraint Programming for Operating Rooms Scheduling with Modified Block Strategy." Operations Research for Health Care, Vol. 23, Pp. 100220, 2019.
- Pareek, S., Manjunata, H., Esfahani, ET. and Kesavadas, T., "MyoTrack: Realtime Estimation of Subject Participation in Robotic Rehabilitation using sEMG and IMU." IEEE Access, Vol. 7, Pp. 76030-76041, 2019.
- Jujjavarapu, S., Memar, AH., Karami, MA and Esfahani, ET., "Variable Stiffness Mechanism for Suppressing Unintended Forces in Physical Human Robot Interaction." Journal of Mechanism and Robotics, Vol. 11, No. 2, Pp. 020915, 2019.
- Baghdadi, A., Megahed, F., Esfahani, ET. and Cavuoto, L., "A Machine Learning Approach to Detect Changes in Gait Parameters Following a Fatiguing Occupational Task." Ergonomics, Vol. 61, No. 8, Pp. 1116-1129, 2018.
- Memar, AH., and Esfahani, ET., "Physiological Measures for Human Performance Analysis in Human-Robot Tele-Exploration." IEEE Access, Vol. 6, Pp. 3694-3705, 2018.
- Ghobadi, M., Singla, P. and Esfahani, ET., "Robust Attitude Estimation from Uncertain Observations of Inertial Sensors using Covariance-Inflated Multiplicative Extended Kalman Filter IEEE Transactions on Instrumentation and Measurement. Vol. 67(1), Pp. 209-217, 2018
- Ghobadi, M., and Esfahani, ET., "A Robust Automatic Gait Monitoring Approach using a Single IMU for Home-based Applications." Journal of Mechanics in Medicine and Biology. Vol. 17, No. 5, Pp. 17500771-20, 2017.

10. Briefly list the most recent professional development activities

    None

1. Name: **Aaron Estes**

2. Education
- Ph.D., Mechanical Engineering, University at Buffalo, 2016
- B.S.E., Mechanical Engineering, Arizona State University, 2011

3. Academic Experience
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor of Teaching, 2017 – present, full-time
- University at Buffalo Department of Mechanical and Aerospace Engineering, Adjunct Instructor, 2016, part-time
- University at Buffalo Department of Mechanical and Aerospace Engineering, MAE Ph.D. Teaching Fellow, 2016, part-time
- University at Buffalo Department of Mechanical and Aerospace Engineering, Research Assistant, 2016, part-time
- University at Buffalo Department of Mechanical and Aerospace Engineering, Teaching Assistant, 2011 – 2015, part-time

4. Non-academic experience
   None

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
   None

7. Honors and awards
- Vanderhoef Faculty Award, University at Buffalo (2019)
- Professor of the Year, awarded by Tau Beta Pi Engineering Honor Society, University at Buffalo (2018)
- Excellent Reviewer Recognition, AIAA Journal of Guidance, Control, and Dynamics, Oct.1, 2017 – Sept. 30, 2018; Oct. 1, 2015 – Sept. 30, 2016.
- Teaching Assistant of the Year, awarded by Tau Beta Pi Engineering Honor Society, University at Buffalo (2013)
- National Merit Finalist Scholarship, Arizona State University (2007-2011

8. Service activities (within and outside of the institution)
- Freshman-Faculty Mentor Program (Spring 2020)
- Faculty Committee: Women in Science and Engineering (WiSE) (since Fall 2018)
- Instructor UB Seminar—The Places You'll Go (EAS 198) (Fall 2019)

- MAE Scholarship Review Committee (Since Fall 2018)
- MAE Student Excellence and Diversity Committee (Since Fall 2017)
- MAE Faculty Mentor, (Fall 2018, Spring 2018, Fall 2017)
- Sustainable Manufacturing and Advanced Robotic Technologies (SMART) Infrastructure Committee (Spring 2017)
- Reviewer: (2020, 2016) American Control Conference; Journal of Guidance, Control, and Dynamics; Journal of Astronautical Sciences

9. Briefly list the most important publications and presentations from the past five years

- Hulme, K., Estes, A., Schiferle, M., Lim. R., "Game-based Learning to Enhance Post-secondary
- Engineering Training Effectiveness" Interservice/Industry Training, Simulation, and Education Conference, Dec., 2019.
- Hulme, K., Estes, A., Schmid, M., Torres, E., Hendrick, C., Sivashangaran, S., "Game-based Proving- grounds Simulation to Assess Driving & Learning Preferences" Interservice/Industry Training, Simulation, and Education Conference, Nov., 2018.
- Mou, F., Khakpour, H., Estes, A., Hall, J., "Weighted-Least Squares Optimization Method for Control and Shape Design of an Adaptive Blade Twist Distribution to Increase Wind Capture," ASME Dynamic Systems and Control Conference, Atlanta, GA, Sep. 30-Oct. 3, 2018, doi:10.1115/DSCC2018-9233.
  Mou, F., Khakpour, H., Estes, A., Hall, J., "A Weighted-Least Squares Approach for the Design of Adaptive Aerodynamic Structures Subjected to an Out-Of-Plane Transformation," ASME International Design Engineering Technical Conferences & Computer and Information in
- Engineering Conference, Quebec City, Canada, Aug. 2018, oi:10.1115/DETC2018-86101.
  Estes, A., Singh, T., Majji, M., "A Post-maneuver Penalty Approach to Robust
- Input-Shaper Design," AIAA/AAS Astrodynamics Specialist Conference, Vail, CO, Aug. 2015, AAS 15-811.
- Estes, A., Majji, M., Juang, J., "Time-Varying Methods for Identification ofConstrained Flexible
- Structures," AIAA/AAS Astrodynamics Specialist Conference, San Diego, CA, Aug. 2014, AIAA 2014-4305, https://doi.org/10.2514/6.2014-4305.

10. Briefly list the most recent professional development activities

    None

1. Name: **Danial Faghihi**

2. Education
- Postdoc., Computational Mathematics, The University of Texas at Austin, 2013 – 2015
- Ph.D., Structural Engineering and Mechanics, Louisiana State University, 2008 – 2012
- M.S., Geotechnical Engineering, Sharif University of Technology, Iran, 2005 – 2008
- B.S., Civil Engineering, K.N.Toosi University of Technology, Iran, 2000 - 2005

3. Academic Experience
- Department of Mechanical and Aerospace Engineering, Assistant Professor, 2019 – present, full-time
- Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin, Research Associate, 2015 – 2019, full-time
- Department of Biomedical Engineering, The University of Texas at Austin, Senior Instructor, 2018 – 2019, part-time
- Department of Civil and Environmental Engineering University of Texas at San Antonio, Instructor, 2016, part-time
- Department of Aerospace Engineering and Engineering Mechanics, The University of Texas at Austin, Instructor, 2013, part-time

4. Non-academic experience
   None

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- American Society of Mechanical Engineering

7. Honors and awards
- Society of Engineering Science (SES) travel award 2013, SES 50th Annual Technical Meeting and ASME Summer Meeting, Brown University, Providence, RI
- National Science Foundation (NSF) Summer Institute Fellowship, 2013, U.S. National Science Foundation, Summer Institute on Nanomaterials and Micro/Nanomanufacturing, Northwestern University, Evanston, IL
- Doctoral Dissertation Year Fellowship, 2012 – 2013
- School of Engineering nominee for Distinguished Dissertation Award, 2013
- Graduate School Enhancement Award, 2008 – 2012

8. Service activities (within and outside of the institution)

- ASME International Mechanical Engineering Congress & Exposition Symposium: Modeling of the behavior of the micro/nano-structured thin films (2014)
- ASME International Mechanical Engineering Congress & Exposition Symposium: Damage and failure of composites (2014)
- ASME Computing in Applied Mechanics Technical Committee Member (2014-Present)
- ASCE/Eng. Mechanics Institute (EMI) Nanomechanics And Micromechanics Technical Committee Member (2014-Present)
- ASCE/Eng. Mechanics Institute (EMI) Modeling Inelasticity and Multiscale Behavior Technical Committee Member (2014-Present)

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

- Oden, J. T., Babuska, I., and Faghihi, D. (2017). Predictive Computational Science: Computer Predictions in the Presence of Uncertainty. In Encyclopedia of Computational Mechanics. John Wiley & Sons.
- Faghihi, D., Carey, V., Michoski, C., Hager, R., Janhunen, S., Chang, C. S., and Moser, R.D. (2020). Moment Preserving Constrained Resampling with Applications to Particle- in-Cell Methods. Journal of Computational Physics.
- Faghihi, D., Sarkar, S., Naderi, M., Hackel, L., and Iyyer, N. (2018). A Probabilistic Design Method for Fatigue Life of Metallic Component. ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems - Part B: Mechanical Engineering.
- Oden, J. T., Lima, E.A., Almeida, R.C., Feng, Y., Rylander, M.N., Fuentes, D., Faghihi, D., Rahman, M.M., DeWitt, M., Gadde, M. and Zhou, J.C. (2016). Toward Predictive Multiscale Modeling of Vascular Tumor Growth. Archives of Computational Methods in Engineering.
- Farrell, K., Oden, J. T., Faghihi, D., (2015). A Bayesian Framework for Adaptive Selection, Calibration, and Validation of Coarse-grained Models of Atomistic Systems. Journal of Computational Physics.
- Faghihi, D., Lima, E., Feng, X., Oden, J.T., Yankeelov, T. A Coupled Phase-Field and Deformation Theory of Multi-constituent Tumor Growth. 15th U.S. National Congress on Computational Mechanics (USNCCM XV). Symposium: Advances in Computational Biomechanics. August 2019, Austin, TX.
- Faghihi, D., Farrell K., and Oden, J.T. Estimation of Error for Coarse-Grained Models of Atomic Systems. 13th US National Congress on Computational Mechanics (USNCCM XIII). Symposium: Applications of Error Estimation and Model Adaptation in Computational Mechanics. July 2015, San Diego, CA.
- Lima, E. A., Faghihi, D., Philley, R., Yang, J., Virostko, J., Yankeelov, T. E. (2019). Stochastic calibration of an agent-based tumor growth model using time-resolved microscopy data. AACR Annual Meeting 2019.

10. Briefly list the most recent professional development activities

    None

1. Name: **John F. Hall**

2. Education Ph.D.,
– Mechanical Engineering, The University of Texas at Austin, 2012
– M.S., Mechanical Engineering, The University of Texas at Austin, 2005
– B.S., Mechanical Engineering, Missouri University of Science and Technology, 1992

3. Academic experience
– University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor, 2013 – present (full time)
– The University of Texas at Austin, Advanced Power Systems and Control Laboratory, Post-Doctoral Research Associate, 2012 – 2013 (full time)
– The University of Texas at Austin, Department of Mechanical Engineering, Teaching Assistant, 2008 – 2013 (part time)
– The University of Texas at Austin, Applied Research Laboratories, Graduate Research Assistant, 2006 – 2008 (full time)
– The University of Texas at Austin, Robotics Research Group, Graduate Research Assistant, 2003 – 2005 (part time)

4. Non-academic experience
– Hall and Associates, Principal Engineer, 2003 – 2013 (part time)
– Asyst Technologies, Senior Design Engineer, 2000 – 2005 (full time)
– Asyst Technologies, Reliability Engineer, 1997 – 2000 (full time)
– Westinghouse Electric Corporation, Manufacturing Engineer, 1994 – 1997 (full time)
– Westinghouse Electric Corporation, Tool Design Engineer, 1993 – 1994 (full time)
– Westinghouse Electric Corporation, Maintenance Supervisor, 1992 – 1993 (full time)
– General Motors Corporation, Powertrain Division, Reliability Engineering Intern, Summer 1991 (full time)
– General Motors Corporation – Chevrolet Pontiac Canada Division, Process Engineering Intern, Spring 1991 (full time)

5. Certifications or professional registrations
– Licensed Professional Engineer (1997)

6. Current membership in professional organizations
– American Society of Mechanical Engineers
– National Society of Professional Engineers
– Pi Tau Sigma
– Tau Beta Pi

7. Honors and awards

– University of Texas Outstanding Dissertation Award Nominee (2013)
– Cockrell College of Engineering Doctoral Fellowship (2006)
– Tau Beta Pi Honor Society (2004)
– Westinghouse Electric Engineering/Manufacturing Professional Development Program(1994)
ASME International Gas Turbine Institute Scholar (1991)
– General Motors Scholar (1990)

8. Service activities

– Co-Coordinator, Mechanical and Aerospace Engineering Seminar Series, August 2017 - present
– Member, Teaching Professor Search Committee, September 2016– November 2016
– Chair, Adjudication Committee, December 2015
– Member, Teaching Fellowship Selection Committee, February 2015 – March 2015
– Member, Design and Optimization Faculty Search, January 2015– April 2015
– Faculty Advisor, Pi Tau Sigma Honor Society, October 2014 – present
– Member, MAE 177/277/377 Course Streamline Committee, June 2014– October 2014
– Member, Undergraduate Studies Committee, June 2014 – present
– Committee Member, Scholarship Selection Committee, November 2016 - present
– Mentor, Freshman EAS 202 course, March 2015 – present

9. Significant publications and presentations from the past five years

– F. Mou[*†]; H. Khakpour[*], A. Estes; J.F. Hall[‡], "Weighted Least Squares Approach for an Adaptive Aerodynamic Engineered Structure With Twist Transformation", ASME Journal of Energy Resources Technology, Feb 18, 2019.
– Trends in Energy Research and Development from the Small to Large Scale, 2018 Inner Mongolia International Energy Conference, Ordos, Inner Mongolia, China, August 10–13, 2018
– H. Khakpour[*†] and J.F. Hall[‡], "Modeling and Design Method for an Adaptive Wind Turbine Blade With Out–of–Plane Twist," ASME Journal of Solar Energy Engineering, May 29, 2018.
– An Adaptive Mathematical Framework for Scalability in Microgrid Modeling, Sustainability Summit, Xavier University, Bhubaneswar, Odisha, India, February 9–10, 2018
– H. Khakpour[*], S. Chaudhari[*], and J.F. Hall[†‡], "A Design Methodology for Selecting Ratios for a Variable Ratio Gearbox used in a Wind Turbine with Active Blades," Renewable Energy, January 2018, 118.
– Lall[*†], H. Khakpour[*], and J.F. Hall[‡], "A Methodology to Synthesize Gearbox and Control Design for Increased Power Production and Blade Root Stress Mitigation in a Small Wind Turbine," ASME Journal of Mechanical Design, June 2017, 139(9).
– D. Stratton[†], D. Martino, F.M. Pasquali[*], K.E. Lewis, and J.F. Hall[‡], "A Design Framework for Optimizing the Mechanical Performance, Cost, and Environmental Impact of a Wind Turbine Tower," ASME Journal of Solar Energy Engineering, April 2016, 138(4).

10. Briefly list the most recent professional development activities

None

1. Name: **Susan Zonglu Hua**

2. Education
- Ph.D. Materials Science & Engineering, University of Maryland, 1993
- M.S. Physics, Peking University, 1984
- B.Sc. Physics, Peking University, 1982

3. Academic Experience
- University at Buffalo, Department of Mechanical & Aerospace Engineering and Department of Physiology & Biophysics, Professor, 2009 – present, full-time
- University at Buffalo, Department of Mechanical & Aerospace Engineering and Department of Physiology & Biophysics, Associate Professor, 2007 – 2009, full-time
- University at Buffalo, Department of Mechanical & Aerospace Engineering and Department of Physiology & Biophysics, Assistant Professor, 2004 – 2007, full-time
- University at Buffalo, Department of Mechanical & Aerospace Engineering, Research Associate Professor, 2000 – 2004, full-time

4. Non-academic experience
- Materials Innovation Inc, Senior Scientist, 1994-2000, full-time
- National Institute of Standards & Technology, Postdoctoral Research Associate, 1993-1994, full-time

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- American Society of Mechanical Engineers (ASME)
- Biophysical Society (BPS)
- Materials Research Society (MRS)

7. Honors and awards
- NIH Single Cell Analysis Program Phase I finalist, 2015
- Recipient of UB Sustained Achievement Award, 2015.
- Visionary Innovator Award, University at Buffalo, 2006, 2012.
- Results on stability and mechanics of quantum and Sharvin conductors highlighted by the American Physical Society’s Physics - spotlighting exceptional research, NSF, MRS, ASM, etc. (2011).
- SUNY Chancellor Award of Promising Inventor, 2002.

8. Service activities (within and outside of the institution)

- Member, Presidential Review Board (PRB), 2016-2019.
- Member, Strategic Planning Committee (SPC), 2014-2016, 2019-present.
- Lead person, Faculty Search Committee (area of Materials), 2015, 2017, 2019.
- Member, Search Committee for Director of BioXFEL Research Center, 2015-16.
- Member, Faculty Personal Committee, School of Engineering and Applied Science, 2008-2011.
- Director, Graduate Studies Committee, 2008-2010.
- Reviewer/Panelist, NIH-EBIT study section, 2015
- Reviewer/Panelist, NIH-SBIR/STTR-Bioengineering, 2011, 2012, 2013, 2014, 2016
- Reviewer/Panelist, NSF-IRES, 2013, 2015, 2017
- Reviewer/Panelist, NSF-CMMI, 2005, 2006, 2007, 2009, 2012
- Reviewer for various journals, including Nature protocol, Scientific Reports, Biophysical Journal, American J. of Physiology: cell physiology, Analytical Chemistry, Journal of Biomechanics, Annals of Biomedical Engineering, Sensor & Actuators A, Sensor & Actuators B, Biomicrofluidics, etc.

9. Most important publications and presentations from the past five years

- Shear stress induced nuclear shrinkage through activation of Piezo1 channels in epithelial cells. Jetta, D., Gottlieb, P. A., Verma, D., Sachs, F. & Hua, S. Z. Journal of cell science, 132, 226076 (2019).
- Enantiomeric Abeta peptides inhibit the fluid shear stress response of PIEZO1. Maneshi, M. M., Ziegler, L., Sachs, F., Hua, S. Z. & Gottlieb, P. A. Sci Rep 8, 14267 (2018).
- Heterogeneous Cytoskeletal Force Distribution Delineates the Onset Ca(2+) Influx Under Fluid Shear Stress in Astrocytes. Maneshi, M. M., Sachs, F. & Hua, S. Z. Frontiers in cellular neuroscience 12, 69 (2018).
- E-cadherin mediated lateral interactions between neighbor cells necessary for collective migration. Suffoletto, K., Jetta, D. & Hua, S. Z. Journal of biomechanics 71, 159-166 (2018).
- Flow induced adherens junction remodeling driven by cytoskeletal forces. Verma, D., Bajpai, V. K., Ye, N., Maneshi, M. M., Jetta, D., Andreadis, S. T., Sachs, F. & Hua, S. Z. Experimental cell research 359, 327-336 (2017).
- Mechanical stress activates NMDA receptors in the absence of agonists. Maneshi, M. M., Maki, B., Gnanasambandam, R., Belin, S., Popescu, G. K., Sachs, F. & Hua, S. Z. Sci Rep 7, 39610 (2017).
- A Microfluidic Approach for Studying Piezo Channels. Maneshi, M. M., Gottlieb, P. A. & Hua, S. Z. Curr Top Membr 79, 309-334 (2017).

10. Briefly list the most recent professional development activities

None

1. Name: **Vojislav D. Kalanovic**

2. Education
– Ph.D., Mechanical Engineering, Clemson University, Dept. of Mechanical Engineering, Clemson, SC, 1987 – 1991
– M.S., Electrical Engineering, School of Electrical Engineering, University of Belgrade, Belgrade, Yugoslavia, 1984 – 1986
– B.S., Mechanical Engineering/Controls, School of Mechanical Engineering University of Belgrade, Belgrade, Yugoslavia, 1976 - 1982

3. Academic Experience (all full time)
– University at Buffalo, Director of Engineering Science MS (Robotics) Program, School of Engineering and Applied Sciences, 2019-Present
– University at Buffalo, Professor of Practice, School of Engineering and Applied Sciences, Buffalo Manufacturing Works, 2017-Present
– University at Buffalo, Director of Robotics Minor, School of Engineering and Applied Sciences, 2017-Present
– South Dakota School of Mines and Technology, Professor of Mechanical Engineering Department of Mechanical Engineering, 1998-2017

4. Non-academic experience (all part-time)
- Flexible Robotic Environment, LLC - President, Owner, 2004 -Present
– Currently involved in following market segments: a) laser deposition, b) direct-write, c) 3D printing, d) material removal and polishing, e) robotic motion control software development, f) aircraft manufacturing (substructure drilling) and g) robotic path-planning
– Organized import/export activities to include: a) international IP regulations, b) labor exchange laws, c) supply chain formations, and d) export/import regulations
– Negotiated and obtained marketing and sales channels through Gesswein Inc.
– Negotiated with Parker-Hannifin the use of their sales and marketing channels and the opportunity to build a true integrator's network for this giant in electro-mechanical industry
– Negotiated with Danaher a licensing software agreement
– Negotiated and obtained a vendor status for A3200 Motion Server with Aerotech Inc.
– Worked with 3M and Spartanfelt Inc. to successfully develop, sell, and market a new type of tooling for grinding and polishing of precious metals
– Worked with 3M to successfully investigate and finally deploy the use of passive and active force-control tooling tables in precious metal material removal applications

5. Certifications or professional registrations
None

6. Current membership in professional organizations

– PI-TAU-SIGMA Honorary Mechanical Engineering Fraternity, 1993-Present
– Institute of Electrical and Electronic Engineers, 1991-Present
– International Neural Network Society, 1991-Present
– Society of Manufacturing Engineers, 1991-Present
– American Society of Mechanical Engineers, 1989-Present

7. Honors and awards
- Associate Member of the Graduate Faculty at University at Buffalo, 2019
– Professor Emeritus of Mechanical Engineering, 2017
– International Program Committee Member for CIFA (Conference InternationaleFrancophone d'Automatique), 2000

8. Service activities (within and outside of the institution)
– SDSM&T Tenure and Promotion Committee 2015- 2017
– SDSM&T Ethics Committee Chair 2003 -2017

9. Briefly list the most important publications and presentations from the past five years
– V.D.Kalanovic. Inverse-Kinematics Software Helps Design Modular Robots for 3D-Printing,3D CAD World. March 1, 2015
– A4000 Hybrid Run-Time Motion Platform – Copyright Software, December 2015
– MoDusCAM Path Planning Application Programing Interface - Copyright Software, December 2015

10. Briefly list the most recent professional development activities.
Commercial products on the open market (abridged list)
- VDK 1200-Jewelry Polishing and Material Removal System
- VDK1000 -Jewelry Polishing and Material Removal System
- VDK2000 -Aircraft Substructure Drilling System
- VDK3000 -Laser Deposition System
- VDK4000 -Direct Write System
- VDK5000 -Ultrasound Inspection System
- VDK6000 -Robotic Cell for Metal 3D Printing and Metal Part Refurbishing
- VDK7000 -Out of Axes 5DOF 3D Printer
- VDK8000- Food Processing Delta-Robotic System
- MoDusCAM Robotic Path-Planning Software
- A4000-Hybrid Motion Platform
- 3D Space Distributed Robotic Solution Concept in Modular Robotics - Flexible Robotic Environment (FRE) - based on 4 patents.
- 3D printing of eyewear

1. Name: **Jobaidur R. Khan**

2. Education
- Ph.D., Engineering and Applied Science, University of New Orleans, 20009
- M.S., Mechanical Engineering, University of New Orleans, 2001
- B.S., Mechanical Engineering, Bangladesh University of Engineering and Technology, 1996

3. Academic Experience
- University at Buffalo, Department of Mechanical & Aerospace Engineering, Teaching Assistant Professor, Fall 2013-present, full time
- Georgia Southern University, Department of Mechanical Engineering, Visiting Assistant Professor, Fall 2012-Summer 2013, full time
- University of New Orleans, Department of Mechanical Engineering Adjunct Professor, Spring 2009-Summer 2012, full time

4. Non-academic experience
- South East Louisiana Consulting, Consultant, 2012, full time
- Bayou Information System, Inc., System Engineer, 2001-2002, full time
- Nestle Bangladesh Ltd., Project Engineer, 1997-1998, full time

5. Certifications or professional registrations
- Australian Profession Engineer

6. Current membership in professional organizations
- American Society of Mechanical Engineers (ASME)

7. Honors and awards
- Individual Development Award ($ 995.00), 2019
- Invitation as a Speaker for Conference, 2018: For presenting previous research on Green technology as a speaker in the Conference. Complimentary registration and accommodatewas given in The 8th Annual Low Carbon Earth Summit, Qingdao, China, October 23-25, 2018.
- Invitation as an Eminent Speaker for Conference, 2016: For presenting research on energy conservation as an eminent speaker in the Conference of Power and Energy Engineering 2016, London, UK, July 20-21, 2016.

8. Service activities (within and outside of the institution)
- Supervising undergraduate student for independent study and co-advising students of other professors.
- Serving as an active member of UGSC (Undergraduate Study Committee) for ABET assessment and coordination.

- Served as a Judge at SEAS (School of Engineering and Applied Sciences) Poster Competition for multiple times.
- Served as a Judge at MAE (Mechanical and Aerospace Engineering) Poster Competition for multiple times.
- Served as a Judge for CSTEP (Collegiate Science and Technology Entry Program) Symposium Poster Competition for multiple times
- Served as External Examiner for the course of Fluid Mechanics in University of Pretoria, South Africa for multiple times

9. Briefly list the most important publications and presentations from the past five years

- Islam, W. and Khan, J.R., 2018, "Transient Analysis of Air Flow in a Channel for Unconventional Radiator," Proceedings of the ASME 2018 International Mechanical Engineering Congress and Exposition, IMECE 2018, Pittsburgh, Pennsylvania, USA, November 9-15, 2018, Paper No: IMECE2018-88327.
- Salman, S., Sharma, R., Suri, K., Khetani, Z.M., Junaidy, M.T., Meza, J. and Khan, J.R., 2018, "Experimental Analysis of Air Flow in a Channel for Unconventional Radiator," Proceedings of the ASME 2018 International Mechanical Engineering Congress and Exposition, IMECE 2018, Pittsburgh, Pennsylvania, USA, November 9-15, 2018, Paper No: IMECE2018-88332.
- Raza, H., Porangada, S.S., Islam, W., Naviwala, M. and Khan, J.R., 2017, "Performance Enhancement in Unconventional Radiator," Proceedings of the ASME 2017 International Mechanical Engineering Congress & Exposition Conference, IMECE 2017, Tampa, Florida, USA, November 3-9, 2017, Paper No: IMECE2017-70255.
- Wang, T. and Khan, J.R., 2016, "Discussion of Some Myths/Features Associated with Gas Turbine Inlet Fogging and Wet Compression," ASME Journal of Thermal Science and Engineering Applications, Vol.8, Issue 2, 021001/1-9, 2016.

10. Briefly list the most recent professional development activities

- Presented research on Green technology as a speaker in 8th Annual Low Carbon Earth Summit 2018, Qingdao, China, October 23-25, 2018.
- Presented research on energy conservation as an eminent speaker in the Conference of Power and Energy Engineering 2016, London, UK, July 20-21, 2016.

1. Name: **Francis D. Lagor**

2. Education
- Ph.D., Aerospace Engineering, University of Maryland, 2017
- M.S., Aerospace Engineering, University of Maryland, 2015
- M.S., Mechanical Engineering and Applied Mechanics, University of Pennsylvania, 2009
- B.S., Mechanical Engineering | Summa cum laude, Villanova University, 2006

3. Academic Experience
- University at Buffalo, Mechanical and Aerospace Engineering, Assistant Professor, 2018–present, (full-time)
- University of Maryland, Dept. of Aerospace Engineering, Post-Doctoral Associate, 2017, (full-time)

4. Non-academic experience
- Lockheed Martin Space Systems Company, Spacecraft Design Group MechanicalEngineer, 2009 – 2012, (full-time)

5. Certifications or professional registrations
- Engineer-in-Training Certification, NCEES State Board of Pennsylvania, 2010.

6. Current membership in professional organizations
- AIAA, Senior Member
- ASME, Member
- IEEE, Member
- AHS, Member

7. Honors and awards
- Promoted to Senior Member of AIAA, 2019
- Excellent Reviewer for the Journal of Guidance Control and Dynamics, 2016
- Future Faculty Fellow in UMD School of Engineering Travel Grant, 2016
- Future Faculty Fellow in UMD School of Engineering, 2015–2016
- Student Travel Award for American Controls Conference, 2016

8. Service activities (within and outside of the institution)
- Co-organizer, UB MAE Seminar Series, Summer 2018 - present
- Volunteer, Science is Elementary Outreach at Westminster Community Charter School 2019 - present
- Member, Search committee for MAE Business Analyst, 2018

- Volunteer, UB Faculty call program for admitted students, 2018
- Judge, MAE Graduate Student Poster Competition, 2018, 2020

9. Briefly list the most important publications and presentations from the past five years

- D. F. Gomez, F. D. Lagor, P. B. Kirk, A. Lind, A. R. Jones, and D. A. Paley. "Data-driven estimation of the unsteady flowfield near an actuated airfoil," AIAA J. Guidance, Control, and Dynamics, pp 1–9, 2019. doi:10.2514/1.G004339
- F. D. Lagor, K. Ide, and D. A. Paley, "Non-Gaussian estimation of a potential flow using a controlled Lagrangian sensor guided to invariant set boundaries by augmented observability," IEEE J. Oceanic Engineering, 0364-9059, 2019. doi:10.1109/JOE.2019.2933905
- F. Zhang, F. D. Lagor, H. Lei, X. Tan, and D. A. Paley, "Robotic Fish: Flow-relative control behaviors using distributed flow sensing," ASME Mechanical Engineering Magazine, vol. 138, no. 3, pp. S2–S5, 2016. doi:10.1115/1.2016-Mar-6
- F. D. Lagor, K. Ide, and D. A. Paley, "Incorporating prior knowledge in observability-based path planning for ocean sampling," Systems & Control Letters, vol. 97, pp. 169–175, 2016. doi:10.1016/j.sysconle.2016.09.002
- C. G. Hooi, F. D. Lagor, and D. A. Paley, "Height estimation and control of rotorcraft in ground effect using spatially distributed pressure sensing," Journal of the American Helicopter Society, vol. 61, pp. 1–14, oct 2016. doi:10.4050/JAHS.61.042004
- X. Xu, and F. D. Lagor, "A new expression for quasi-steady effective angle of attack including air- foil kinematics and flow-field nonuniformity," AIAA SciTech Forum, 1782, 2020. doi:10.2514/6.2020-1782
- G. Sedky, F. D. Lagor, and A. R. Jones, "The unsteady aerodynamics of a transverse wing-gust encounter with closed-loop pitch control," AIAA SciTech Forum, 1056, 2020. doi:10.2514/6.2020- 1056
- J. Graff, X. Xu, F. D. Lagor, and T. Singh, "Reduced-order modeling using Dynamic Mode De- composition and Least Angle Regression," AIAA Aviation Forum, 3072, 2019. doi:10.2514/6.2019- 3072
- G. Sedky, A. R. Jones, and F. D. Lagor, "Lift regulation of a finite wing during gust encounters," AIAA Scitech Forum, 1149, 2019. doi:10.2514/6.2019-1146
- D. F. Gomez, F. D. Lagor, P. B. Kirk, A. R. Lind, A. R. Jones, and D. A. Paley, "Unsteady DMD- based flow field estimation from embedded pressure sensors in actuated airfoils," AIAA Scitech Forum, 0346, 2019. doi:10.2514/6.2019-0346
- F. D. Lagor, A. Davis, K. Ide, and D. A. Paley, "Non-Gaussian estimation of a two-vortex flow using a Lagrangian sensor guided by output feedback control," American Control Conference (ACC), pages 1030–1035, Boston, MA, 2016. doi:10.1109/ACC.2016.7525050

10. Briefly list the most recent professional development activities
    None

1. Name: **Kemper Lewis**

2. Education
- Ph.D., Mechanical Engineering, Georgia Institute of Technology, 1996
- M.B.A., School of Management, University at Buffalo, 2003
- M.S., Mechanical Engineering, Georgia Institute of Technology, 1994
- B.S., Mechanical Engineering/B.A., Mathematics, Duke University, 1992

3. Academic Experience (all full time)
- Moog Endowed Professor of Innovation, University at Buffalo, 2019 – present
- Sustainable Manufacturing and Advanced Robotic Technology (SMART) Communityof Excellence, University at Buffalo, Director, 2015 – present
- Char, Department of Mechanical and Aerospace Engineering, University at Buffalo, 2014 – 2020
- Department of Mechanical and Aerospace Engineering, University at Buffalo, Professor, 2006– present
- New York State Center for Engineering Design and Industrial Innovation (NYSCEDII), University at Buffalo, Executive Director, 2005 – 2014
- Department of Mechanical and Aerospace Engineering, University at Buffalo, Associate Professor, 2001 – 2006
- Department of Mechanical and Aerospace Engineering, University at Buffalo, Assistant Professor, 1996 – 2001

4. Non-academic experience
   None

5. Certifications or professional registrations
- Six Sigma Black Belt, American Society for Quality, 2006

6. Current membership in professional organizations
- ASME Fellow, Life Member
- AIAA Associate Fellow, Member
- ASEE Member

7. Honors and awards
- ASME Donald N. Zwiep Innovation in Education Award, 2019
- Sustained Achievement Award, Exceptional Scholar, University at Buffalo, 2017
- Design Automation Award, ASME, 2017
- President Emeritus and Mrs. Myerson Award for Undergraduate Teaching and Mentoring, 2013
- Milton Plesur Excellence in Teaching Award, 2012-2013
- Best Paper Award, ASME Design Education Conference, 2011

- ASEE Fred Merryfield Design Award, 2010
- Recognized as one of the Top Forty Leaders Under Forty in Western New York, 2006

8. Service activities (within and outside of the institution)

- Chair, ASME Mechanical Engineering Department Head Executive Committee, 2019-2020
- ASME Design Automation Executive Committee, 2008-2013
- ASME Design Automation Committee, Chair, 2011-2012
- Associate Member, AIAA Multidisciplinary Design Optimization Technical Committee, 1998-2003
- Member, Department Chair's Advisory Committee, Vice Provost for Faculty Affairs, 2015-2018
- Board of Directors, The Chapel at CrossPoint, 2005-2012, 2014-present

9. Briefly list the most important publications and presentations from the past five years

- Ghiasian, S.E., Jaiswal, P., Rai, R., and Lewis, K., 2020, "A Preference-based Approach to Assess a Component's Design Readiness for Additive Manufacturing," Journal of Mechanical Design, Vol. 142, No. 8.
- Odonkor, P. and Lewis, K., 2019, "Data-Driven Design of Control Strategies for Distributed Energy Systems," Journal of Mechanical Design, Special Issue on Machine Learning in Design, Vol. 141.
- Ball, Z. and Lewis, K., 2018, "Mass Collaboration Project Recommendation Within Open-Innovation Design Networks," Journal of Mechanical Design, Vol 141.
- Odonkor, P. and Lewis, K., 2018, "Automated Design of Energy Efficient Control Strategies for Building Clusters Using Reinforcement Learning," Journal of Mechanical Design, Vol. 141.
- Ball, Z. and Lewis, K., 2018, "Observing Network Characteristics in Mass Collaboration Design Projects," Design Science, Vol. 4.
- Moore-Russo, D., Wilsey, J.N., Parthum Sr., M.J., and Lewis, K., 2017, "Navigating Transitions: Challenges for Engineering Students," Theory into Practice.
- Ghosh, D., Olewnik, A., Lewis, K., Kim, J., and Lakshmanan, A., 2017, "Cyber-Empathic Design – A Data Driven Framework for Product Design," Journal of Mechanical Design, Vol. 139, No. 9.

10. Briefly list the most recent professional development activities

- Designated as a National Science Foundation Panel Fellow in the Increasing Reviewer Risk Tolerance Through Awareness (IRRTTA) Program, 2019-2020.
- Invited Participant, Workshop on Artificial Intelligence and the Future of STEM in Societies, Carnegie Mellon University, December 1-3, 2019.
- 2019 ASME International Engineering Education Leadership Summit, as part of the Executive Committee of ME Department Heads/Chairs, New Orleans, LA, March 20-23, 2019.
- Invited Participant, Emerging Engineering Education Research & Innovation Summit, Purdue University, September 24-25, 2018.

1. Name: **Cyrus K. Madnia**

2. Education
– Ph.D., The University of Michigan, Aerospace Engineering, 1989
– M.S.E., The University of Michigan, Aerospace Engineering, 1982
– B.S.E. (Magna Cum Laude), The University of Michigan, Aerospace Engineering, 1980

3. Academic Experience (all full time)
– University at Buffalo, Department of Mechanical and Aerospace Engineering, Professor, 2006-present
– University at Buffalo, Department of Mechanical and Aerospace Engineering, Associate Professor, 1999 – 2006
– University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor, 1994 – 1999
– University at Buffalo, Department of Mechanical and Aerospace Engineering, Research Assistant Professor, 1992 – 1994
– University at Buffalo, Department of Mechanical and Aerospace Engineering, Postdoctoral Research Associate, 1989 – 1992

4. Non-academic experience
– Visiting Scientist, Theoretical Flow Physics Branch, NASA Langley Research Center, 1990, full time

5. Certifications or professional registrations
None

6. Current membership in professional organizations
– Member, Tau Beta Pi Engineering Honor Society.
– Council member, AIAA Niagara Frontier Professional chapter.
– Member, American Physical Society (APS).
– Member, Combustion Institute.
– Associate Fellow, American Institute of Aeronautics and Astronautics (AIAA).
– Member, American Society of Mechanical Engineers (ASME).

7. Honors and awards
– CAREER Award, National Science Foundation (1996-2001).
– SUNY Chancellor's Award for Excellence in Teaching, 2002.
– Research profile featured as "U.B. Professor Helping NASA Launch it's Future," WKBW TV in Buffalo, NY on 4/21/2010.

- Interviewed by WIVB TV of Buffalo, NY, about the plane crash in Hudson River, 15 January, 2009.
- American Institute of Aeronautics and Astronautics (AIAA) Associate Fellow, 2008
- SUNY Chancellor's Award for Excellence in Teaching, 2002

8. Service activities (within and outside of the institution)

- UB Representative, University Space Research Association Council of Institutions, Washington, D.C., attended the Annual Meetings, 2007 - present.
- Invited Reviewer, Sandia National Laboratories, Combustion Research Facility, Livermore, CA, March 5-7, 2007.
- Deputy Director of Education for the AIAA Northeast Region I (1999-2004).
- Chair, Faculty Search Committee for Fluids and Thermal Sciences (2015-2016). Member, Faculty Search Committee for Fluids and Thermal Sciences (2013-2014). Member, Graduate Studies Committee (Spring 2002-present).
- Chair, Faculty Search Committee for Fluids and Thermal Sciences (2002-2004).

9. Briefly list the most important publications and presentations from the past five years

   <u>Invited Book Chapter</u>:

   R. Jahanbakhshi, C.K. Madnia, "Scalar Transport Near the Turbulent/Non-Turbulent Interface in Reacting Compressible Mixing Layers," Chapter in Modeling and Simulation of Turbulent Mixing and Reaction, pp. 25–46, Editors: D. Livescu, A. Nouri, F. Battaglia, P. Givi (eds). Heat and Mass Transfer, Springer, Singapore (2020).

   <u>Journal Articles</u>:

   S. Sammak, A. Aitzhan, P. Givi & C. K. Madnia, "High Fidelity Spectral-FDF-LES of Turbulent Scalar Mixing,"Combustion Science and Technology, DOI: 10.1080/00102202.2020.1737031, (2020).

   DiGregorio, N. J., Drozda, T. G. and Madnia, C. K., "Comparison of Boundary Layer Similarity Transformations for High Mach Number Flows", AIAA Scitech 2019 Forum, p. 1390, 2019.

   Jahanbakhshi, R. and Madnia, C.K.,"Viscous Superlayer in a Reacting Turbulent Mixing Layer", Journal of Fluid Mechanics Vol. 848, pp. 743-755, 2018.

   Jahanbakhshi, R. and Madnia, C.K.,"The Effect of Heat Release on the Entrainment in a Turbulent Mixing Layer", Journal of Fluid Mechanics Vol. 844 pp. 92-126, 2018.

   Jahanbakhshi, R. and Madnia, C.K., ``Entrainment in a Compressible Turbulent Shear Layer," Journal of Fluid Mechanics, Vol. 797, pp. 564-603, 2016.

   Jahanbakhshi, R., Vaghefi, N.S. and Madnia, C.K., "Baroclinic Vorticity Generation Near the Turbulent/Non-turbulent Interface in a Compressible Shear Layer", Physics of Fluids 27, 105105, 2015.

10. Briefly list the most recent professional development activities

   None

Name: Ardeshir Raihanian Mashhadi

1. Education
- Ph.D., Mechanical Engineering, University at Buffalo, The State University of New York, Buffalo, NY, 2013 - 2018
- M.S., Mechanical Engineering, University at Buffalo, The State University of New York, Buffalo, NY, 2014 - 2017
- B.Sc., Materials Science and Engineering, Sharif University of Technology, Tehran, Iran 2007 – 2012

2. Academic Experience
- University at Buffalo, Mechanical and Aerospace Engineering, Assistant Professor of Teaching, 2018 – Present, full-time
- University at Buffalo, Green Engineering Technologies for Community of Tomorrow (GETCOT) Lab., 2014 – 2018, part-time
- Allameh Helli 3 High School (NODET), Tehran, Iran, Director of Physics Group, 2008 –2013, part-time
- Polymer Lab., Materials Science and Engineering Department, Sharif University of Technology, 2010 – 2012, part-time
- Powder Metallurgy Lab., Materials Science and Engineering Department, Sharif University of Technology, 2010 - 2012, part-time
- Allameh Helli 3 High School (NODET), Tehran, Iran, Associate Director of Research, 2009–2010, part-time

3. Non-academic experience
   None

4. Certifications or professional registrations
   None

5. Current membership in professional organizations
- American Society of Engineering Education (ASEE)
- American Society of Mechanical Engineers (ASME)
- The Institute of Industrial Engineers (IIE)
- Production and Operations Management Society (POMS)
- Society of Manufacturing Engineers (SME)
- Project Management Institute (PMI)

6. Honors and awards
- Academy Award for Sustainable Consumption Topic, International Life Cycle Academy (ILCA), 2017

– Best Paper Award, Design for Manufacturing and the Life Cycle Conference (DFMLC), 2017
– UB Mechanical and Aerospace Engineering Department Ph.D. Teaching Fellow, 2017
– The UB Engineering Alumni Association Leaders in Excellence Scholarship Award, 2016
– New York State Professional Development Award, 2016

7. Service activities (within and outside of the institution)

– Session Organizer, Design for Sustainable Additive Manufacturing, IDETC/CIE 2016, Charlotte, NC, USA.
– Reviewer, International Journal of Production Research
– Reviewer, Applied Energy
– Reviewer, Journal of Computing and Information Science in Engineering
– Reviewer, Journal of Mechanical Design

8. Briefly list the most important publications and presentations from the past five years

– Mashhadi, A.R., Vedantam, A. and Behdad, S., 2019. "Investigation of consumers acceptance of product-service-systems: A case study of cell phone leasing" Resources, Conservation and Recycling, 143, 36-44.
– Mashhadi, A.R. and Behdad, S., 2018. "Discriminant Effects of Consumer Electronics Use-phase Attributes on Household Energy Prediction" Energy Policy, 118, 346-355.
– Mashhadi, A.R. and Behdad, S., 2017. "Ubiquitous Life Cycle Assessment (ULCA): A Proposed Concept for Environmental and Social Impact Assessment of Industry 4.0." SME Manufacturing Letters, 15, 93-96.
– Mashhadi, A.R. and Behdad, S., 2017. "Environmental Impact Assessment of the Heterogeneity in Consumers' Usage Behavior: An Agent Based Modeling Approach." Journal of Industrial Ecology, doi:10.1111/jiec.12622. (ILCA Academy Award Winner)
– Mashhadi, A.R. and Behdad, S., 2017. "Optimal Sorting Policies in Remanufacturing Systems: Application of Product Life-Cycle Data in Quality Grading and End-of-Use Recovery." SME Journal of Manufacturing Systems, 43, pp.15-24.

9. Briefly list the most recent professional development activities

– "Project Management Workshop", 2017 SEAS 360 Professional Development Certification Program, University at Buffalo, Buffalo, NY, USA.
– "Advancing Sustainable Design: Road-mapping and Community Building", AM3D/IDETC/CIE 2016 conference, Charlotte, NC, USA.
– "Early Career Forum", MSEC 2016 conference, Blacksburg, VA, USA.
– "Early Career Forum", MSEC 2015 conference, Charlotte, NC, USA.
– "NSF Proposal Writing Workshop", IDETC/CIE 2014 conference, Buffalo, NY, USA.

1. Name: **Hui Meng**

2. Education
- NIH K25 Training, Neurovascular Biology, University at Buffalo and UCSF, 2004 – 09
- Ph.D., Mechanical Engineering, University of Houston, 1990 – 1994
- DAAD Scholar, Applied Physics, Technische Universität Berlin, 1987 – 1990
- M.S., Optical Engineering, Zhejiang University, 1984 – 1987
- B.S., Optical Engineering, Zhejiang University, 1980 – 1984

3. Academic Experience
- University at Buffalo, Mechanical & Aerospace Engineering, Professor, 2004 – present, full-time
- University at Buffalo, Biomedical Engineering, Adjunct Professor, 2010 - present, part-time
- University at Buffalo, Neurosurgery, Research Professor, 2004 – Present, part-time
- Tohoku Univ., Institute of Fluid Sciences, Visiting Professor, 2010 – 2011, full-time
- University at Buffalo, Mechanical & Aerospace Eng., Associate Professor, 1999 – 2004, full-time
- Kansas State University, Mechanical Engineering, Assistant Professor, 1995 – 1999, full-time

4. Non-academic experience
- Wright Lab, Wright-Patterson Air Force Base, Visiting Professor, 1996 – 1996, full-time

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- American Society of Mechanical Engineering (ASME)
- Biomedical Engineering Society (BMES)
- American Heart Association (AHA)
- American Stroke Association (ASA)
- American Physical Society (APS)
- Society for Women Engineers (SWE)

7. Honors and awards
- UB Distinguished Professor, 2018
- Fellow, American Society of Mechanical Engineers (ASME), 2018
- SUNY Chancellor's Award for Excellence in Scholarship and Creative Activities, 2016
- William L. Young/Allison Raaen Lectureship, Center for Cerebrovascular Research, UCSF, 2015
- Fellow, American Institute for Medical and Biological Engineering (AIMBE), 2014

8. Service activities (within and outside of the institution)
- Administrating PhD Qualifying Exam, 2007-Present
- Faculty Marshal, 2006, 2007, 2008, 2009, 2011, 2012, 2013, 2015, 2016, 2017, 2018
- Graduate Committee, 2012
- Coordinator of Biomechanical Engineering, 2002-2009
- Hosting Women in Science and Engineering (WISE) camp for incoming freshmen (aprogram for females in STEM, Aug 21-22, 2014

9. Briefly list the most important publications and presentations from the past five years
- Hammond AL, Liang Z, Meng H: Holographic deflection imaging measurement of electriccharge on aerosol particles. Exp. Fluids (2019) 60:103. http://doi.org/10.1007/s00348-019-2744-z
- Dou Z, Bragg AD, Hammond AL, Liang Z, Collins L, Meng H: Effects of Reynolds Number and Stokes Number on Particle-pair Relative Velocity in Isotropic Turbulence: A Systematic Experimental Study, J. Fluid Mech. (2018) 839: 271–292. http://doi.org/10.1017/jfm.2017.813
- Dou Z, Ireland PJ, Bragg AD, Liang Z, Collins L, Meng H: Particle-Pair Relative Velocity Measurement in High-Reynolds-Number Homogeneous and Isotropic Turbulence Using 4-Frame Particle Tracking Velocimetry, Exp. Fluids, (2018) 59:30. http://doi.org/10.1007/s00348-017-2481-0
- Dou Z, Pecenak ZK, Cao L, Woodward SH, Liang Z, Meng H: PIV Measurement of High-Reynolds-Number Homogeneous and Isotropic Turbulence in an Enclosed Flow Apparatus withFan Agitation, Measurement Science and Technology, 27(3): 35305-35305, 2016. http://doi.org/10.1088/0957-0233/27/3/035305
- Asgharzadeh H, Shahmohammadi A, Varble N, Levy EI, Meng H, Borazjani I: A Simple Flow Classification Parameter Can Discriminate Rupture Status in Intracranial Aneurysms, Accepted for publication in Neurosurgery on March 18, 2020.

10. Briefly list the most recent professional development activities
- NIH Study Section – Bioengineering, Technology, and Surgical Sciences (BTSS), 10/2019
- NIH Study Section – Small Business: Clinical Neurophysiology, Devices, Neuroprosthetics, and Biosensors, ZRG1 ETTN-C (10), 03/2018
- NIH Study Section – Neuroscience and Ophthalmic Imaging Technologies (NOIT),02/2016
  NIH Special Emphasis Review Panel – ZRG1 ETTN-L 53 R, PAR13-137: Bioengineering
- Research, 02/2016
- NIH Special Emphasis Review Panel – ZHL1 CSR-I (O1) for National Heart, Lung, and Blood Institute, 08/2014

1. Name: **Joseph C. Mollendorf**

2. Education
- Doctor of Philosophy, Mechanical Engineering Cornell University, 1971
- Master of Science, Mechanical Engineering Cornell University, 1969
- Bachelor of Science, Mechanical Engineering Clarkson college of Technology, 1966

3. Academic Experience
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Engineering Machine Shop Supervisor, 2013 – present (part time)
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Professor, 1985–present (full time)
- University at Buffalo, Department of Physiology and Biophysics, Professor, 2003 – 2010 (part time)
- University at Buffalo, Center for Research and Education in Special Environments, Associate Director, 1985 – 1992, 1999 – 2010 (part time)
- University at Buffalo, Special Assistant Vice President for Sponsored Programs, 1985 –1990, (Part Time)
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Associate Professor, 1979 – 1985 (full time)

4. Non-academic experience
- Bell Aerospace, Apollo 11 Lunar Excursion Module Ascent Engine, Wheatfield, NY, Engineer, 1966 – 1966 (full time)

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- Golden Key
- Sigma Xi
- Tau Beta Pi
- Pi Tau Sigma
- American Society of Mechanical Engineers - Fellow
- American Association for the Advancement of Science

7. Honors and awards
- Distinguished Inventor of the Year, Rochester Intellectual Property Association, 2010
- Elected Fellow ASME, "The Fellow grade of membership recognizes exceptional engineering achievements and contributions to the engineering profession.", May 2008

- Visionary Innovator Award, “In recognition of Licensing Your Invention ‘Height and Width Adjustable Saddle Sling Seat Walker with Controllable Directional Tracking and Optional Supports’ to Northeastern Biomechanical Manufacturing Corporation”, 2006 (awarded in 2007)
- 2007 Inventor of the Year Nomination, Niagara Frontier Intellectual Property Law Association & Technical Societies Council of the Niagara Frontier
- Visionary Innovator Award, “In recognition of Licensing Your Invention ‘Thermal Destruction of Biotoxins by Compressive Heating of Airstreams’ to Buffalo BioBlower Technologies, LLC”, 2005 (awarded in 2006)
- Visionary Innovator Award, “In recognition of Licensing Your Invention ‘Low Drag Swim Apparel’ to TYR Sport, Inc”, 2004 (awarded in 2005)

8. Service activities (within and outside of the institution)

- Ad-hoc Graduate Grievance Committee, Chair, Fall 2014
- Summer Teaching Fellows Selection Committee, Spring 2015
- Faculty Advisor, AIAA Design, Build and Fly; Design, Build and Fly International Competition, Wichita, Kansas 9/1/12
- Promotions committee, 2010
- Faculty Personnel Committee (elected), Fall 1999-2000.
- Member M. ENG. Committee, 1989-1990.
- Harrison Radiator Coop Committee, 1984 - 1988.

9. Briefly list the most important publications and presentations from the past five years

- Richter, Joseph P., Joshua M. Weisberger, Brian T. Bojko, Joseph C. Mollendorf, and Paul E. DesJardin. "Numerical modeling of homogeneous gas and heterogeneous char combustion for a wood-fired hydronic heater." Renewable energy 131 (2019): 890-899.
- Richter, J.P., Weisberger, J.M., Mollendorf, J.C., DesJardin, P.E., "Emissions from a domestic two-stage wood-fired hydronic heater: Effects of non-homogeneous fuel decomposition”, Renewable Energy, 2017.
- Richter, J.P., Bojko, B.T., Mollendorf, J.C., DesJardin, P.E., “Measurement of Fuel BurnRate, Emissions and Thermal Efficiency from Domestic Two-Stage Wood-Fired Hydronic Heater”, Renewable Energy, 2016.
- Richter J.P., Mollendorf, J.C., DesJardin, P.E., “Absolute and Relative Emissions Analysis in Practical Combustion Systems – Effect of Water Vapor Condensation”, Measurement Science and Technology, 2016.
- Newman, Andrew J., Sarah H. Hayes, Abhiram S. Rao, Brian L. Allman, Senthilvelan Manohar, Dalian Ding, Daniel Stolzberg, Edward Lobarinas, Joseph C. Mollendorf, and Richard Salvi. "Low-cost blast wave generator for studies of hearing loss and brain injury: Blast wave effects in closed spaces." Journal of neuroscience methods 242 (2015): 82-92.

10. Briefly list the most recent professional development activities
    None

1. Name: **D. Joseph Mook**

2. Education
- Ph.D., Engineering Mechanics, Virginia Tech, 1982-1986
- M.S., Engineering Mechanics, Virginia Tech, 1981-1982
- B.S., Engineering Science and Mechanics, Cum Laude, Math Minor, Virginia Tech, 1975-1979

3. Academic Experience
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Full Professor, 1997-present, full-time
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Department Chairman and Professor, 2204-2007, full-time
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Associate Professor, 1991-1996, full-time
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor, 1986-1991, full-time
- University at Buffalo, School of Engineering and Applied Sciences, Assistant Dean for International Education, 1997-2007, part-time
- Universite de Technologie de Troyes, Mechanical Engineering, Visiting Professor, 2003-2005, 2015-2019, full-time
- Thai Nguyen University of Technology, Mechanical Engineering, Visiting Professor, 2011, full-time
- Universite de Technologie de Compiegne, Visiting Professor in Office of the President, 2008-2009, full-time
- Institut National des Sciences Appliquées de Toulouse (INSA), Department of Mechanical Engineering, Visiting Professor, 2008, full-time
- Chiang Mai University, Mechanical Engineering, Visiting Professor, 2006, full-time
- Universitaet Hannover, Visiting Professor, 1994, full-time
- Technische Universitaet Darmstadt, Visiting Professor, 1992, full-time

4. Non-Academic Experience
- National Science Foundation, Program Manager, International Science and Engineering, 2009-2011, full-time
- Pratt and Whitney Aircraft Company, Analytical Engineer in Combustor Durability group, worked to improve the life cycle durability of large turbofan engines (various JT9- D model engines, used on Boeing 747s, Lockheed L1011s, others), 1979-1980, full-time

5. Certifications or Professional Registrations
- EIT exam, 1979

6. Current Membership in Professional Organizations
   None
7. Honors and Awards

- Global Engineering Education Exchange (largest organization promoting international exchanges for engineering students among the world's leading universities), elected to Executive Committee 2000-2009; Elected Chair of the Executive Committee (highest office), 2003-2006 and again 2006-2009
- Select national-level NSF-sponsored leadership:
  - Invited participant in the NSF "National Summit Meeting on the Globalization of Engineering Education", Newport, Rhode Island, November 5-6, 2008; one of 19 original signatories to the "Newport Declaration to Globalize U.S. Engineering Education", published in the NSF report of the meeting, Educating Engineers as Global Citizens: A Call for Action, and in various other engineering education publications (e.g., ASEE) and venues
  - Invited member of the 12-person US delegation, NSF/JSPS co-sponsored binational workshop, "Strategic Initiative for University Internationalization," Washington, DC, May 25-28, 2008; and Tokyo, Kyoto, and Osaka, Japan, December 1-7, 2008. For the meetings in Japan, one of only 4 speakers from the US delegation..... etc
- The subject of Chapter 6 of the book, What is Global Engineering Education For? The Making of International Educators, edited by Gary Lee Downey and Kacey Beddoes, Morgan and Claypool, Publishers, 2011. This book highlights the professional autobiographical stories of16 people identified as groundbreaking leaders in efforts to help internationalize US academic engineering institutions.
- SUNY Chancellor's Award for Excellence in Internationalization, 2006
- SUNY Chancellor's Award for Excellence in Teaching, 2002
- Milton Plesur Outstanding Educator Award, 2000
- Japan Society for the Promotion of Science Senior Research Fellow, 2000
- Alexander von Humboldt Research Fellow, 1994

8. Service Activities

- University Faculty Senator, representing School of Engineering and Applied Science,2017-present
- Member of Dean-level review board for untenured faculty, 2018-2019; alternate, 2019- 2020

9. Briefly list the most important publications and presentations from the past five years

- Numerous invited presentations to various student groups on topics including professional development, international opportunities, graduate study, career paths, etc.

10. Professional Development

- Attended several one-day workshops intended to promote collegiality, communication, cooperation, etc, sponsored by SEAS Dean's Office

1. Name: **Mostafa A. Nouh**

2. Education
- Ph.D., Mechanical Engineering, University of Maryland, College Park, 2013
- M.S., Mechanical Engineering, University of Maryland, College Park, 2012
- B.S., Mechanical Engineering, Cairo University, Egypt, 2008
- I.G.C.S.E., Cambridge University, UK, International General Certificate of Secondary Education, 2003

3. Academic Experience
- University at Buffalo, Dept. of Mechanical and Aerospace Engineering, Assistant Professor, 2015 – Present (full time)
- University of Maryland, Dept. of Mechanical Engineering, Adjunct Faculty, 2014 – 2015 (full time)
- University of Maryland, Smart Materials & Structures Research Center, Postdoctoral Research Associate, 2013 – 2015 (full time)
- University of Maryland, Dept. of Mechanical Engineering, Research Assistant, 2009 – 2013 (full time)
- American University in Cairo, Dept. of Physics, Research Assistant, 2008 – 2009 (full time)
- University of Oslo, Energy Research Group, Dept. of Physics, Research Assistant, 2007 (full time)

4. Non-academic Experience
- Home and Personal Care Factory, Unilever Co., Egypt, Mechanical Engineer, 2006 (full time)

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- American Society of Mechanical Engineers, ASME (2009 – Present)
- International Society for Optics and Photonics, SPIE (2015 – Present)

7. Honors and awards
- ONR Phononics Fellowship Award, 07/2019
- NSF CAREER Award, 02/2019
- 2018 SEAS Early Career Teacher of the Year, 12/2018
- Buffalo Blue Sky Gold Coin Award, 08/2018
- 2018 Vibration Institute Academic Award, 05/2018

8. Service activities (within and outside of the institution)

- MAE Graduate Studies Committee (2017 – Present)
- SEAS Search Committee - Mechanics Instructor (2018)
- SEAS Adjudication Committee Chair (2018)
- SEAS Presidential Fellowship Review Committee (2019)
- Noise Control and Acoustics Division (NCAD), ASME
- Adaptive Structures and Material Systems (ASMS) Branch, ASME

9. Briefly list the most important publications and presentations from the past five years

- M. Attarzadeh, J. Callanan, and M. Nouh, Experimental Observation of Nonreciprocal Waves in a Resonant Metamaterial Beam, Phys. Rev. Applied, 13, 021001 (2020).
- H. Al-Babaa, S. Nandi, T. Singh, and M. Nouh, Uncertainty Quantification of Tunable Elastic Metamaterials, Journal of Applied Physics, 127, 015102 (2020).
- A. Aladwani and M. Nouh, Mechanics of Metadamping in Flexural Dissipative Metamaterials: Analysis and Design in Frequency and Time Domains, Int. J. of Mechanical Sciences, 173, 105459 (2020).
- H. Al-Babaa, M. Nouh, and T. Singh, Dispersion and Topological Characteristics of Permutative Polyatomic Phononic Crystals, Proc. of the Royal Society A, 475, 2226 (2019).
- M. Attarzadeh, S. Maleki, J. L. Crassidis, and M. Nouh, and T. Singh, Non-reciprocal Wave Phenomena in Energy Self-reliant Gyric Structures, Journal of the Acoustical Society of America, 146(1), 789-801 (2019).
- H. Al-Babaa, J. Callanan, and M. Nouh, Emergence of Pseudo-Phononic Gaps in Periodically Architected Pendulums, Frontiers in Materials, 6, 119 (2019).
- J. Callanan and M. Nouh, Optimal Thermoacoustic Energy Extraction via Temporal Phase Control and Traveling Wave Generation, Applied Energy, 241, 599-612 (2019).
- H. Al-Babaa and M. Nouh, and T. Singh, Control of Spatial Wave Profiles in Finite Lattices of Repelling Magnets, Journal of Dynamic Systems, Measurement, and Control, 141(11), 111015 (2019).
- A. Aladwani, A. Almandeel, and M. Nouh, Fluid-Structural Coupling in Metamaterial Plates for Vibration and Noise Mitigation in Acoustic Cavities, Int. J. of Mechanical Sciences, 159, 151-166 (2019).
- W. Akl, M. Nouh, O. Aldraihem, and A. Baz, Energy Dissipation Characteristics of Polyurea and Polyurea/Carbon Black Composites, Mechanics of Time-Dependent Materials, 23(2), 223-247 (2019).
- C. Banquet, H. Al-Babaa, M. Frazier, M. Nouh, and M. Hussein, Metadamping: Dissipation Emergence in Elastic Metamaterials, Advances in Applied Mechanics, 51, 115-164 (2018).
- H. Al-Babaa, J. Callanan, M. Nouh, and T. Singh, Band Gap Synthesis in Elastic Monatomic Lattices via Input Shaping, Meccanica, 53(11), 3105-3122 (2018).

10. Briefly list the most recent professional development activities

None

1. Name: **Shenqiang Ren**

2. Education
- B.S., Materials Chemistry, Nanjing University of Aero & Astro, China, 2004
- Ph.D., Materials Science, University of Maryland, College Park, USA, 2009
- Postdoc, Nanoscale Science, Massachusetts Institute of Technology, USA, 2011

3. Academic Experience
- University at Buffalo, Mechanical and Aerospace Engineering Department, Professor, 2018-Present, full-time
- Temple University, Associate Professor of Engineering, 2015-2017, full-time
- University of Kansas, Associate Professor of Chemistry, 2014-2015, full-time
- University of Kansas, Assistant Professor of Chemistry, 2011-2014, full-time
- Massachusetts Institute of Technology (MIT), Department of Materials Science and Engineering, Postdoctoral Scholar, 2009-2011, full-time
- University of Maryland, Department of Materials Science and Engineering, Research Assistant, 2005-2009, full-time

4. Non-academic experience
None

5. Certifications or professional registrations
None

6. Current membership in professional organizations
- Materials Research Society
- American Chemical Society

7. Honors and awards
- NSF – CAREER – 2015
- Army Research Office - Young Investigator Award – 2014
- Air Force Summer Faculty Fellowship – 2013
- NSF Kansas-EPSCoR First Award – 2013
- New Faculty General Research Fund Award, University of Kansas - 2012
- Dean's Doctoral Research Award (First Prize), University of Maryland, College Park – 2009
- Distinguished Doctoral Dissertation Award, University of Maryland, College Park – 2009
- China’s National Award for Outstanding Graduate Students Abroad - 2009

8. Service activities (within and outside of the institution)

- North American Editor – Journal of Experimental Nanoscience
- Reviewer - Nature Nanotechnology, Nature Communication, Chemical Society Reviews, ACS Nano, Advanced Materials, Small, Physical Review Letters, Applied Physics Letters, Journal of Applied Physics, Chemistry of Materials, Nanotechnology, Journal of Materials Chemistry, Langmuir

9. Briefly list the most important publications and presentations from the past five years

- Z. Zhang, R. C. Remsing, H. Chakraborty, W. Gao, G. Yuan, M. L Klein*, Shenqiang Ren*, Light-induced dilation in nano-sheets of charge transfer complexes, Proceedings of the National Academy of Sciences 10.1073/pnas.1800234115 (2018).
- Y.Guan, Z.Zhang, Y. Tang, J. Yin, Shenqiang Ren*, Kirigami Inspired Nanoconfined Polymer Conducting Nanosheets with 2,000% Stretchability, Advanced Materials 10.1002/adma.201706390 (2018).
- W. Gao, R. Brennan, Y. Hu, M. Wuttig, G. Yuan,* E. Quandt,* and Shenqiang Ren,* Energy Transduction Ferroic Materials, Materials Today, DOI: 10.1016/j.mattod. 2018.01.032 (2018).
- B. Xu, H. Chakraborty, V. K. Yadav, Z. Zhang, M. L. Klein and Shenqiang Ren*, Tunable two-dimensional interfacial coupling in molecular heterostructures, Nature Communications, 8, 312 (2017).
- Z. Zhang, P.Li, Y. Tang, A. J. Wilson, K. Willets, M. Wuttig,* R.Xiong,* Shenqiang Ren*, Tunable electroresistance and electro-optic effects of transparent molecular ferroelectrics, Science Advances e1701008 (2017).
- B. Xu, Z. Luo, A. J. Wilson, K. Chen, W. Gao, G. Yuan, H. D. Chopra, X. Chen, K. A. Willets,
- Z. Dauter, and Shenqiang Ren*, Multifunctional charge-transfer single crystals through supramolecular assembly, Advanced Materials, adma201600383 (2016)
- B. Xu, H. Li, H. Li, A. J. Wilson, L. Zhang, K. Chen, K. A. Willets, F. Ren, J. C. Grossman, Shenqiang Ren*, Chemically driven interfacial coupling in charge-transfer mediated functional superstructures, Nano Letters, 10.1021/acs.nanolett.6b00712 (2016)
- B. Xu, H. Li, A. Hall, W. Gao, M. Gong, G. Yuan, J. Grossman and Shenqiang Ren*, All-polymeric control of nanoferronics, Science Advances, 1, e1501264 (2015)
- Y. Xie, M. Gong, T. Shastry, J. Lohrman, M. Hersam, and Shenqiang Ren*, "Broad Spectral Response Nano-Carbon Bulk Heterojunction Excitonic Photodetectors", Advanced Materials, 25, 3433 (2013). Featured on the cover for Advanced Materials.
- M. Gong, T. A. Shastry, Y. Xie, M. Bernardi, D. Jasion, K. A. Luck, T. J. Marks, J. C. Grossman, Shenqiang Ren*, and Mark C. Hersam*, "Polychiral Semiconducting Carbon Nanotube-Fullerene Solar Cells", Nano Letters, 14, 5308 (2014).

10. Briefly list the most recent professional development activities

    None

1. Name: **Matthew J. Ringuette**

2. Education

- Ph.D., Aeronautics (Fluid Mechanics), California Institute of Technology, Pasadena, CA, 2004
- M.S., Aeronautics, California Institute of Technology, Pasadena, CA, 2000
- B.S., Aeronautical & Mechanical Engineering, Rensselaer Polytechnic Institute, Troy, NY, 1999

3. Academic Experience

- University at Buffalo, Dept. of Mechanical and Aerospace Engineering, Associate Professor, Director of Undergraduate Studies in Aerospace Engineering, 2014 – present, full-time
- University at Buffalo, Dept. of Mechanical and Aerospace Engineering, Assistant Professor, 2008 – 2014, full-time
- Princeton University, Dept. of Mechanical and Aerospace Engineering, Postdoctoral Research Associate, 2005 – 2008, full-time
- California Institute of Technology, Research/Teaching Assistant, Graduate Aeronautical Laboratories (GALCIT), 2000 – 2004, full-time

4. Non-academic experience

None

5. Certifications or professional registrations

None

6. Current membership in professional organizations

- Senior Member, American Institute of Aeronautics and Astronautics (AIAA).
- Member, American Physical Society (APS), Division of Fluid Dynamics (DFD).
- Member, NATO STO Task Group AVTG-282: Unsteady Aerodynamic Response of Rigid Wings in Gust Encounters (2015−2020).
- Member, Massively Separated Flows Discussion Group (Organized through AIAA FDTC).

7. Honors and awards

- UB School of Engineering & Applied Sciences Senior Teacher of the Year Award (2019)
- Professor of the Year (teaching award), Tau Beta Pi, NY Nu Chapter at UB (2010)
- Air Force Office of Scientific Research (AFOSR) Young Investigator Research Program Award (2010) for proposal: "Flapping-Wing Propulsion Characterized Using Optimal Vortex Formation." Funding: $359,510 over 3 years.

8. Service activities

- Assistant Organizer, 2020 AIAA SciTech Forum: Vortex Dyn., Fluid-Structure Interactions.
- Member, AIAA Fluid Dynamics Technical Committee (FDTC, Feb. 2019−present).

- Member, AIAA FDTC Awards Committee (Oct. 2019−present).
- NSF Panel Review for Chemical, Bioengineering, Environmental, and Transport Systems (CBET), 2014, 2016, 2018, 2019.
- Director of Undergraduate Studies in Aerospace Engineering (2014−present).
- Member, SEAS Undergraduate Academic Planning Committee (APC) (2014−present).
- Career Development Committee (mentoring) member for 3 MAE Dept. faculty (2019−present).
- Member, Undergraduate Studies Committee (2010−present).
- Coordinator for MAE Dept. teaching lab upgrades (2008−present).
- Reviewer for: J. Fluid Mechanics, Physical Review Fluids, Experiments in Fluids, J. Fluids & Structures, AIAA J., PLOS ONE, Bioinspiration & Biomimetics, AIAA J. Aircraft, AIAA J. Spacecraft & Rockets, IEEE J. Ocean Engineering, Aerospace Science & Technology, J. Visualization, J. Fluids Engineering, Experimental Thermal & Fluid Science.

9. Recent Publications/Presentations (Bold: grad students/postdocs; *italicized*: undergrads)

- Chowdhury, J., *Smith, C.*, & Ringuette, M. J. "The Lift Force Produced by an Unsteady Translating Plate with a Rotating Tip." *AIAA Paper 2020-2045, AIAA Science and Technology Forum and Exposition (SciTech Forum)*, Orlando, FL, 6-10 Jan. 2020.
- Chowdhury, J. & Ringuette, M. J. "A Simple Vortex-Loop-Based Model for Unsteady Rotating Wings." *J. Fluid Mech.*, Vol. 880, 2019, pp. 1020-1035.
- Chowdhury, J., *Cook, L.*, & Ringuette, M. J. "The Vortex Formation of an Unsteady Translating Plate with a Rotating Tip." *AIAA Paper 2019-0348, Special Session: Unsteady Aerodynamics – Surging and Surging/Pitching II, AIAA Science and Technology Forum and Exposition (SciTech Forum)*, San Diego, CA, 7-11 Jan. 2019.
- Chowdhury, J. & Ringuette, M. J. "The Lift of a Translating Plate with Tip Sweep and Rotation." *72nd APS Division of Fluid Dynamics Meeting*, Seattle, WA, Nov. 2019.
- Chowdhury, J. & Ringuette, M. J. "A Simple Analytical Vortex Loop Model for the Unsteady Lift of Rotating Wings." *71st APS Division of Fluid Dynamics Meeting*, Atlanta, GA, Nov. 2018.
- Burge, M. & Ringuette, M. J. "Forces Produced by a Flapping Wing During Stroke Reversal." *70th APS Division of Fluid Dynamics Meeting*, Denver, CO, Nov. 2017.
- Burge, M. & Ringuette, M. J. "Vortex Topology of a Flapping Wing." Video for Gallery of Fluid Motion, Entry #V0072, shown at *69th APS Division of Fluid Dynamics Meeting*, Portland, OR, Nov. 2016. Available: https://gfm.aps.org/meetings/dfd-2016/57d892f1b8ac311791000081b
- Jones, A. R., Manar, F., Phillips, N., Nakata, T., Bomphrey, R., Ringuette, M. J., Percin, M., van Oudheusden, B., & Palmer, J. "Leading-Edge Vortex Evolution and Lift Production on Rotating Wings (Invited)." *AIAA Paper 2016-0288, 54th AIAA Aerospace Sciences Meeting (Part of Science and Technology Forum, SciTech)*, San Diego, CA, 4-8 Jan. 2016.

10. Most recent professional development activities

- Workshop, "Tomographic PIV & Shake-the-Box 4D-PTV One-Day Workshop at APS 2017," organized by LaVision, Inc. (Nov. 18, 2017).
- Workshop, "LaVision Tomographic PIV One-Day Workshop at APS 2015," organized by LaVision, Inc. (Nov. 21, 2015).

1. Name: **David Salac**

2. Education
– Ph.D., Mechanical Engineering, University of Michigan, 2007
– M.S., Mathematics, University of Michigan, 2007
– B.S., Mechanical Engineering, Michigan Technological University, 2002

3. Academic Experience
– University at Buffalo, Department of Mechanical and Aerospace Engineering, Associate Professor, 2016 – present, full-time
– University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor, 2010 – 2016, full-time
– Northwestern University, Department of Engineering Sciences and Applied Mathematics, NSF Research and Teaching Grant Postdoctoral Fellow, 2007 – 2010, full-time

4. Non-academic experience
None

5. Certifications or professional registrations
None

6. Current membership in professional organizations
– American Physical Society
– Society for Industrial and Applied Mathematics
– American Chemical Society

7. Honors and awards
– Senior Teacher of the Year, 2018
– University at Buffalo, Early Career Teacher of the Year, 2015.
– National Science Foundation, Pan-American Advanced Studies Institute Fellow, 2006
– National Science Foundation, Graduate Research Fellowship Honorable Mention, 2004

8. Service activities (within and outside of the institution)
– Mechanical and Aerospace Engineering Director of Graduate Studies, 2015-present
– Undergraduate Mentor for University at Buffalo Engineering Class of 2017-2022
– Mechanical and Aerospace Engineering Graduate Committee, 2013-2015
– Mechanical and Aerospace Engineering Faculty Search Committee, 2013-2018
– Department of Mechanical and Aerospace Engineering Seminar Series co-chair, 2012-2013.
– Reviewer for Western New York Prosperity Scholarship.

- NSF Panelist in 2012-2019

9. Briefly list the most important publications and presentations from the past five years

- Gera P. and Salac D. "Three-dimensional multicomponent vesicles: dynamics and influence of material properties", Soft Matter (14), 7690-7705, 2018.
- Gera P. and Salac D. "Modeling of multicomponent three-dimensional vesicles", Computers & Fluids (172), 362-383, 2018.
- Gera P. and Salac D. "Stochastic phase segregation on surfaces", Royal Society Open Science4 (8) 170472, 2017.
- Gera P. and Salac D. "Cahn–Hilliard on surface: A numerical study", Applied Mathematics Letters 73, 56-61, 2017.
- Velmurugan G., Kolahdouz E.M., and Salac D. "Level set jet schemes for stiff advection equations: The SemiJet method", Computer Methods in Applied Me- chanics andEngineering 310, 233-251, 2016.
- Salac D. "A general, mass-preserving Navier–Stokes projection method", Com- puterPhysics Communications 204, 97-106, 2016.
- Aghakhani H., Dalbey K., Salac D. and Patra A. "Heuristic and eulerian interface capturing approaches for shallow water type flow and application to granular flows", Computer Methods in Applied Mechanics and Engineering 304, 243-264, 2016.
- Kolahdouz E.M. and Salac D. "Electrohydrodynamics of three-dimensional vesi- cles:A numerical approach", SIAM Journal on Scientific Computing 37 (3), B473- B494,2015.
- Kolahdouz E.M. and Salac D. "Dynamics of three-dimensional vesicles in DC electricfields", Physical Review E 92, 012302, 2015.
- Kolahdouz E.M. and Salac D. "A numerical model for the trans-membrane voltage ofvesicles.", Applied Mathematics Letters 39 (1), 7-12, 2015.

10. Briefly list the most recent professional development activities

    None

1. Name: **Tarunraj Singh**

2. Education
- Ph.D., Mechanical Engineering, University of Waterloo, Waterloo, Ontario, Canada, 1991
- M.E., Mechanical Engineering, Indian Institute of Science, Bangalore, India, 1988
- B.E., Mechanical Engineering, Bangalore University, Bangalore, India, 1986

3. Academic Experience (all full time)
- University at Buffalo, Mechanical & Aerospace Engineering, Professor, 2005 – present
- University at Buffalo, Mechanical & Aerospace Engineering, Associate Professor, 1999 – 2005
- University at Buffalo, Mechanical & Aerospace Engineering, Assistant Professor, 1993 – 1999
- Texas A & M University, Aerospace Engineering, Assistant Research Engineer, 1991 – 1993
- University of Waterloo, Mechanical Engineering, Research Assistant, 1988 – 1991

4. Non-academic experience (all full time)
- Data Systems, Bangalore, India Research Engineer, 1988 – 1988 PSI

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- American Society for Mechanical Engineers (ASME).
- Institute of Electrical and Electronics Engineers (IEEE).
- American Association for the Advancement of Science (AAAS).

7. Honors and awards
- 2019 SEAS Senior Researchers of the Year Award
- 2018 IEEE Region 1 Technological Innovation in Academic Award
- 2018 Theodore von Kármán-Fellow (Incoming), RWTH Aachen (Exploratory Research Space)
  2017 Senior Teacher of the Year, School of Engineering and Applied Sciences
- 2017 NAGS Outstanding Teaching Award at the Master's level.

8. Service activities (within and outside of the institution)
- Technical Editor: IEEE/ASME Transactions on Mechatronics (2017-Present)
- Guest Editor for Special Issue commemorating Rudolph E. Kalman : ASME Journal for Dynamic Systems Measurement and Control, July 1, 2016-June 30, 2017.
- Associate Editor: ASME Journal for Dynamic Systems Measurement and Control, July 1,2013-June 30, 2016.
- Served on a National Science Foundation, Dynamics and Control Panel (2013).

- AACC Award Subcommittee for the Control Engineering Practice Award (2011-Present)
- NSF Review panels
- Mentor of Assistant Professors (Amin Karami, Ehsan Esfahani, Sara Behdad, Frank Lagor, Jiyeong Kang)
- ASME Faculty Advisor (1994-), University at Buffalo.
- Freshmen student mentor, University at Buffalo, School of Engineering

9. Briefly list the most important publications and presentations from the past five years

- Al Ba'ba'a, Hasan, Nouh, Mostafa, and Singh, Tarunraj, "Dispersion and topological characteristics of permutative polyatomic phononic crystals", *Royal Society Proceedings A*, Vol. 475, No. 2226, July 2019. 10.1098/rspa.2019.0022.
- O. Ogunbodede, S. Nandi, and T. Singh, "Periodic Control of Unmanned Aerial Vehicles based on Differential Flatness", *ASME Journal of Dynamic Systems, Measurement and Control*, Vol. 141, No. 7, July 2019, pp 071003-1 to 071003-10.
- Nandi, Souransu, and Singh, Tarunraj, "Non-Intrusive Global Sensitivity Analysis for Linear Systems with Process Noise", *ASME Journal of Computational and Nonlinear Dynamics*, Vol. 14, No. 2, 2019, pp 021003-1 to 021003-12.
- Nandi, Souransu, and Singh, Tarunraj, "Glycemic Control of People with Type 1 Diabetes based on Probabilisitc Constraints", *IEEE Journal of Biomedical and Health Informatics*, Vol. 23, No. 4, July 2019, pp 1773 to 1783.
- Adurthi, N., Singla, P. and Singh, T., "Conjugate Unscented Transformation: Applications to Estimation and Control", *Journal of Dynamic Systems, Measurement and Control*, Vol. 140, No. 3, March 2018.
- Pouget, S., Bursik, M., Singla, P., and Singh, T., "Sensitivity Analysis of a one-dimensional model of a volcanic plume with particle fallout and collapse behavior", *Journal of Volcanology Geothermal Research*, 326, Oct., 2016, pp 43-53.
- Niri, Ehsan Dehghan, Singh, Tarunraj, "Unscented Transformation based Estimation of Parameters of Nonlinear Models using Heteroscedastic Data", *Pattern Recognition*. Vol. 55, 2016, pp 160-171.

10. Briefly list the most recent professional development activities

- Participated in the 1997 NSF Enhancement Workshop "A Unified Classical/Modern Approach for Undergraduate Control Education, with Integrated Laboratory", July 21-25, 1997.
- Participated in Faculty Development Program, Office of Teaching Effectiveness, UB, Aug. 15, 1994.
- Participated in the conference on "A German-American Dialogue on the Future of the University", Nov. 13, 2004, Cornell University, Ithaca, NY.
- Participated in the NSF sponsored "U.S.-Japan Planning Visit: Large Flexible Space Structures", Dec. 12 – Dec. 16, 2005, Tokyo, Japan.
- Participated in the Humboldt Colloquium: "Global Research in the 21st Century: Perspectives of the U.S. Humboldt Network", Washington D.C., March 2-4, 2017.

1. Name: **Jennifer Stamm**

2. Education
- Ph.D., Mechanical Engineering, University at Buffalo, 2015
- M.S., Mechanical Engineering, University at Buffalo, 2008
- B.S.E., Mechanical Engineering, University at Buffalo, 2005

3. Academic Experience
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Assistant Professor of Teaching, 2020 – present, full-time
- University at Buffalo, School of Engineering and Applied Sciences, Assistant Professor of Teaching, 2017-2019, full-time
- University at Buffalo, Control, Dynamics and Estimation Laboratory, Research Assistant, 2010-2012, part-time
- University at Buffalo, Student Excellence Initiatives and Small Groups Programs, Instructor, 2010-2011, part-time

4. Non-academic experience
- Sentient Science Corporation, Director of Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR), 2015-2018, full-time
- Sentient Science Corporation, Research Engineer for Uncertainty Quantification and Analysis, and Data Fusion Expert, 2015-2016, full-time
- Sentient Science Corporation, Implementation Manager and Research Engineer for Sensor-Model Fusion and System Control, 2013-2015, full-time
- Sentient Science Corporation, Contractor and Research Engineer for Sensor-Model Fusion in DigitalCloneTM System, 2013, part-time

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- American Helicopter Society International, 2012-2017
- American Society of Mechanical Engineers, 2005-2017
- American Wind Energy Association, 2014-2017
- Wind Europe, 2016-2017
- European Wind Energy Association, 2014-2016
- Society for Industrial and Applied Mathematics, 2008-2010

7. Honors and awards
- EOP Friends Award, 2018

- Sentient Science team recipient of the “New Energy Pioneers Award” from Bloomberg New Energy finance at the Future of Energy Summit 2016, New York, NY. Selected from global competition as “game changer” in clean energy, 2016
- Sentient Science team recipient of “Best Technological Innovation Award”, 2016
- Sentient Science team recipient “National Science Foundation Tibbetts Award” presented at the White House, 2014
- Western New York Prosperity Scholarship, 2011

8. Service activities (within and outside of the institution)

- University at Buffalo, Faculty Mentor Program for Freshman Engineers, 2017-2020
- University at Buffalo, Instructor Search Committee Member, 2017-2020
- Wayne State University, Math Corps Summer Camp Visit, 2019
- Intel International Science and Engineering Fair, University Representative, 2017-2018
- Guest Speaker, University at Buffalo Female Engineering TINKER Camp, 2017

9. Briefly list the most important publications and presentations from the past five years

- Haggerty, J., Minimum-Time Optimal Output Transitions using Pre- and Post-Actuated Inputs: Impact of Zeros on the Structure of the Optimal Control Profile. Publication February 1st, 2015.
- Haggerty, J. and T. Singh, Time-Optimal Output Transition for Minimum-Phase Systems. Journal of Dynamic Systems, Measurement, and Control, 2013. 135(6): p. 061014.
- Haggerty, J. and T. Singh. Time Optimal Output Transitions for Minimum Phase Systems: A Frequency Domain Approach to Post-Actuation. 2012 American Control Conference. 2012 Fairmont Queen Elizabeth, Montreal, Canada.
- Haggerty, J., Minimax Control of Flexible Structures using Quadratically Constrained Programming, in Mechanical Engineering Department. 2010, State University at Buffalo.

10. Briefly list the most recent professional development activities

- Office of Research Advancement Faculty Workshop: “Research Fundamentals for New Faculty”, 2019.
- Academic Publishing Workshop for Early-Career Faculty, Session 1: “Advice for New Academic Authors from Editors and Publishers”, Session 2: “Copyright and Fair Use for Faculty”, 2017.
- SEAS Professional Development Session – “Respectful Confrontation”, 2017.
- Completed Department of Energy’s Phase I Dawnbreaker Commercialization Assistance Program (CAP) Training Program, Resulting in a Phase II Program Award titled “Predictive Modeling Tools for Metal-Based Additive Manufacturing”, 2015.

1. Name: **Robert C. Wetherhold**

2. Education
- Ph.D., Applied Sciences, Department of Mechanical and Aerospace Engineering, University of Delaware, 1981 – 1983
- Master of Mechanical and Aerospace Engineering, Department of Mechanical and Aerospace Engineering, University of Delaware, 1974 – 1976
- BME and BA, (5-year arts-engineering program), Department of Mechanical and Aerospace Engineering, University of Delaware, 1969 – 1974

3. Academic Experience (all full-time)
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Professor, 2002– present
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Professor, Associate Professor, 1989 – 2002
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Professor, Assistant Professor, 1983 – 1989
- University at Buffalo, Department of Mechanical and Aerospace Engineering, Professor, Graduate Director, 2001 – 2007

4. Non-academic experience (all full-time)
- E.I. Dupont De Nemours & Co., Engineering Dept., Design Division, Specialist Engineer, 1980-1981
- E.I. Dupont De Nemours & Co., Engineering Dept., Design Division, Engineer, 1977-1978
- E.I. Dupont De Nemours & Co., Textile Fibers Research and Development Laboratory, Engineer, 1980-1981

5. Certifications or professional registrations
   None

6. Current membership in professional organizations
- Member, American Institute of Aeronautics and Astronautics Advisory Council Member of Niagara Frontier Section of AIAA (1983-89)
- Faculty Advisor and Member, Society of Automotive Engineers (1986-96)
- Member, American Society of Mechanical Engineers (1992-);
- Member (1992-), Vice-Chair (1996-98), Chair (1998-2000) of Composites Committee of Materials Division, ASME;
- Member, Composites Committee of Applied Mechanics Division (1995-).
- Member, Executive Committee of Materials Division (2001-06), including Chair (2005- 06)

7. Honors and awards

- Elected Fellow of American Society of Mechanical Engineers, (2011).
- J. William Fulbright Fellow, University of Kaiserslautern (Institut für Verbundwerkstoffe), Fall 1997-Spring 1998.
- Associate Fellow of AIAA (1996).
- Listed in: Who's Who in America, 69th ed. (2015), Who's Who in the East, 41st ed. (2014); American Men and Women of Science, 28th ed. (2012), Who's Who in Science and Engineering, 10th ed, (2008-09), Who's Who in American Education, 7th ed. (2005).
- Ralph R. Teetor Engineering Educator Award (1992) and Faculty Advisor Award (1995), Society of Automotive Engineers.

8. Service activities (within and outside of the institution)

- Director of Undergraduate Studies, Mechanical Engineering (2007-present)
- Member, UG Academic Planning Committee (2007-present)
- Director, Graduate Studies, MAE (2001-2007).
- "Key Person" in Western New York for SERVAS, international organization for peace and understanding through travel (2001-present)

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

- R.C. Wetherhold, P. Padliya, "Design aspects of non-linear vibration analysis of rectangular orthotropic membranes," (technical note) ASME J Vibr Acoust, 136 (2014), 034506, doi: 10.1115/1.4027148 .
- R.C. Wetherhold, G. Dargush, "Improvement of adhesive strength at a bi-material interface by adjusting the interface angles at the free edge," Theo Appl Fracture Mech, 77 (2015), 69- 73. http://dx.doi.org/10.1016/j.tafmec.2015.02.002
- R. C. Wetherhold, "Damage and Failure of Composite Materials," AIAA Journal, (2014), accessed March 17, 2014, doi: http://arc.aiaa.org/doi/abs/10.2514/1.J053007 (book review).

10. Briefly list the most recent professional development activities

    None

1. Name: **Minghui Zheng**

2. Education
- Ph.D., Mechanical Engineering, University of California, Berkeley 2017
- M.S., Control Science and Engineering, Beihang University, 2011
- B.S., Engineering Mechanics, Beihang University, 2008

3. Academic Experience
- University at Buffalo, Mechanical and Aerospace Engineering, Assistant Professor, 2017–present, full-time

4. Non-academic experience
None

5. Certifications or professional registrations
None

6. Current membership in professional organizations
- ASME Vibrations Technical Committee since 2017, Secretary (2018-2019), Vice Chair (2019-Present)
- ASME Mechatronics Technical Committee 2017-Present
- IFAC Technical Committee in Control Design, 2017-Present
- ASME Bio-Systems and health Care Technical Committee, 2017-Present

7. Honors and awards
- Finalist (co-author) of Best Paper, AIM 2017
- Finalist (1st author) of Best Student Paper, DSCC 2016
  Winner of Best Collaboration Idea, Competition at Postgraduate Workshop Mechatronics 2016
- Fellowship of "Otto and Herta F. Kornei Endowment Fund", University of California, Berkeley
- J.K. Zee Fellowship, University of California, Berkeley
- Graduate Division NRST Award, University of California, Berkeley

8. Service activities (within and outside of the institution)
- Seminar Series Coordinator Committee, MAE Department
- Volunteer for "Science is Elementary"
- Outreach activities at Westminster Charter School
- Robotics Day at UB
- Demonstration of robotic techniques to faculty, students, and local community
- SMART Design Camp 2018

- SMART Automation Sandbox lab tour
- CSExplore Camp 2018
- Control and Automation lab tour
- 2018 MAE Poster Competition Judging

9. Briefly list the most important publications and presentations from the past five years

Publications

- Zheng, M., & Tomizuka, M. (2019). A frequency-shaping methodology for discrete- time sliding mode control. International Journal of Control, 92(7), 1662-1671.
- Zheng, M., Zhang, F., & Liang, X. (2018). A systematic design framework for iterative learning control with current feedback. IFAC Journal of Systems and Control, 5, 1-10.
- Liang, X., Zheng, M., & Zhang, F. (2018). A scalable model-based learning algorithmwith application to UAVs. IEEE control systems letters, 2(4), 839- 844.
- Wang, C., Zheng, M., Wang, Z., Peng, C., & Tomizuka, M. (2018). Robust iterative learning control for vibration suppression of industrial robot manipulators. Journal of Dynamic Systems, Measurement, and Control, 140(1).
- Zheng, M., Wang, C., Sun, L., & Tomizuka, M. (2017). Design of arbitrary-order robust iterative learning control based on robust control theory. Mechatronics, 47, 67- 76.
- Zheng, M., Tomizuka, M., Chen, X., Xi, W., & Guo, G. (2017). U.S. Patent No. 9,542,966. Washington, DC: U.S. Patent and Trademark Office.

Presentations

- "Intersection of Data-driven and Physics-based Learning for Robotic Systems," Center for Cognitive Science, University at Buffalo, NY, 10/2019.
- "Reasoning from Physics: A Learning-Based Control Strategy for Robotic Systems," Department of Mechanical Engineering, City College of New York, NY, 09/2019.
- "Human-Robot Collaboration in Remanufacturing," Communities of Excellence, University at Buffalo, NY, 09/2019.
- "Robust iterative learning control considering uncertainties," Autonomous Systems Laboratory, Stanford University, 09/2016.

10. Briefly list the most recent professional development activities

    None

APPENDIX C-EQUIPMENT

Below is a list of major pieces of equipment used by the program in support of instruction.

Responsibility	Course	Location	Equipment
Estes, Raihamian	MAE 334	810/811 Furnas	National Instruments data acquisition boards; Experimental platforms for various labs, including Quanser rotary servos; Power supplies; Arduino microcontrollers; Sensors (including accelerometers, rotary encoders, strain gauges); Actuators (including servo- stepper- and DC-motors, solenoids, ball screws);
Khan, Sabato	MAE 338	214/216 Jarvis	Room 216 Jarvis-- Table in south wall Two sets of Armfield Plate and Shell Heat Exchanger experimental setup. Two sets of Armfield Concentric Tube Heat Exchanger experimental setup. This includes a computer with data acquisition for temperature. Blue M Thermal Storage. Table in west wall Two sets of Drag on a Sphere experimental setup. 4 sets of Transient Heat Conduction Experimental Setup, which includes a computer set up with data acquisition. North Wall Two sets of Viscosity Measurement experimental setup. Room 216 Jarvis Two sets of Flow Meter Calibration experimental setup.
Armstrong	MAE 385	618 Furnas	MTS 810 servo-hydraulic mechanical testing machine United electro-mechanical testing machine Metallograph
		619 Furnas	Heat-treatment furnaces; Charpy impact tester Rotating beam fatigue testers

		620 Furnas	Metallurgical mounting and polishing equipment
		621 Furnas	Hardness testers; PASCO Materials Testing Systems w/laptops Table-top rolling mills
Burge/Ringuette	MAE 339	214 Jarvis	1ft x 1ft test section teaching wind tunnel; Airfoil and flat-plate models; Sphere and coffee filter models Pressure transducer; Pitot-static probe; Force balance; National Instruments data acquisition board 20-tube Manometer Bank 0.5ft x 1ft test section teaching slow speed water channel with acrylic gravity-feed dye delivery system Airfoil, cylinder, sphere internal dye-flow models (2) Cannon DSLR Cameras with Tripods Galil DMC 4xxx Motion Controller w/ Amplifiers MicroMo motor/gear head/encoder assembly 10ft Drop Tunnel with vacuum pump/pedestal High-Speed Camera (3) FLIR E60 Cameras 2C-2D PIV System (532nm Laser, Sheet Optics, CMOS Camera, Timing card)

			1ft x 1ft test section teaching wind tunnel; Airfoil and flat-plate models; Sphere and coffee filter models Pressure transducer; Pitot-static probe; Force balance; National Instruments data acquisition board 20-tube Manometer Bank 0.5ft x 1ft test section teaching slow speed water channel with acrylic gravity-feed dye delivery system Airfoil, cylinder, sphere internal dye-flow models (2) Cannon DSLR Cameras with Tripods Galil DMC 4xxx Motion Controller w/ Amplifiers MicroMo motor/gear head/encoder assembly 10ft Drop Tunnel with vacuum pump/pedestal High-Speed Camera (3) FLIR E60 Cameras
			2C-2D PIV System (532nm Laser, Sheet Optics, CMOS Camera, Timing card)

Table C-1. Major Pieces of Equipment

APPENDIX D – INSTITUTIONAL SUMMARY

Programs are requested to provide the following information.

1. The Institution

a. Name and address of the institution

University at Buffalo
The State University of New York 12 Capen Hall,
Buffalo, NY 14260-1660

b. Name and title of the chief executive officer of the institution

Dr. Satish K. Tripathi President, University at Buffalo

c. Name and title of the person submitting the Self-Study Report.

Dr. Kemper E. Lewis
Dean, School of Engineering and Applied Sciences

d. Name the organizations by which the institution is now accredited, and the dates of the initial and most recent accreditation evaluations.

The University at Buffalo is accredited by **The Middle States Commission on Higher Education**

Initial accreditation evaluation: 1921. Most recent accreditation evaluation: Spring 2014

2. Type of Control

Description of the type of managerial control of the institution, e.g., private-non-profit, private-other, denominational, state, federal, public-other, etc.

State-assisted Public Research University

3. Educational Unit

Describe the educational unit in which the program is located including the administrative chain of responsibility from the individual responsible for the program to the chief executive officer of the institution. Include names and titles. An organization chart may be included. The educational unit is the administrative unit having academic responsibility for the program(s) being reviewed by a given Commission of ABET.

The School of Engineering and Applied Sciences (SEAS) is one of twelve schools at the University at Buffalo. As shown in the organizational chart for the University at Buffalo (Figure D-1), the administrative chain of command is from President Tripathi, to Provost Weber, to Dean Lewis. Dr. Ann Bisantz is UB's dean of undergraduate education, with oversight of academic policies and curriculum management. Dean Bisantz is also responsible for the strategic vision and management of UB's 21st century general education program, the UB Curriculum, the Office Experiential Learning and Research, the Center for Excellence in Writing, and the University Honors College.

The organization structure as it pertains to undergraduate education in the School of Engineering and Applied Sciences is shown in Figure D-2. The associate dean for undergraduate education is Prof. Jeffrey Errington. Dr. Kerry Collins Gross is the assistant dean for undergraduate education. Dr. Collins-Gross works closely with Prof. Errington and oversees the SEAS advisement office. Mr. Bill Wild, director of the Student Excellence Initiative, also reports to Prof. Errington. In addition, Prof. Errington oversees the undergraduate experiential learning spaces. Our experiential learning program is directed by Prof. Andrew Olewnik, Assistant Professor, Department of Engineering Education.

Each department appoints a director of undergraduate studies, who is responsible for curriculum matters at the program level. For Mechanical Engineering, this is currently Prof. Robert Wetherhold. The directors meet twice per month with Prof. Errington to discuss and approve policies and procedures that affect the SEAS undergraduate student population.

A list of all units within the School of Engineering and Applied Sciences including names and titles of lead individuals is included in a table below.

Dean's Advisory Council

The Dean's Advisory Council members assist the School of Engineering and Applied Sciences in achieving its goal of preeminence in education, research, and service by providing support and advice to the dean in several key areas, including but not limited to industrial relations, long-term planning and strategy, development, educational and professional identity, placement, curriculum, classroom enrichment, and new programs.

The Dean's Council meets twice during the academic year, with each meeting spanning about a day and a half. The meetings include presentations to the Dean's Council, visits to departments and facilities on campus, discussions, executive session, and culminating debriefings with the President and/or Provost. The current members of the Dean's Council are listed below.

Dean's Advisory Council

Council Members	Council Members
Michael J. Cadigan, BS'79 **Chair** Senior Vice President, Global Sales and Business Development, ASICS Business Unit Global Foundries	Patrick F. Abrami, BS'72, MS'75 Consultant
Russell L. Agrusa, BS'76 Founder, President and CEO, ICONICS, Inc.	Paul Ameis, BS'94 General Manager, Lockport VanDeMark
Ron Benczkowski, BS'82 Vice President-Engineering, Moog, Inc., Space and Defense Group	David Cadigan, BS'08 Computer Hardware Engineer, IBM
James Chou, BS'84 Chief Technology Officer, Kabbage, Inc.	Dennis Elsenbeck, BS 96 Head of Energy and Sustainability, Energy Consulting Services, Phillips Lytle LLP
Judy Feldmen Executive Vice President, Chief Information Officer, Value Centric	Robert Girardi, BS'90, MBA'92 President and CEO, SofTrek, retired
Karianne Gomez, BS'00 Vice President of Strategic Value, Network of Executive Women	Robert G. Harrison, P.E., BS'83 Vice President of Engineering and Construction, Transmission Developers, Inc.
Cynthia A. Hoover, PhD'95 Executive Director, Linde	Rob Jacoby, MS'80 Consultant to the Energy Industry
Ashok Jain Vice President, Systems Management and Engineering, Safran	Joe Kessler, P.E., BS'93, ME'00, MBA'10 Chief Operating Officer, New York Power Authority
Anil Kshirsagar, MS'77, MBA'79 Executive Chair, CAPIOT Software, Inc	Gina Lee-Glauser, BS'82, MS'88 Vice President for Research and Scholarship; Provost Office at Clarkson University
Jeff Markin, BS'80 Chief Operating Officer, eHealth Technologies	Edward C. Morris, P.E., BS'73 President, ECM Management Consultants, LLC
Susan R. Nowicki Director of Engineering, Northrop Grumman Amherst Systems	Ashish Shah, MS'89, PhD'93 Vice President of Research and Development, Viant, Inc.
Alice Smith Joe W. Forehand/Accenture Distinguished Professor of the Industrial and Systems Engineering Department, Auburn University	Stephen E. Still, BS'76 Retired. Former co-founder and consultant, Seabury Airline Planning Group LLC
Jonathan Watts, P.E., BS'00, BS'03 Vice President, Watts Architecture & Engineering DPC	Candace Yano Gary & Sherron Kalbach Chair in Business Administration and Professor of Operations and Information Technology Management, University of California, Berkeley

Last Updated: May 2020

Figure D-1. University at Buffalo Organizational Chart

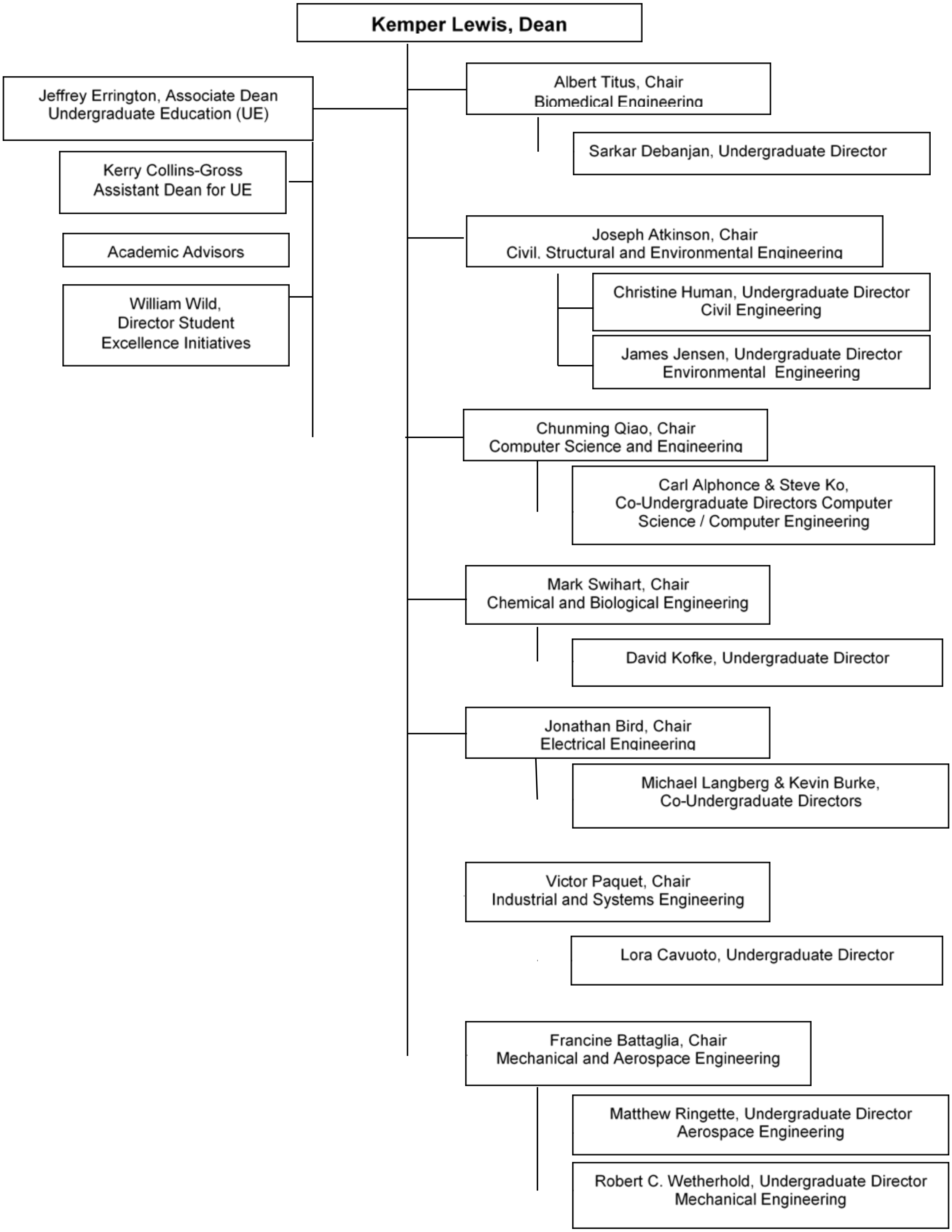


Figure D-2. SEAS Undergraduate Educational Organization

SEAS Leadership

Unit	**Name, Title**
School of Engineering and Applied Sciences	Kemper Lewis, Dean
Undergraduate Education	Jeffrey Errington, Associate Dean
Graduate Education and Research	Shambhu Upadhyaya, Associate Dean
Faculty Affairs and Diversity	Rajan Batta, Associate Dean
Student Affairs and Accreditation	Christine Human, Associate Dean
Academic Departments • Biomedical • Chemical and Biological • Civil, Structural and Environmental • Computer Science and Engineering • Electrical • Engineering Education • Industrial and Systems • Materials Design and Innovation • Mechanical and Aerospace	 Albert Titus, Chair Mark Swihart, Chair Joseph Atkinson, Chair Chunming Qiao, Chair Jonathan Bird, Chair Carl Lund, Chair Victor Paquet, Chair Krishna Rajan, Chair Francine Battaglia, Chair

Support Services • Advancement • Career Services • Communications • Cybersecurity and Applied Sciences • Digital Education • Engineering Outreach • Engineering Machine Shop • Experiential Learning • Facilities Planning and Management • Finance • Grants Management • Personnel • Strategic Initiatives • Shared Instrumentation • Science and Engineering Node Services (SENS)	Patrizia Porcari, Executive Director Holly Justice (Engineering Career Counselor) Jane Stoyle Welch, Director Dave, Yearke, Director Lisa Stephens, Assistant Dean Tim Leyh, Executive Director Joseph Mollendorf Andrew Olewnik, Director Sujata Rawal, Assistance Dean Diane Porter, Assistant Dean Linda Bovino, Assistant Dean Eileen Hassett, Assistant Dean Jennifer Giegel, Director Donald Goralski, Director Jason Lasker, Director

4. Academic Support Units

List the names and titles of the individuals responsible for each of the support units that teach courses required by the program being evaluated, e.g., mathematics, physics, etc.

Unit	Responsible Individual
College of Arts and Sciences	Robin Schulze, Dean
Academic Departments	
• Biological Sciences	Paul Gollnick, Professor and Chair
• Chemistry	David F. Watson, Professor and Chair
• Geography	Chris P. S. Larsen, Professor and Chair
• Geology	Beata Csatho, Professor and Chair
• Mathematics	Gino Biondini, Professor and Chair
• Physics	Sambandamurthy Ganapathy, Professor and Chair

UB Curriculum	Danielle LaMarre-Smith, Director Jeffrey J. Kohler, Capstone Clinical Instructor Alexander Reid, Interim Director of Writing Across the Curriculum
English Language Institute	Timothy Cauller, Program Director

5. Non-academic Support Units

List the names and titles of the individuals responsible for each of the units that provide non-academic support to the program being evaluated, e.g., library, computing facilities, placement, tutoring, etc.

Unit	Responsible Individual
Academic Integrity	Kelly Ahuna, Director
Accessibility Resources	Randy Borst, Director
Blackstone LaunchPad by Techstars	Hadar Borden, Director
Career Services	Arlene Kaukus, Director
Center for Excellence in Writing	Rhonda Reid, Director
Center for Education Innovation	Christine Kroll, Assistant Vice Provost and Director
Cora P. Maloney Center	Shanna Crump-Owens, Director
Counseling Services and Wellness	Sharon Mitchell, Senior Director
Educational Effectiveness	Carol Van Zile-Tamsen, Assistant Vice Provost and Director
Experiential Learning Network	Mara Huber, Associate Dean, Undergraduate Research and Experiential Learning
International Admissions	Steven Shaw, Assistant Vice Provost and Director
International Student Services	Katie Tudini, Director
Math Place (Tutoring)	Angela Samul, Coordinator
Student Conduct and Advocacy	Elizabeth Lidano, Director
Study Abroad Programs	Mary Odrzywolski, Director
Tutoring and Academic Support Services	Vivian Jimenez, Interim Director

University Admissions	Lee Melvin, Vice Provost for Enrollment Management
University Libraries	Jill Hackenberg, Computer Science Erin Rowley, Engineering Librarian
UBit	J. Brice Bible, Vice President and CIO

6. Credit Unit

It is assumed that one semester or quarter credit normally represents one class hour or three laboratory hours per week. One academic year normally represents at least 28 weeks of classes, exclusive of final examinations. If other standards are used for this program, the differences should be indicated.

No differences from the assumed standards.

7. Tables

Complete the following tables for the program undergoing evaluation.

Table D-1. Program Enrollment and Degree Data

Name of the Program Mechanical Engineering

	Academic Year		Enrollment Year[1] 1st	2nd	3rd	4th	5th	Total Undergrad	Total Grad	Degrees Awarded Associates	Bachelors	Masters	Doctorates
Current Year	19-20	FT	132	150	226	430		938	93		245	42	11
		PT	1	0	2	16		19	89				
1 year prior to current year	18-19	FT	113	176	202	387		878	91		225	40	10
		PT	0	1	2	18		21	79				
2 years prior to current year	17-18	FT	135	157	203	361		856	83		232	68	9
		PT	0	2	0	22		24	82				
3 years prior to current year	16-17	FT	92	167	165	405		829	83		250	41	9
		PT	0	1	3	18		22	96				
4 years prior to current year	15-16	FT	110	140	213	377		840	75		217	56	12
		PT	1	0	3	22		26	89				

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the on-site visit.
[1]Enrollment year based upon credit hours completed, 1st: 0-29 hours, 2nd: 30-59 hours, 3rd: 60-89 hours, 4th > 90 hours

FT—full-time

PT—part-time (UG < 12 credit hours in a semester, Grad < 9 credit hours in a semester)

Table D-2. Personnel

Mechanical and Aerospace Engineering

Year[1]: **2019**

	HEAD COUNT		FTE[2]
	FT	PT	
Administrative[2]	1	5	3
Faculty (tenure-track)[3]	32	0	32
Other Faculty (excluding student Assistants)	9	0	9
Student Teaching Assistants[4]	43	77	81.5
Technicians/Specialists	3	0	3
Office/Clerical Employees	8	0	8
Others[5]			

Report data for the program being evaluated.

1. Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

2. Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

3. For faculty members, 1 FTE equals what your institution defines as a full-time load

4. For student teaching assistants, 1 FTE equals 20 hours per week of work (or service).

5. Specify any other category considered appropriate, or leave blank.

SUBMISSION ATTESTING TO COMPLIANCE

Only the Dean or the Dean's Delegate can electronically submit the Self-Study Report.

ABET considers the on-line submission as equivalent to that of an electronic signature of compliance attesting to the fact that the program has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Applied and Natural Science Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

Appendix E follows this page.

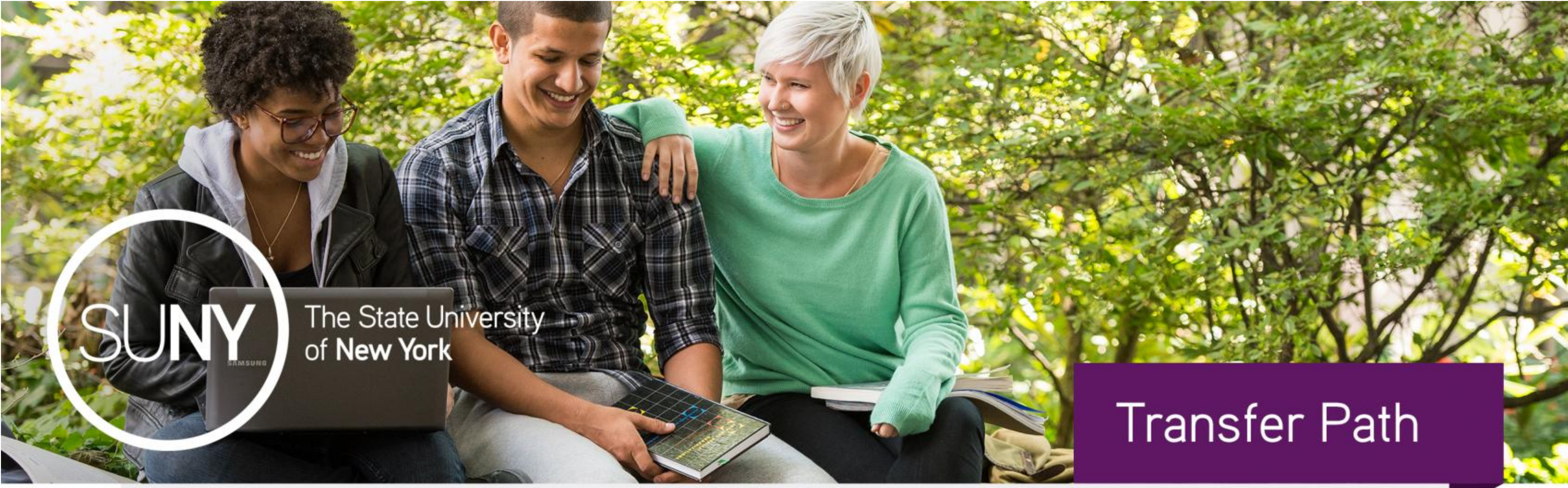
Appendix E

Background Information

B. Program History

Included policies and documents

- SUNY Seamless Transfer



Discipline: Mechanical Engineering

SUNY transfer paths outline the knowledge and skills that are essential for students to complete during their first two years of study for a major in a given discipline. The coursework described below will meet degree requirements at all SUNY campuses offering majors in the above discipline. If you complete this coursework successfully, you will be well-positioned to finish your degree with an additional two years of study at your SUNY transfer college.

Use this transfer path to discover both courses related to your major and general education requirements that will prepare you for transfer. Click on each course to view a course description. Then, to map your first two years of courses, visit Planning Your Coursework.

Lower-Division Major Requirements

The courses below are specifically related to your field of study and are part of the requirements for graduation in your major:

Engineering Core Requirements:

- Introduction to Engineering
- Calculus-based Physics I: Mechanics (with lab)
- Calculus-based Physics II: Electromagnetism (with lab)
- Calculus I
- Calculus II
- Calculus III
- General Chemistry I (with lab)
- Differential Equations
- Computer Programming

Specific requirements for Mechanical Engineering:

- Statics
- Dynamics
- Strength of Materials
- Circuits I

Campus specific requirements:
The transfer path for engineering includes up to three campus specific courses that you should complete prior to transferring to achieve junior status. Consult with your academic advisor and transfer campus for more information on completing these courses. A list of campus specific requirements can be found here, by campus and discipline.

Transfer Path

Advising Notes

Campus transfer path requirements are required technical (not General Education) classes selected based on the intended transfer institution. Each four-year insitution will specify what courses are included in this category. The transfer path requirements may include courses taught at a two-year institution or courses from a four-year institution taken online or through distance learning programs. The needed credit hours in this category will vary depending on the intended transfer institution, but should not exceed three academic courses.

For articulated courses, differences in credit hours should not matter. For example, if a 3 credit hour math course at a community college is articulated with a 4 credit hour course at a four-year institution, students are credited with satisfying the 4 credit-hour requirement.

There may be additional courses in your major which would transfer, or courses which could be substituted for one of the above. These may be established on a case by case basis. Please see an advisor at your transfer campus to explore those options.

Transfer students must satisfy 5 of the 10 SUNY GER areas outlined on the following page. With Mathematics and Natural Sciences satisfied by Engineering Core and Discipline Specific Requirements, at least three additional areas must be satisfied. One of the SUNY GER areas covered must be Basic Communications. Students may need to take additional General Education courses depending on the requirements of the transfer institution.

Transfer Path

General Education Requirements

General Education courses are related to key academic disciplines and may be outside your field of study. To earn a SUNY bachelor's degree, you must earn 30 credits in at least seven of the following ten skill areas, and demonstrate two competencies. For AS programs in Engineering, students must satisfy five of the following ten skill areas.

Skill Areas:

- Basic Communication (required)
- Mathematics (required)
- American History
- Other World Civilizations
- Foreign Language
- Social Sciences
- Humanities
- The Arts
- Natural Sciences
- Western Civilization

Competencies:

- Critical Thinking (required)
- Information Management (required)

General Education requirements vary by campus and by major. However, if you satisfy the SUNY General Education Requirement (SUNY-GER) area at one campus with a grade of C or higher, you will have met that SUNY-GER area at every other SUNY campus. Visit Campus Requirements to determine the skill areas required by each campus and the courses available within those areas.

Last updated: November, 2016

Criterion 1. Students

A. Student Admissions

Included policies and documents

- Domestic Freshman Admission (Section A.1.a)
- Domestic Transfer Admission (Section A.1.c)
- International Freshman and Transfer Admission (Sections A.1.b and A.1.d)

Freshmen Admission

The UB School of Engineering and Applied Sciences Office of Undergraduate Education works closely with the university's Office of Admissions to review the applications of undergraduate freshmen applying to any of our undergraduate engineering and applied sciences majors.

- Admissions Criteria
- Admissions Decisions

Apply Now

To be considered for admission to the School of Engineering and Applied Sciences (SEAS), all you need to do is select the engineering or applied science major of interest on the standard application form. A separate application is not required. If you are undecided about the particular field within SEAS you would like to pursue, simply indicate "engineering." If you decide on a major after you send in your application, contact the UB Office of Admissions with the update. You need not submit a new application. Enrolled students who remain in good standing can readily switch majors in their first year.

Admissions Criteria

Admission to the university and SEAS majors is competitive. Admission decisions are based on a holistic review of each application, with factors such as an applicant's high school academic performance, standardized test scores, Regents and Common Core Examination scores, personal statements, letters of recommendation, and noncognitive attributes considered.

Admissions Decisions

After a careful review of an applicant's academic record, one of the following decisions is processed:

1. Admission to the *approved* major: When the applicant is deemed to have a high likelihood of success within an engineering or applied science major, they are placed into the *approved* major. This represents the final step in the admissions process to SEAS. Students are eligible to participate in all courses required for the major.
2. Admission to the *intended* major: When concerns are identified in an applicant's academic history (e.g., low high school average, SAT/ACT score, and/or Regents or Common Core Examination scores), the applicant is placed into the *intended* major. To be eligible to earn a degree from SEAS, the student must be admitted to the approved major at a later point. This admissions process is fully described at our Admission to SEAS for Current UB Students web page. Intended engineering and applied science majors are permitted to enroll in math, science, general education, and 100- and 200-level SEAS courses required for the major.
3. Declined admission: When significant concerns are identified in an applicant's academic record, the applicant is declined admission to UB.

Transfer Admission

Admission to the School of Engineering and Applied Sciences at the University at Buffalo comprises a two-step process:

1. Students must first apply to and be admitted by the University at Buffalo
2. Students then submit a Supplemental Application that is reviewed by the School of Engineering and Applied Sciences.

Admissions Criteria

Admission to engineering or computer science as an approved major requires the following:

1. Submission of the UB Application. Students are strongly encouraged to submit an application by the end of March for fall admission and by early October for spring admission. Submission of an application by these suggested dates will allow ample time for processing and provide time for advisement before the start of the semester.
2. Admission to the University at Buffalo.
3. Submission of the School of Engineering and Applied Sciences Supplemental Application.
   Note: Incoming international students do not need to submit this application.
4. Completion of four required core courses (see below) with grades of C– or better and a combined core course grade point average of at least 2.5. Students are permitted to repeat at most two core courses one time.
   Note: A 'R' (resign) grade does not count as a repeat. Students are also permitted to repeat test and college credit originally earned while attending High School without penalty from this policy.
5. The minimum overall cumulative GPA required for the major. The GPAs required for admission vary by academic year and requested major. The table below provides the GPA requirement for the 2019-20 academic year. Learn more about overall cumulative GPA requirements for previous academic years.

Core Courses

Engineering Courses:

1. Calculus 1 (MTH 141 or MTH 153)
2. Calculus 2 (MTH 142 or MTH 154)
3. General Chemistry 1 (CHE 101, CHE 105, or CHE 107)
4. General Physics 1 (PHY 107 or PHY 117)

Computer Science / Bioinformatics Courses:

1. Calculus 1 (MTH 141 or MTH 153; students applying for the BA computer science degree may complete MTH 121 or MTH 131)
2. Introduction to Computer Science for Majors 1 (CSE 115)

3. Introduction to Computer Science for Majors 2 (CSE 116)
4. Discrete Structures (CSE 191 or MTH 191)

Overall GPA Requirements

Major	Overall GPA
Aerospace, Computer, and Mechanical Engineering; Computer Science (BA and BS); Bioinformatics and Computational Biology	2.8
Biomedical, Chemical, Civil, Electrical, Environmental, and Industrial Engineering; Engineering Physics	2.5

The School of Engineering and Applied Sciences will consider a student's entire academic record in reaching an admission decision. Factors such as a history of repeating, resigning, or failing classes, or low grades in classes relevant to the student's desired discipline may result in conditional admission or denial of admission.

Admissions Decisions

After a careful review of an applicant's academic record, one of the following decisions is processed:

1. Admission to the A*pproved* Major: The applicant meets the criteria to join the major, and is placed into the *approved* major. This represents the final step in the admissions process to SEAS. Students are eligible to participate in all courses required for the major.

2. Admission to the *Intended* Major: The applicant does not currently meet the criteria for the major, but could be admissible in the future, and is placed into the *intended* major. For example, this case applies to an applicant who has not completed all of the core courses relevant to the major. To be eligible to earn a degree from SEAS, the student must be admitted to the major in a subsequent term. To facilitate this review, SEAS periodically examines the academic records of all students in an intended engineering or computer science major. As a result of this review, students are either (1) admitted to the approved major, (2) maintained in the intended SEAS major, or (3) placed into the UB undecided major. Intended engineering and computer science majors are permitted to enroll in 100- and 200-level SEAS courses (EAS, BE, CE, CIE, CSE, EE, IE, MAE) required for the major. Intended students with more than 60 credits completed who expect to receive financial aid should consult with a financial aid advisor since this status could affect certain types of aid.

LEARN MORE ABOUT SEAS ACADEMIC REVIEW

3. Conditional Admission: The applicant has ungraded transfer credit for the core courses or has legitimate extenuating circumstances and has petitioned for exemption from the course repeat restriction. Specific examples include documented medical issues of the student or an immediate family member, the death of an immediate family member, a disability, military orders, or other significant personal hardships. A semester course plan is required with consultation of an academic advisor.

4. Declined Admission: The applicant is not currently admissible and will not be admissible in the future, and is placed into the UB *undecided* major. For example, this case applies to an applicant who has completed all of the core courses with one core course repeat and has a core course GPA below 2.5. In this case, we recommend that students planning on pursuing an engineering or computer science program explore engineering/technology or computer science programs at other institutions. Students are welcome to attend UB, but will not be able to pursue an engineering or computer science degree. UB undecided majors are not permitted to enroll in SEAS courses. Following a decline decision, students are not eligible to be reconsidered for admission to SEAS for one year. The applicant must then present a convincing case that circumstances have changed and that there is now a reasonable likelihood of success within the major of interest.

Code of Professional Conduct

Students who have acted in a manner that is inconsistent with the SEAS Code of Professional Conduct may be denied admission to the School of Engineering and Applied Sciences.

Once You're Admitted

Submit Final Transcripts

Once you have been admitted to UB and the School of Engineering and Applied Sciences, please submit your final official transcripts from your current (or previous) institution showing all completed coursework. This is necessary for financial aid as well as courses posting to your UB account. More information about how to forward your final transcripts to UB can be found on the UB Admission Website.

Pay Your Tuition Deposit

Be sure to pay your tuition deposit and confirm your intent to enroll at UB!

Applying for Financial Aid

Please ensure your financial aid paperwork is submitted in a timely manner. This is especially important for transfer students who are currently receiving TAP and/or Excelsior aid from New York State. Work with the Office of Financial Aid to ensure all deadlines are met.

Late financial aid paperwork could create holds on your account and prevent you from registering for classes.

Admissions Criteria

The University at Buffalo wants students who excel academically and who will succeed in our rigorous and demanding academic environment.

ON THIS PAGE:

> Freshman applicant
> Transfer applicant
> Graduate applicant

You can learn about UB's international admission requirements by following the navigation links to the left, or if you know your English proficiency score, you can start by finding your score under your applicant type (freshman or transfer) below.

Am I a freshman or transfer?

Freshman or transfer status has a strict definition which is based upon the facts of your educational background.

What is a freshman?

- You have *never* studied or enrolled in *any* college / university or postsecondary studies after completing secondary school.
- You are a freshman even if you have "advanced standing" for which you may receive university credits. This includes A Levels, International Baccalaureate (IB) and Advanced Placement (AP).

What is a transfer?

- You have completed secondary school and you subsequently enrolled or studied one or more subjects in a college or university.
- You may or may not have passed the class(es); you may or may not have earned university credit for the class(es); you may or may not have changed your major or stopped studying because you did not like your major.
- If you engaged in ***any*** study in a college or university, you must apply as a transfer applicant; you cannot "choose" to be a freshman.

Still not sure if you are a freshman or transfer? Take this test.

If a minimum of *one* item in statement 1 and all of statement 2 is true, then you are a freshman applicant. Otherwise you are a transfer applicant.

STATEMENT 1: A minimum of *one* item must be true.

A. I am currently studying in high school (secondary school).

B. Even though I am not in high school, I am studying a secondary school curriculum.

C. I have completed high school.

AND

STATEMENT 2: This statement must also be true.

I have never enrolled in or studied at a postsecondary institution after completing secondary school.

Both are true? You will apply as a Freshman.

Any part not true? You will apply as a Transfer.

Am I an international student?

You are an international applicant if a visa is required for you to reside and study in the United States.

A U.S. citizen or permanent resident who currently lives and studies outside the U.S. is considered a domestic applicant with foreign credentials.

Freshman applicant

Below are the minimum scores to be eligible for consideration for admission to undergraduate programs at the University at Buffalo.

Find your score and then choose the admission type that is right for you by clicking on the link at the bottom of that column to learn more about the specific English proficiency requirements and other admission criteria.

Are you unable to take the IELTS, PTE or TOEFL?

If you are not able to take the IELTS, PTE or TOEFL tests because they are cancelled due to the Coronavirus (COVID-19), the University at Buffalo will accept the Duolingo English Test (DET) for proof of English proficiency. This test can be taken online, in your own home.

Test Type	University Admission
TOEFL (IBT) (including MyBest scores)	70
TOEFL (PBT)	523
IELTS	6.0
PTE	50
ACT (English and Reading)	18
SAT I ERWS	500
Duolingo English Test (DET) *for students currently living in China	105
Other recognized tests	Learn about other tests for freshman applicants

Learn More About Admission for Freshmen

Don't see your scores here?

If your English Language Proficiency scores are lower than those listed above, you may still be considered for admission if:

1. You retake the English Language test and submit a passing score

2. You successfully complete UB's ELI-IEP through Bridge Admission

Transfer applicant

Below are the minimum scores to be eligible for consideration for admission to undergraduate programs at the University at Buffalo.

Find your score and then choose the admission type that is right for you by clicking on the link at the bottom of that column to learn more about the specific English proficiency requirements and other admission criteria.

Are you unable to take the IELTS, PTE or TOEFL?

If you are not able to take the IELTS, PTE or TOEFL tests because they are cancelled due to the Coronavirus (COVID-19), the University at Buffalo will accept the Duolingo English Test (DET) for proof of English proficiency. This test can be taken online, in your own home.

Test Type	University Admission
TOEFL (IBT) (Including MyBest scores)	70
TOEFL (PBT)	523
IELTS	6.0
PTE	50
ACT	

(English and Reading)	18
SAT I ERWS	500
Duolingo English Test (DET) *for students currently living in China	105
Other recognized tests	Learn about other recognized tests for transfer applicants

Learn More About Admission for Transfers

Don’t see your scores here?

If your English Language Proficiency scores are lower than those listed above, you may still be considered for admission if:

1. You retake the English Language test and submit a passing score

2. You successfully complete UB's ELI-IEP through Bridge Admission

Graduate applicant

Learn more about graduate admissions criteria

Criterion 1. Students

B. Evaluating Student Performance

Included policies and documents

- UB Academic Standards Review (Section B.1.a)
- SEAS Academic Review (Section B.1.b)
- SEAS Periodic Review (Section B.1.c)

Academic Standards Review

Academic Standards Review

To maintain academic standards and determine eligibility for continued enrollment, financial aid, and participation in university activities, the University at Buffalo regularly reviews the academic records of all undergraduate students. This review addresses the quality of the student's studies as measured by the student's course grades.

Academic review is conducted at the end of each fall and spring semester.

Academic Good Standing

A student is in academic good standing if the student's cumulative UB grade point average (GPA) is 2.000 or greater and the student's most recent semester GPA at UB is 2.000 or greater.

A student in academic good standing is eligible for all university activities.

Academic Warning

Many students go through an adjustment period when beginning their baccalaureate studies at the university. Therefore, any student — freshman or transfer — whose first-semester GPA is less than 2.000 will be on academic warning in his/her second semester of study at the university.

Additionally, any student will be placed on academic warning if the student's cumulative UB GPA is 2.000 or greater but the student's most recent semester GPA is less than 2.000.

Although a student on academic warning will be considered in good standing for purposes of participation in university activities, he/she may be subject to an advisement service indicator — a mandatory discussion with an academic advisor to help build an effective academic strategy before the student may complete any further registration activity.

Academic warning will not be noted on a student's official transcript, but will be part of the student's record.

Academic Probation

A student is on academic probation and not in academic good standing if his/her cumulative UB GPA is 2.000 or greater but his/her most recent two consecutive semester GPAs (fall/spring) are less than 2.000.

A student is on academic probation and not in academic good standing if his/her cumulative UB GPA is less than 2.000 and quality point deficit is less than 20 after two or more semesters (fall/spring) of study at UB.

Through their academic advisor, students may request to have their UB summer or winter session grades evaluated for purposes of reconsideration of their academic probationary or dismissal status. In these instances, winter and summer term coursework is treated as though it was taken during the prior regular term (fall or spring, respectively) when a manual recalculation of the term GPA is conducted. This recalculation is for the purposes of reevaluating the academic standing only and is not reflected on the academic transcript.

Students on academic probation are not eligible to participate in university activities. In addition, students on academic probation may be subject to an advisement service indicator — a mandatory discussion with an academic advisor to help build an effective academic strategy before the student may complete any further registration activity.

Academic probation will not be noted on a student’s official transcript, but will be part of the student’s record.

Academic Dismissal

A student enrolled at UB for two or more semesters who has a cumulative UB GPA less than 2.000 and a quality point deficit of 20 or greater points will be dismissed from the university regardless of his/her most recent semester GPA.

Each dismissed student will receive official notification via U.S. mail and his/her UB email account, and all future fall or spring semester registrations will be removed and/or blocked. Dismissed students may register in or will keep their enrollments in the summer or winter session immediately following dismissal (e.g., students dismissed in December 2020 may enroll in winter 2021 courses).

A dismissed student may register as a non-degree student for enrollment in winter or summer sessions after review and approval by the Scholastic Standards Committee. Students can apply to be readmitted one academic year after their dismissal (e.g., a student dismissed after spring 2020 may apply for re-admittance for fall 2021).

A dismissed student may appeal the dismissal in writing to the Dean of Undergraduate Education during a period of time specified in the dismissal letter. Consultation with an academic advisor is required as part of the dismissal appeal process. If the appeal is granted, notice of that will include the terms and conditions of continued study.

Academic dismissal will be noted on the student’s official transcript and will be part of the student’s record.

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2015 Academic Review Policy

For Approved Majors Entering the School of Engineering and Applied Sciences Fall 2015 or Later

Overview

To maintain academic standards and determine eligibility for continued enrollment, the School of Engineering and Applied Sciences reviews the academic records of all undergraduate students. SEAS academic review is conducted at the end of each fall and spring semester.

Please note that the University at Buffalo Office of Educational Affairs completes an independent academic standards review at the end of each fall and spring semester.

Learn more about the UB academic review policy.

SEAS Academic Good Standing

SEAS considers the technical GPA (TGPA) in its academic review. The TGPA is based on engineering, math, and science courses taken at UB.

A student is in SEAS academic good standing if their cumulative UB technical grade point average (CTGPA) is 2.0 or greater and their most recent semester technical GPA (STGPA) at UB is 2.0 or greater.

Poor academic standing within SEAS may limit a student's ability to participate in SEAS and other university activities.

SEAS Academic Probation

SEAS academic probation is an official notification that the student's academic performance must improve or the student will be subject to academic dismissal from SEAS.

A student is placed on SEAS academic probation if

P.1. their STGPA is less than 2.0 and their CTGPA is less than 1.4 and they are in their first fall or spring semester at UB, or

P.2 their STGPA is less than 2.0 and their CTGPA is greater than 1.4, or

P.3. their STGPA is greater than 2.0 and their CTGPA is less than 2.0

After the first SEAS academic probation, students will receive a hold that will limit their ability to register in courses until they satisfy a required advisement session. The probation letter provides details regarding the advisement session.

SEAS Academic Dismissal

SEAS takes the action of academic dismissal on the premise that the student is currently unable to make satisfactory academic progress toward a bachelor's degree.

A student who has been enrolled at UB for two or more semesters is dismissed from SEAS if

D.1. their STGPA is less than 2.0 and their CTGPA is less than 1.4, or

D.2. their CTGPA and STGPA are both less than 2.0 while they are on academic probation, or

D.3. they do not follow the curriculum in their SEAS major for two consecutive semesters

A change in a student's academic status due to a deficiency in their CTGPA or STGPA may not be negotiated. SEAS will review cases only wherein there is a change in a course grade or a calculation error was made.

Students with legitimate extenuating circumstances may petition for immediate reinstatement. Specific examples include documented medical issues of the student or an immediate family member, the death of an immediate family member, a disability, or military orders. In such cases, it is expected that the student will consider an Academic Withdrawal from University Coursework . Successful petitions will present sufficient evidence that an Academic Withdrawal request is deemed to have a reasonable likelihood of being granted. Petition requests are submitted via an online form and are generally due within two weeks of notification of dismissal (see dismissal letter for specific details). Petition submissions require a statement and relevant supporting documentation. Therefore, students are encouraged to begin assembling the petition application soon after notification of dismissal.

Students who do not submit a petition or unsuccessfully petition for reinstatement will be removed from the SEAS major and dropped from any engineering courses and 200 level or higher computer science courses they are enrolled in for the following fall or spring semester. These processes are generally completed within one week of the petition deadline. Students dismissed from SEAS are strongly encouraged to work with UB's academic advisors to explore other majors.

Students dismissed from SEAS at the end of the fall (spring) semester will be allowed to continue enrollment in SEAS courses during the winter (summer) term that immediately follows. Outside of this limited period, dismissed students are not permitted to register for SEAS courses.

Students are eligible to reapply to the School of Engineering and Applied Sciences after at least one fall or spring semester away.

The Associate Dean for Undergraduate Education is the arbiter for these regulations.

Communications

Students will receive official notifications of their SEAS academic standing via UB email.

Summary

The table that follows summarizes the SEAS academic review process.

CTGPA = UB Cumulative Technical GPA

STGPA = UB Semester Technical GPA

Status	Fall or Spring Semester Performance	Action
Good Standing	CTGPA ≥ 2.0 and STGPA ≥ 2.0	Good Standing
	CTGPA ≥ 1.4 and STGPA < 2.0	Probation
	CTGPA < 2.0 and STGPA > 2.0	Probation
	CTGPA < 1.4 and STGPA < 2.0 and first semester at UB	Probation
	CTGPA < 1.4 and STGPA < 2.0 and more than one semester at UB	Dismissal
Probation	CTGPA ≥ 2.0 and STGPA ≥ 2.0	Good Standing
	CTGPA ≥ 2.0 and STGPA < 2.0	Probation
	CTGPA < 2.0 and STGPA ≥ 2.0	Probation
	CTGPA < 2.0 and STGPA < 2.0	Dismissal

Periodic Review of Intended Majors

Overview

The School of Engineering and Applied Sciences periodically reviews the academic records of all students in an intended undergraduate SEAS major. An analysis is completed to evaluate the potential for intended majors to gain admission to the approved major. One of the actions detailed below result from the Periodic Review.

Students who follow the standard curricular plan for a SEAS program are eligible for admission to the approved major after the second semester of study. Students are generally not permitted to remain within an intended SEAS major beyond their fourth semester at UB.

Information regarding SEAS admissions requirements is provided at our Admission to SEAS for Current UB Students page.

Admission to the Major

Students who are admissible to the SEAS program they wish to enter are placed into the approved major.

Continuation within the Intended Major

Student who are not currently admissible, but are making progress towards completing admissions requirements, remain in the intended SEAS major.

Risk levels are used to convey the extent to which students are on track to complete SEAS admissions requirements. All continuing students are placed into one of three risk categories (high, moderate, low). The risk level is based upon a student's performance in core courses associated with the major and ability to meet the overall GPA requirement for the major.

> Low Risk: Continued strong performance will result in admission to the major. Students placed in this risk level have performed at a level that meets or exceeds admissions standards for their major of interest. However, one or more core courses need to be completed to be eligible for the approved major.
>
> Moderate Risk: Improvement is needed to satisfy admissions requirements. Students placed in this risk level have a core course and/or overall GPA that is below the standard for the major. Such students may also have a UB Academic Standing of “Warning”. Students are strongly encouraged to meet with an academic advisor to review their progress and discuss strategies for improving their academic performance.
>
> High Risk: Significant improvement is needed to satisfy admissions requirements. Students placed in this risk level have grades less than C- in one or more core courses, a low core course GPA, and/or an overall GPA that is sufficiently below the standard for the major. Students are required to (1) complete the SEAS Intended Program Review Worksheet and (2) meet with an academic advisor. A hold is added to the student’s record to prevent registration until the worksheet and meeting are completed.

All continuing students are encouraged to meet regularly with an academic advisor to review progress and discuss their academic plans.

If you expect to receive financial aid please consult with a Financial Aid Advisor particularly if you earn more than 60 college credit hours (e.g. test credit, transfer coursework, UB coursework) as intended major status could affect certain types of aid.

Dismissal from the Intended Major

Students who are unable to make satisfactory progress towards satisfying SEAS admissions requirements are dismissed from the intended SEAS major. Specifically, students are dismissed from the SEAS intended major if

- their UB Academic Standing is “Probation” or “Dismissal”.
- they are unable to satisfactorily complete the core course requirement. Specific examples include:
  - grades lower than C- in two attempts to complete a specific core course
  - grades lower than C- for three or more core courses
  - a core course GPA below 2.5 and an inability to sufficiently improve the GPA with the core courses and/or repeats that remain
  - (effective Fall 2020 Periodic Review) inability to complete the core course requirement by the end of the fourth Fall/Spring semester as an active matriculated student at the University at Buffalo.
- (effective Fall 2020 Periodic Review) their Admission Quality Point Deficit exceeds the limit outlined in the table below. The limit decreases with the number of Fall/Spring semesters for which the student has been active since they first matriculated at the University at Buffalo. Students are encouraged to use the Progress Report to check their Admission Quality Point Deficit.
  - Admission Quality Point Deficit = (Overall GPA Hours Attempted x Overall GPA Requirement) – Overall Quality Points
  - Example 1: A student who completed 30 overall credit hours (UB or another institution) with an overall GPA of 2.2 and is pursuing a major with an overall GPA requirement of 2.5 has an Admission Quality Point Deficit of (30 x 2.5 – 30 x 2.2) = 9
  - Example 2: If the student noted in Example 1 decides to pursue a major with an overall GPA requirement of 2.8, their Admission Quality Point Deficit would change to (30 x 2.8 – 30 x 2.2) = 18

UB Semester	Maximum Admission QP Deficit
1	Not Reviewed
2	12
3	6
4	0

Students with legitimate extenuating circumstances may petition for immediate reinstatement. Specific examples include documented medical issues of the student or an immediate family member, the death of an immediate family member, a disability, or military orders. In such cases, it is expected that the student will pursue an Academic Withdrawal from University Coursework. Successful petitions present sufficient evidence that an Academic Withdrawal request is deemed to have a reasonable likelihood of being granted. Students who successfully petition for reinstatement are returned to the intended SEAS major.

Upon dismissal, students are removed from the intended engineering or computer science major, placed into the UB Exploratory Transitions Major, and dropped from engineering and 200-level or higher computer science courses. Students dismissed from SEAS are strongly encouraged to work with UB's academic advisors to successfully transition to other majors. Students may be eligible to return to the School of Engineering and Applied Sciences via the reconsideration policy. The one-year reconsideration process requires students to satisfy specific, rigorous, reentry requirements, and can impact timeliness to graduation and eligibility for financial aid.

The Associate Dean for Undergraduate Education is the arbiter for these regulations.

Communications

Students receive official notifications of admission to an approved SEAS major or removal from an intended SEAS major via UB email.

Criterion 1. Students

C. Transfer Students and Transfer Courses

Included policies and documents

- UB Transfer Credit (Section C.2)
- UB TAURUS (Section C.2)
- SUNY Seamless Transfer (Section C.3)

Transferring Credit to UB

The University at Buffalo reserves the right to evaluate all credit-bearing courses.

All credit-bearing courses (regardless of mode of delivery) from regionally accredited institutions of higher learning are considered transferable to the University at Buffalo; the grades earned in these courses are used in overall GPA calculations. The term “accredited,” as used here, refers to the following regional accreditation organizations:

- MSA/CHE, Middle States Association of Colleges and Schools/Commission of Higher Education
- NEASC, New England Association of Schools and Colleges
- NCA, North Central Association of Colleges and Schools
- NASC, Northwest Association of Schools and CollegesSASC-COC, Southern Association of Schools and Colleges-Commission on Colleges
- WASC-Sr., Western Association of Schools and Colleges-Accrediting Commission for Senior Colleges
- WASC-Jr., Western Association of Schools and Colleges-Accrediting Commission for Community and Junior Colleges

Credit courses from institutions with other than regional accreditation are evaluated for transfer purposes on a case-by-case basis.

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University Transfer Credit Policy

The State University of New York (SUNY) System maintains a comprehensive program to facilitate the transfer of qualified students from one SUNY institution to another. The University at Buffalo has implemented the components of SUNY Seamless Transfer and supports processes which help these qualified students transfer seamlessly from one SUNY campus to another as simply and efficiently as possible. The intention is that students who adhere to the tenets of the program will not only be able to transfer seamlessly, but earn their degrees in a timely fashion. To achieve that end, UB has delineated what is required for all four year undergraduate programs as needed to benefit from SUNY Seamless Transfer.

Within the initiative, specific prescribed programs of study are indicated in SUNY Transfer Paths which should be followed by all students seeking to transfer to another SUNY campus in one of the selected fields of study. Students wishing to transfer to UB will generally be prepared to enter UB at the junior level and graduate with that major in two years of additional study if they have fulfilled the following:

- the Transfer Path courses
- an Associate of Science or Arts degree or 60 credits from a bachelor's level program;
- at least seven of the of the ten SUNY General Education Requirements (GER); and
- all other requirements as indicated in UB's catalog

Students interested in transferring to UB should review the information included in UB's catalog pages for the program as well as viewing information about transferability of courses via TAURUS, UB's articulation website. In certain bachelor's programs, UB offers several degree programs such as a BA and BS or BA and BFA or numerous specific concentrations within a degree. To ensure efficient transfer and timely degree completion, students are urged use the academic advising directory to contact advising units to discuss all program requirements.

UB students who choose to transfer to another SUNY campus should be eligible for junior status if they have followed the Transfer Paths and general education requirements cited above as well as fulfilling any other requirements of the campus they seek.

All students considering transfer to another SUNY campus should consult the website for SUNY Transfer Policies.

In recognition of the challenges caused by the COVID-19 pandemic, a number of institutions required or offered students the option of pass/fail or satisfactory/unsatisfactory grading. Pass (TP) and Satisfactory (TS) grades

earned in transfer coursework completed in spring 2020 at domestic higher education institutions may be applied towards UB Curriculum and major requirements.

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Official Transcript Evaluation

UB accepts all college-level credits from regionally accredited two- or four-year degree-granting institutions. Applicants can check how their courses have been matched to UB's courses and requirements on TAURUS, UB's course articulation website. Students must submit an official transcript from each institution they have attended to have their courses transferred and evaluated at UB.

Courses transferred from another institution to UB will be transferred with full semester credit value. Conversion of credits from trimester, quarterly and other calendar systems will be completed based on nationally accepted practices. For example, trimester hours are generally equal to semester hours, and quarterly hours are generally equal to two-thirds semester hours.

UB also grants credit for a number of alternative forms of credit. These alternative forms of credit are not considered at the time of admission. They are added to a student's record after starting courses at UB. Students must submit an official score report to have their alternative credit evaluated.

Additional Information

- How to Request an Official Transcript
- How to Request Official Score Reports for Exam Credit
- TAURUS, UB's course articulation website

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SUNY Seamless Transfer

The State University of New York (SUNY) System maintains a comprehensive program to facilitate the transfer of qualified students from one SUNY institution to another. The University at Buffalo has implemented the components of SUNY Seamless Transfer and supports processes which help a qualified student transfer seamlessly from one SUNY campus to another as simply and efficiently as possible. The intention is that a student who adheres to the tenets of the program will not only be able to transfer seamlessly, but earn their degree in a timely fashion. To achieve that end, UB has delineated what is required for all four year undergraduate programs as needed to benefit from SUNY Seamless Transfer.

Within the initiative, specific prescribed programs of study are indicated in SUNY Transfer Paths which should be followed by a student seeking to transfer to another SUNY campus in one of the selected fields of study. A student wishing to transfer to UB will generally be prepared to enter UB at the junior level and graduate with that major in two years of additional study if they have fulfilled the following:

- the Transfer Path courses
- an Associate of Science or Arts degree or 60 credits from a bachelor's level program;
- at least seven of the of the ten SUNY General Education Requirements (GER); and
- all other requirements as indicated in the policy section of UB's catalog

A student interested in transferring to UB should review the information included in UB's catalog pages for the program as well as viewing information about transferability of courses via TAURUS, UB's articulation website. In many bachelor programs, UB offers several degree types (e.g. BA and BS) as well as concentration options within a degree. To ensure efficient transfer and timely degree completion, a student should use the academic advising directory and contact the relevant advising unit to discuss the requirements of the desired program of study.

A UB student who chooses to transfer to another SUNY campus should be eligible for junior status if they have followed the Transfer Paths and general education requirements cited above as well as fulfilling any other requirements of the campus they seek.

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Transfer Course Articulation

Course articulation is when external credit-bearing courses are formally reviewed and approved by faculty for course equivalency here at UB. Once a course has been reviewed and approved to be transferred to UB, the Office of the Registrar will create a course articulation, which can be viewed through the Course Equivalency Guide located on the TAURUS website. The benefit of having a course articulated is that it may grant course equivalency that will fulfill specific major and general education requirements. Any course that comes from a regionally accredited institution may articulate for a course at UB. Post-secondary institutions that have other than regional accreditation are reviewed by a case-by-case basis according to the University Transfer Credit Policy.

In recognition of the challenges caused by the COVID-19 pandemic, a number of institutions required or offered students the option of pass/fail or satisfactory/unsatisfactory grading. Pass (TP) and Satisfactory (TS) grades earned in transfer coursework completed in spring 2020 at domestic higher education institutions may be applied towards UB Curriculum and major requirements.

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Transfer Course Work

The Office of the Registrar manages your transfer courses and how your coursework from post-secondary institutions is applied toward UB major and general education course requirements. The Course Equivalency Guide that is located on the TAURUS website(Transfer Articulation of University Requirements at UB system) is a tool that students and staff can use to look up current course articulations that we have with other institutions by school or course.

In order for credit to be transferred to UB, official transcripts must be sent from the institution to the Office of Admissions, University at Buffalo, 12 Capen Hall, Buffalo, NY 14260-1660. You can also visit our Undergraduate Admissions page, which outlines the steps to transfer to the University at Buffalo.

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TAURUS (Transfer Articulation and University Requirements at UB System) is the University at Buffalo's (UB) articulation website that outlines the articulation process and includes the Course Equivalency Guide (CEG). The Course Equivalency Guide displays course articulation approved by UB faculty. Click below to search the Course Equivalency Guide (CEG) by school or course.

Search Equivalency by School SCHOOL TUTORIAL (PDF)

Search Equivalency by Course COURSE TUTORIAL (PDF)

Alternative/Exam Credit

Transfer students can see what University at Buffalo courses will satisfy SUNY General Education Requirements**.**

Users are responsible for these Cautions **and** Important Notes**.**

Articulation Request Process

If a student has course work from a previous institution that does not appear in the TAURUS Course Equivalency Guide, and feels it might work towards their major degree or UB Curriculum requirements, then they should submit a course articulation request. Depending on the student's status at UB, they will enter their request(s) through one of the following methods:

Newly admitted or current UB students

Students with a UB person number can login to the TAURUS Articulation Request System **to place their request(s), using their UBIT name and password.**

For Non-UB students and/or users without a person number

Please submit request(s) through the Guest System**.**

If you are admitted to the University at Buffalo, but do not know your UBIT name and/or password, please contact the UBIT Help Center **for assistance.**

Requests are sent to the appropriate academic department for review. TAURUS only handles the process of sending the request and processing the final decision in the TAURUS course equivalency guide. This process can take an estimated 10-15 business days to complete. The time frame can vary depending on the time of year. We do not guarantee requests will be complete by a specific date or deadline (i.e. registration, drop/add, etc.).

Students should always meet with their academic advisor prior to submitting any requests, to make sure course articulation is necessary.

Any discrepancies with a current articulation decision listed in the TAURUS equivalency guide must be brought directly to the appropriate academic department that made the decision.

TAURUS holds the right to deny any request if the proper rules and guidelines are not followed.

Course Articulation Cautions

- **TAURUS course articulation is relative to the year and term a course is taken. Course credits transferred to UB from institutions with other academic calendar systems will be converted to semester credits. The** Course Equivalency Guide (CEG) **cannot guarantee course articulation for future academic year terms. You MUST note the starting and ending dates of any articulation rule to determine whether it includes your course/s.**
- **Articulation compares course content NOT credit. Articulated courses may carry different amounts of credit even though they are matched to each other. See the** Transfer Credit Policy **for information on UB's evaluation of transfer credit.**
- **UB reserves the right to change articulations at any time. UB also reserves the right to deny articulation on student records if there are errors found within the equivalency guide.**
- **Articulation course equivalencies on this website DO NOT guarantee transfer credit which is calculated for each individual student.**
- **TAURUS is the repository of articulation rules for the University of Buffalo. The** Course Equivalency Guide (CEG) **published in TAURUS is NOT an official document.**
- **Students transferring from SUNY institutions may be provided with a General Education Transcript Addendum (GETA) that provides information about the SUNY General Education Requirements (GERs) the student has completed. When students transfer from one SUNY institution to another, the new campus honors any SUNY GERs that were fulfilled at other SUNY institutions. UB applies incoming GETAs to the appropriate general education requirement for any transfer student who provides them. If a UB student earns a GETA from another SUNY institution after while they have matriculated at UB, the GETA will not be applied to the SUNY GERS and only the direct course articulation will meet the student's UB Curriculum (general education) requirements. This includes (but is not limited to) GETAs earned at other institutions via cross registration or during summer or winter sessions of an academic year during which the student is an active UB student.**

Important Notes

1. **Students are responsible for UB's Transfer Credit Policy, published each year in the University at Buffalo Undergraduate Catalog.**
2. **Students with SUNY transfer courses may use the SUNY Transfer Credit Appeal Process to petition the UB credit and course equivalencies awarded for these courses.**
3. **Please visit our Repeat Policy located in the Undergraduate Catalog regarding course repetition application to transfer courses.**

UB's Office of the Registrar maintains TAURUS. Hours of support are Monday – Friday, 8:30 a.m. to 4:30 p.m.

Transfer Path

Discipline: Mechanical Engineering

SUNY transfer paths outline the knowledge and skills that are essential for students to complete during their first two years of study for a major in a given discipline. The coursework described below will meet degree requirements at all SUNY campuses offering majors in the above discipline. If you complete this coursework successfully, you will be well-positioned to finish your degree with an additional two years of study at your SUNY transfer college.

Use this transfer path to discover both courses related to your major and general education requirements that will prepare you for transfer. Click on each course to view a course description. Then, to map your first two years of courses, visit Planning Your Coursework.

Lower-Division Major Requirements

The courses below are specifically related to your field of study and are part of the requirements for graduation in your major:

Engineering Core Requirements:

- Introduction to Engineering
- Calculus-based Physics I: Mechanics (with lab)
- Calculus-based Physics II: Electromagnetism (with lab)
- Calculus I
- Calculus II
- Calculus III
- General Chemistry I (with lab)
- Differential Equations
- Computer Programming

Specific requirements for Mechanical Engineering:

- Statics
- Dynamics
- Strength of Materials
- Circuits I

Campus specific requirements:
The transfer path for engineering includes up to three campus specific courses that you should complete prior to transferring to achieve junior status. Consult with your academic advisor and transfer campus for more information on completing these courses. A list of campus specific requirements can be found here, by campus and discipline.

SUNY The State University of New York

Transfer Path

Advising Notes

Campus transfer path requirements are required technical (not General Education) classes selected based on the intended transfer institution. Each four-year insitution will specify what courses are included in this category. The transfer path requirements may include courses taught at a two-year institution or courses from a four-year institution taken online or through distance learning programs. The needed credit hours in this category will vary depending on the intended transfer institution, but should not exceed three academic courses.

For articulated courses, differences in credit hours should not matter. For example, if a 3 credit hour math course at a community college is articulated with a 4 credit hour course at a four-year institution, students are credited with satisfying the 4 credit-hour requirement.

There may be additional courses in your major which would transfer, or courses which could be substituted for one of the above. These may be established on a case by case basis. Please see an advisor at your transfer campus to explore those options.

Transfer students must satisfy 5 of the 10 SUNY GER areas outlined on the following page. With Mathematics and Natural Sciences satisfied by Engineering Core and Discipline Specific Requirements, at least three additional areas must be satisfied. One of the SUNY GER areas covered must be Basic Communications. Students may need to take additional General Education courses depending on the requirements of the transfer institution.

General Education Requirements

General Education courses are related to key academic disciplines and may be outside your field of study. To earn a SUNY bachelor's degree, you must earn 30 credits in at least seven of the following ten skill areas, and demonstrate two competencies. For AS programs in Engineering, students must satisfy five of the following ten skill areas.

Skill Areas:

- Basic Communication (required)
- Mathematics (required)
- American History
- Other World Civilizations
- Foreign Language
- Social Sciences
- Humanities
- The Arts
- Natural Sciences
- Western Civilization

Competencies:

- Critical Thinking (required)
- Information Management (required)

General Education requirements vary by campus and by major. However, if you satisfy the SUNY General Education Requirement (SUNY-GER) area at one campus with a grade of C or higher, you will have met that SUNY-GER area at every other SUNY campus. Visit Campus Requirements to determine the skill areas required by each campus and the courses available within those areas.

Last updated: November, 2016

Criterion 1. Students

D. Advising and Career Guidance

Included policies and documents

- SEAS Professional Development Blueprint (Section D.2.b)

University at Buffalo
School of Engineering and Applied Sciences

Professional Development Blueprint

The Professional Development Blueprint (85 KB) is a co-curricular roadmap focused on career preparation for undergraduate applied science and engineering students.

FILTER BY INDUSTRY RESEARCH

▼ EXPLORATION

Year 1	Year 2	Year 3	Year 4
Review the credentials and specializations of faculty and industry professionals. Explore SEAS clubs/organizations and attend general meetings for those that interest you. Research study abroad opportunities.	Review research articles on topics of interest. Attend the Celebration of Academic Excellence. Explore entrepreneurship resources.	Explore graduate schools and prepare for required standardized admissions tests. Attend seminars to keep abreast of current research, projects and developments in your discipline. Attend the spring Graduate Student Poster Competition. Research requirements for careers of interest and identify opportunities to fill skills gaps.	Continue to explore the cost of living, job market, and average salary in geographic areas of interest. Observe an MS thesis or PhD dissertation defense presentation.

▼ CONNECTIONS

Year 1	Year 2	Year 3	Year 4
Sign up for Engineering Small Groups. Volunteer in the community through Saturdays of Service. Attend the spring Senior Design Expo.	Attend a networking workshop. Register for the Real Experience and Leadership Mentoring Program (REALM). Research professional technical societies related to your discipline and interview current members.	Develop a relationship with a faculty advisor. Identify and meet a career mentor through the UB Career Connector Network. Join a technical society related to your discipline.	Attend technical society meetings to network with professionals in your field. Join groups on LinkedIn related to topics or careers of interest. After graduation, stay in touch with UB through UB Connect and LinkedIn.

▼ EXPERIENCE

Year 1	Year 2	Year 3	Year 4

Year 1	Year 2	Year 3	Year 4
Pursue self-led hands-on tinkering modules to develop technical skills.	Participate in engineering intramurals, short-term extra-curricular projects completed in small groups.	Participate in a CURCA research project at UB or spend the summer at an REU site.	Continue internships, research, and other projects or find a student assistant/grader position.

▼ CAREER FUNDAMENTALS

Year 1	Year 2	Year 3	Year 4
Learn about professional communication and etiquette. Participate in a time management workshop. Create a resume and set up a student profile on Bullseye. Observe the fall STEAM UP job and internship fair.	Attend a LinkedIn workshop. Attend a job and internship search strategy workshop. Make an appointment for a resume, cover letter, and LinkedIn profile review prior to applying for an internship. Engage in a leadership or communication workshop.	Polish your interviewing skills by doing a practice interview session with Career Services. Update your resume as you master new skills, projects, and experiences. Learn about the requirements for Professional Engineer Licensure.	Search for job opportunities at the fall STEAM UP job and internship fair. Apply to graduate schools and/or graduate fellowships. Register to take the Fundamentals of Engineering Exam. Learn how to manage multiple job offers and negotiate your salary. Take a professional oath during the Pledge to Professionalism ceremony. Complete the UB First survey in the fall following graduation.

A roadmap for career preparation and success.

While academic success is crucial to earning your credentials, many other experiences and skill sets developed outside of the classroom are integral to securing a job or pursuing graduate school.

The Professional Development Blueprint consists of an inventory of activities that will prepare you to be an experienced, connected, and informed engineer or applied scientist.

Download the blueprint (85 KB)

Criterion 1. Students

E. Work in Lieu of Courses

Included policies and documents

- Alternative Credit Overview
- Advanced Level Program
- Advanced Placement (AP)
- College Credit Recommendation Services (CREDIT)
- College Level Examination Program (CLEP)
- Dantes Subject Standardized Tests (DSST)
- Excelsior College
- General Certificate of Education (GCE A-Level)
- Global Assessment Certificate (GAC)
- International Baccalaureate (IB)
- Military Credit
- UB College Credit Examinations

Alternative Credit Overview

After enrollment at UB, students may be awarded credit toward their university degree through methods other than completing UB course work. Examples are proficiency examinations and military training. All types of credit earned by alternative methods and accepted by UB are described below. This credit may shorten the time required to complete a UB degree, but only transfer credit awarded during the admission process for courses completed at other institutions is calculated for purposes of admission to UB. Credit awarded for transfer coursework earned before or after matriculation at UB is evaluated according to UB's transfer credit policy.

Students should designate UB (SUNY Center Buffalo/School Code 2925) at the time they take an exam or when requesting score reports for UB. Students can request evaluation of accepted alternative credit types for possible UB credit awards by having official documentation and score reports sent directly to the Office of Admissions, University at Buffalo, 12 Capen Hall, Buffalo, NY 14260-1660.

University-level exams, passed at or above the minimum score required by UB, are awarded credit with a "P" or pass grade. (Pass grades do not affect UB grade averages.) Exams may be awarded elective credit or credit toward specific degree requirements when articulated — that is matched — to a specific UB course or degree requirement. UB articulation results for commonly requested types of alternative credit are available on the Alternative/Exam Credit web page or from the TAURUS website. Articulation for other types of alternative credit may be awarded on an ad hoc basis.

Credit will not be awarded for any exam or content that duplicates the content of a college course for which a student has already received credit or if a student has completed more advanced study, i.e. beyond the level covered by an exam. Students may decline exam or military credit that has been awarded by UB at any time with the Alternative Exam Credit Declination form (PDF). Students may recover previously declined alternative exam credit with the Alternative Exam Credit Recovery form, if that credit can be utilized to fulfill a degree requirement. When exam credit is not declined and the exam or its articulated course content is subsequently repeated, credit will only be awarded for the second taking. UB does not award experiential credit or accept experiential credit transferred from other institutions. Evaluation of credit earned by alternative methods is based on articulated course and requirement equivalencies in effect at the time the credit is requested. General guidelines for alternative credit types accepted by the university are described in the sections below.

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Advanced Level Program

An official score report from the College Board's Puerto Rico and Latin America Office showing a minimum score of 3 on the ALP Spanish test will guarantee credit will be awarded. In some cases, credit awarded may apply toward major, general education requirements, or other university degree requirements. ALP credit awards are listed on the Advanced Level Program Test (ALP) chart (PDF). Credit for other ALP tests may be awarded when ALP test syllabi are available in English translation.

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Advance Level Program (ALP)
CollegeBoard Puerto Rico, UB Course Articulation

ALP Test	Credit Award	UB Course Articulation and Comments	Required Score
Spanish	6	SPA210 How to Read a Spanish Text + SPA313 Advanced Grammar	4, 5
Spanish	6	SPA208 Spanish Conversation and Composition + SPA210 How to Read a Spanish Text	3
Spanish	0	Contact Spanish Language Program Director for placement, www.rll.buffalo.edu	2, 1

Advanced Placement (AP)

An official score report from the College Board showing a minimum score of 3 on any AP Exam will guarantee credit will be awarded. In some cases, credit awarded may apply toward major, general education, or other university degree requirements. AP credit awards for the current academic year are listed on the Advanced Placement Exam (AP) chart (PDF). Students should designate UB (SUNY Center Buffalo/School Code 2925) at the time they take an exam or when requesting that AP scores be sent to UB.

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2020-2021 Advanced Placement (AP) Exam Articulation

HUB AP Code	AP Exam	Score	UB Course Articulation	Cr. Hrs	Comments
ARH	Art: Art History	3	APC999TR	6	
ARH	Art: Art History	4, 5	AHI101LR + AHI102LR	6	
ASD	Art: Studio Art: Drawing Portfolio	3	APC999TR	6	
ASD	Art: Studio Art: Drawing Portfolio	4, 5	ART999TRSAE	6	Studio Art elective credit for Art majors. Only 6 credits of AP Studio Art will be accepted toward Art major requirements
A2D	Art: Studio Art: 2D Design Portfolio	3	APC999TR	6	
A2D	Art: Studio Art: 2D Design Portfolio	4, 5	ART999TRSAE	6	Studio Art elective credit for Art majors. Only 6 credits of AP Studio Art will be accepted toward Art major requirements
A3D	Art: Studio Art: 3D Design Portfolio	3	APC999TR	6	
A3D	Art: Studio Art: 3D Design Portfolio	4, 5	ART999TRSAE	6	Studio Art elective credit for Art majors. Only 6 credits of AP Studio Art will be accepted toward Art major requirements
BY	Biology	3	APC999TR	7	
BY	Biology	4	BIO200LLB + APC 999TR	7	A score of "4" also matches BIO129-BIO130 .(This is intended for non-majors to satisfy the Scientific Literacy & Inquiry Requirement)
BY	Biology	5	BIO200LLB + BIO201LLB	7	A score of "5" also matches BIO129-BIO130. (This is intended for non-majors to satisfy the Scientific Literacy & Inquiry Requirement)
MAB	Calculus AB*	3	APC999TR	4	
MAB	Calculus AB*	4, 5	MTH141LR	4	
MBC	Calculus BC*	3	APC999TR	4	
MBC	Calculus BC*	4, 5	MTH141LR	4	
CALAB	AB sub score on Calculus BC exam*	3	APC999TR	4	
CALAB	AB sub score on Calculus BC exam*	4, 5	MTH141LR	4	
CH	Chemistry	3	APC999TR	9	
CH	Chemistry	4, 5	CHE101LR + CHE113LAB + CHE102LR + CHE114LAB	9	
CLC	Chinese	3	APC999TR	6	Equivalent to proficiency for admission to Chinese - Minor
CLC	Chinese	4, 5	CHI201LEC + CHI202LEC	6	
CSA	Computer Science A**	3, 4	APC999TR	4	
CSA	Computer Science A**	5	CSE115LR	4	
CSAB	Computer Science AB**	4, 5	CSE113LR + CSE114LR	8	Exam is no longer offered.
CSP	Computer Science Principles	3	APC999TR	4	
CSP	Computer Science Principles	4,5	CSE101LLB	4	
EMA	Economics: Macro	3	APC999TR	3	
EMA	Economics: Macro	4,5	ECO181LD	3	
EMI	Economics: Micro	3	APC999TR	3	
EMI	Economics: Micro	4, 5	ECO182LD	3	
ENGC	English Lang & Comp	3	APC999TR	3	
ENGC	English Lang & Comp	4, 5	ENG105LEC	4	
ELC	English Lit & Comp	3, 4, 5	APC999TR	3	No comparable course or requirement
ENV	Environmental Science	3	GEO104LEC	3	
ENV	Environmental Science	4,5	GEO104LEC	3	Also matches as EVS118LEC

FRA	French Language	3	FR104LEC	5	
FRA	French Language	4	FR152LEC	3	
FRA	French Language	5	FR999TR200	3	Please contact the Romance Language & Literature department for exact articulation.
FLA	French Literature	3	FR152LEC	3	Exam is no longer offered.
FLA	French Literature	4, 5	FR 211LEC + FR 212LEC	6	Exam is no longer offered.
GM	German Language	3	GER151LEC + APC999TR	6	
GM	German Language	4	GER151LEC + GER152LEC	6	
GM	German Language	5	GER337LEC + GER338LEC	6	
GPU	Govt & Politics: US	3	APC999TR	3	
GPU	Govt & Politics: US	4, 5	PSC101LEC	3	
GPC	Govt & Politics: Comparative	3	APC999TR	3	
GPC	Govt & Politics: Comparative	4, 5	PSC103LEC	3	
EH	History: European	3,4,5	APC999TR	6	Credit will be given toward appropriate concentration and distribution requirements in the History major or minor but not towards the overall requirement of 12 courses/36 credit hours for completion of the History major.
UH	History: US	3	APC999TR	6	Credit will be given toward appropriate concentration and distribution requirements in the History major or minor but not towards the overall requirement of 12 courses/36 credit hours for completion of the History major.
UH	History: US	4, 5	TR999TR DIVL + APC999TR	6	Credit will be given toward appropriate concentration and distribution requirements in the History major or minor but not towards the overall requirement of 12 courses/36 credit hours for completion of the History major.
WH	History: World	3,4,5	APC999TR	6	Credit will be given toward appropriate concentration and distribution requirements in the History major or minor but not towards the overall requirement of 12 courses/36 credit hours for completion of the History major.
HGEO	Human Geography	3,4,5	GEO102LEC	3	Students may request an alternate course, GEO103LEC. Call 716-645-2722
ITALC	Italian	3	ITA104LEC	5	
ITALC	Italian	4	ITA152LEC	3	
ITALC	Italian	5	ITA207LEC	3	
IELAP	International English Language [APIEL]	3	APC999TR	3	Exam is no longer offered.
IELAP	International English Language [APIEL]	4, 5	ESL407LEC	3	Exam is no longer offered.
JAPLC	Japanese	3	JPN201LEC + APC999TR	6	
JAPLC	Japanese	4, 5	JPN201LEC + JPN202LEC	8	
LTL	Latin: Literature	3	APC999TR	6	Exam is no longer offered.
LTL	Latin: Literature	4, 5	LAT201LEC + LAT202LEC	6	Exam is no longer offered.
LTV	Latin: Vergil	3	APC999TR	6	
LTV	Latin: Vergil	4, 5	LAT201LEC + LAT202LEC	6	
MSL	Music Literature	3	APC999TR	3	
MSL	Music Literature	4, 5	MUS115LEC	3	
MST	Music Theory	3	APC999TR	3	
MST	Music Theory	4, 5	MUS116LEC	3	
PHB	Physics B	3, 4, 5	PHY101LR + PHY102LR + PHY151LAB + PHY152LAB	10	This exam has been redesigned as of FALL 2014, please see Physics 1 and Physic 2 exams
PHY1	Physics 1	3, 4, 5	PHY101LR + PHY151LAB	5	
PHY2	Physics 2	3, 4, 5	PHY102LR + PHY152LAB	5	
PHCE	Physics C: Elec & Magnetism	3	APC999TR	4	
PHCE	Physics C: Elec & Magnetism	4, 5	PHY108LR	4	Will also grant 1 credit for PHY158LAB if student received a 4 or 5 in the Physics C: Mechanics exam. Contact TAURUS@buffalo.edu if you have obtained the appropriate score and need your record updated.

PHCM	Physics C: Mech	3	APC999TR	4	
PHCM	Physics C: Mech	4, 5	PHY107LR	4	
PY	Psychology	3	APC999TR	3	
PY	Psychology	4, 5	PSY101LEC	3	
SPL	Spanish Language	3	SPA104LEC	5	
SPL	Spanish Language	4	SPA152LEC	3	
SPL	Spanish Language	5	SPA207LEC	3	
SPLL	Spanish Literature	3	SPA151LEC	3	
SPLL	Spanish Literature	4	SPA152LEC	3	
SPLL	Spanish Literature	5	SPA210LEC	3	
STAT	Statistics	3	APC999TR	4	
STAT	Statistics	4, 5	STA119LEC/REC	4	

*** Maximum award for AP Calculus is 8 credits total, All BC exams include an AB sub score**
**** Maximum award for AP Computer Science is 8 credits total**

GLOSSARY

APC999TR – General Exam Credit
ART999TRSAE - Studio Art Elective
FR999TR200 - 200-Level French Elective
TR999TRDIVL – Diversity Learning Requirement

College Credit Recommendation Services (CREDIT)

Credit may be awarded for certain non-collegiate training programs usually offered in agencies, professional associations, and public and private corporations. Students should contact the sponsor of the training program to determine whether the American Council on Education (ACE) has evaluated it for credit. Credit for such programs can be considered for elective or articulated college credit only when the program has been recognized and evaluated for credit by ACE.

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College Level Examination Program (CLEP)

Official CLEP score reports showing the minimum score required by UB on exams considered university-level will be awarded credit. In some cases, the credit awarded may apply toward major, general education, or other university degree requirements. UB articulation of CLEP exams is listed on the College-Level Examination Program (CLEP) chart (PDF). Prior to taking a CLEP exam, UB students are advised to contact an academic advisor to determine if credit for the exam can be awarded.

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University at Buffalo
The State University of New York

CLEP Exam Articulations

Exam	Credit	UB Course Articulation	Minimum Score	Comments
Analyzing and Interpreting Literature	3	CPC999TR	50	
American Government	3	PSC101LEC	50	
American Literature	3	ENG241LEC	50	Also matches as ENG242LEC
Biology	7	CPC999TR	50 - 54	
Biology	7	BIO129LEC/LAB and BIO130LEC/LAB	55 [per dept.]	
Business Law, Introductory	3	CPC999TR	50	NOC: MGT
Calculus	4	CPC999TR	50-59	
Calculus	4	MTH141LR	60	
Chemistry	4	CPC999TR	50	
College Algebra	4	ULC147LEC	50	
College Mathematics	3	CPC999TR	50	
College Composition	3	CPC999TR	50	
College Composition - Modular	3	CPC999TR	50	
Educational Psychology, Intro. to	3	CPC999TR	50	NOC:PSY
English Literature	3	ENG231LEC	50	
Financial Accounting	3	MGA201LR	50	
French Language (Levels 1 and 2)	3	CPC999TR	50-52 [per dept.]	
French Language (Levels 1 and 2)	3	FR 151LEC	53-54 [per dept.]	
French Language (Levels 1 and 2)	3	FR 152LEC	55 [per dept.]	
German Language (Levels 1 and 2)	3	CPC999TR	50-63 [per dept.]	
German Language (Levels 1 and 2)	3	GER151LEC	63-64 [per dept.]	
German Language (Levels 1 and 2)	3	GER152LEC	65 [per dept.]	
History of the US I	3	TR999TRDIVL	50	See Glossary below
History of the US II	3	TR999TRDIVL	50	See Glossary below
Human Growth and Development	3	PSY336LEC or NSG250LR	50	
Humanities	3	CPC999TR	50	NOC: HMN
Info. Systems & Computer Apps.	3	CPC999TR	50	NOC: CSE,MGT
Macroeconomics, Principles of	3	CPC999TR	50-67	
Macroeconomics, Principles of	4	ECO181LD	68 [per dept.]	
Microeconomics, Principles of	3	CPC999TR	50-67	
Microeconomics, Principles of	4	ECO182LD	68 [per dept.]	
Marketing, Principles of	3	CPC999TR	50	
Management, Principles of	3	CPC999TR	50	
Natural Science	3	CPC999TR	50	NOC: Undergrad. College
Pre-calculus	4	ULC148LEC	50	
Psychology, Introductory	3	PSY101LEC	50	
Social Science and History	3	CPC999TR	50	NOC: Undergrad. College
Sociology, Introductory	3	SOC101LEC	50	
Spanish Language, /Level 1	5	CPC999TR	50-54	
Spanish Language, /Level I	5	SPA102LEC	55-61 [per dept.]	
Spanish Language, /Level 2	3	SPA151LEC	62-67 [per dept.]	
Spanish Language, /Level 2	3	SPA152LEC	68 [per dept.]	

Spanish with Writing	5	CPC999TR	50-54	
Spanish with Writing	5	SPA102LEC	55-61[per dept.]	
Spanish with Writing	3	SPA151LEC	62-67[per dept.]	
Spanish with Writing	3	SPA152LEC	68[per dept.]	
Western Civilization I	3	CPC999TR	50	NOC: HIS
Western Civilization II	3	CPC999TR	50	NOC: HIS
RETIRED EXAMS				
Accounting, Principles of	3	MGA201LR	50	
College Algebra/Trig.	4	ULC148LEC	50	
English Composition with Essay	3	CPC999TR	50	
English Composition without Essay	3	CPC999TR	50	
Freshman College Composition	3	CPC999TR	50	
Trigonometry	3	CPC999TR	50	

NOC - No Comparable course, as per the UB academic department REV.10/2019

GLOSSARY

CPC999TR – CLEP General Elective Credit

TR999TRDIVL – Diversity Learning (This will satisfy the Diversity Learning requirement in the UB Curriculum and the American Pluralism requirement in the 2002-2016 General Education program.)

DANTES Subject Standardized Tests (DSST)

Official DSST exam score reports showing the minimum score required by UB on DSST exams considered university-level by UB will be awarded credit. In some cases, credit awarded may apply toward major, general education requirements, or other university degree requirements. UB articulation of DSST exams is listed on UB's DSST Subject Standardized Tests chart (PDF). Prior to taking a DSST exam, UB students are advised to contact an academic advisor to determine whether credit for the exam can be awarded.

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DANTES Subject Standardized Test (DSST) Articulation Chart

DANTES Examination	Credit	UB Course Articulation	Minimum Score
Anthropology, General	3	DNT999TR (NOC)	47/400
Art of the Western World	3	AHI102LR	48/400
Astronomy	3	DNT999TR (NOC)	48/400
Auditing I	3	DNT999TR (NOC)(Retired exam)	47/400
Automotive Service, Basic	0	No Credit Allowed	-
Business Law II	3	DNT999TR (NOC)	44/400
Business Mathematics	3	DNT999TR (NOC)	48/400
Business, Introduction to	3	DNT999TR (NOC)	46/400
Carpentry, Introduction to	0	No Credit Allowed	-
Civil War and Reconstruction, The	3	HIS209LEC	47/400
Computers with Programming in BASIC, Intro	3	DNT999TR (NOC)(Retired exam)	48/400
Computing, Introduction to	3	CSE101LLB	45/400
Cost Accounting, Introductory	3	DNT999TR (NOC)(Retired exam)	46/400
College Algebra, Fundamentals of	4	ULC147LEC	47/400
Counseling, Fundamentals of	3	DNT999TR (NOC)	45/400
Criminal Justice	3	SOC317LEC	400
Drug and Alcohol Abuse/Substance Abuse	3	DNT999TR (NOC)(Retired exam)	49/400
Education, Foundations of	3	DNT999TR (NOC)(Retired exam)	46/400
Electric Circuits	0	No Credit Allowed	-
Electronic Communication Systems, Principles	0	No Credit Allowed	-
Electronics, Fundamentals of	0	No Credit Allowed	-
Environment and Humanity: The race to save the planet	3	DNT999TR (NOC)	46/400
Ethics In America	3	PHI107LEC	46/400
Geology, Physical	3	GLY103LAB	46/400
German I, Beginning	3	GER101LEC (Retired exam)	45/400
German II, Beginning	10	GER102LEC (Retired exam)	45/400
Here's To Your Health	3	DNT999TR (NOC)	48/400
History of the Vietnam War	3	HIS275LEC	44/400
Human/Cultural Geography	3	DNT999TR (NOC)	48/400
Human Resource Management	3	DNT999TR (NOC)	46/400
Italian I, Beginning	5	ITA101LEC(Retired exam)	46/400
Law Enforcement, Introduction to	3	DNT999TR (NOC)	45/400
Management Information Systems	3	DNT999TR (NOC)	46/400
Modern Middle East, An Intro. to the	3	DNT999TR (NOC)	47/400
Money and Banking	3	DNT999TR (NOC)	48/400
Organizational Behavior	3	PSY333LEC	48/400
Personal Finance	3	DNT999TR (NOC)	46/400
Personnel/Human Resource Management	3	DNT999TR (NOC)(Retired exam)	48/400

Physical Sci I, Principles of	3	DNT999TR (NOC)	47/400
Principles of Finance	3	DNT999TR (NOC)	46/400
Principles of Financial Accounting	3	DNT999TR (NOC)	47/400
Principles of Supervision	3	DNT999TR (NOC)	46/400
Lifespan Developmental Psychology	3	PSY336LEC or NSG250LR	46/400
Public Speaking, Principles of	3	COM326REC with minimum score and passing grade on speech	47/400 and pass on speech
Refrigeration Technology, Principles	0	No Credit Allowed	-
Rise & Fall of the Soviet Union	3	HIS999TRMOD	45/400
Spanish I, Beginning	5	SPA101LEC(Retired exam)	48/400
Spanish II, Beginning	5	SPA102LEC(Retired exam)	46/400
Statistics, Principles of	4	STA119LEC/REC Statistical Methods	48/400
Substance Abuse	3	SSC999TRHSN	400
Technical Drafting, Basic	0	No Credit Allowed	-
Technical Writing	3	DNT999TR (NOC)	46/400
Western Europe Since 1945	3	DNT999TR (NOC)	45/400
World Religions, Intro to	3	RSP213LEC	48/400

Glossary: NOC - No Comparable Course
DNT999TR- General Elective Credit
HIS999TRMOD – Modern Europe Requirement
SSC999TRHSN – Intermediate Requirement for Human Services

REVISED: 1.26.2016

Excelsior College

Excelsior (formerly Regents) College offers college-level proficiency examinations that may be considered for elective or articulated college credit if they have been recognized and evaluated for credit by the American Council on Education (ACE).

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General Certificate of Education (GCE A-Level)

GCE A-level examinations at the Advanced Level or Advanced Subsidiary Level and submitted on official score reports showing grades of “E” or better will guarantee credit will be awarded. In some cases, credit awarded may apply toward major, general education requirements, or other university degree requirements. GCE exam articulation is available on UB’s General Certificate of Education Advanced Level Exam (GCE) chart (PDF). No credit is awarded for English language exams taken in a non-native English-speaking country or taken by a student whose native language is not English.

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GCE A-Level Exam Articulation

GCE A-Level Grades	US Grades	NOTES:
A or B	A	**1. Credits granted at UB for A-level examinations are elective credits unless:** -The exam is matched by articulation to a UB course or requirement (see list below). -Any condition such as a minimum grade or petition for articulation is fulfilled. **2. No credit is granted for Ordinary Level Examinations.** **3. Grade requirement for articulation is based on the grade received on the GCE A-Level Exam, not the US grade conversion.**
C or D	B	
E	C	

GCE A-Level Examinations	Test #	Credit	UB Course Articulation and Comments
Accounting, AS Level	9706	3	ALV999TR
Accounting, A Level	9706	6	ALV999TR
Accounting, Principles of -- A Level		6	ALV999TR
Accounting, Principles of -- H2		6	ALV999TR
Akan, A Level		6	ALV999TR
Ancient History, A Level		6	CL 331 and CL 332
Applied Information and Communication Technology, A Level	9713	6	ALV999TR
Arabic, AS Level Foreign Language	8680	4	ARI201
Arabic, AS Literature		5	ARI102
Arabic, A Level	9680	8	ARI202 + ALV999TR
Art, AS Level		3	ALV999TR
Art, A Level		6	ALV999TR
Art and Design, AS Level	9704	3	ALV999TR
Art and Design, A Level	9704	6	ALV999TR
History of Art and Design, A Level	9029	6	ALV999TR
Bengali, A H1 Level		3	ALV999TR
Biblical Hebrew, A Level	9618	6	ALV999TR
Biology, AS Level	8044	3.5	ALV999TR
Biology, A Level	9044	7	ALV999TR
Biology, A H1 Level		3	ALV999TR
Biology, A H2 Level	9648	7	BIO129 or BIO130 + ALV999TR
Human Biology, AS Level	8046	3.5	ALV999TR
Human Biology, A Level	9046	7	Grade of "A" or "B" = BIO129LEC/LAB-BIO130LEC/LAB Grade of "C", "D", or "E" = ALV999TR
Business Studies, AS Level	9707	3	ALV999TR
Business Studies, A Level	9707	6	ALV999TR
Chemistry, AS Level	8701	5	Grade of "A", "B" or "C" = CHE101LR + CHE113LAB Grade of "D" or "E" = ALV999TR
Chemistry, A Level	9701	10	Grade of "A", "B" or "C" = CHE101LR + CHE113LAB + CHE102LR + CHE114LAB Grade of "D" or "E" = ALV999TR
Chemistry, A H1 Level	8872	5	Grade of "A", "B" or "C" = CHE101LR + CHE113LAB Grade of "D" or "E" = ALV999TR
Chemistry, A H2 Level	9647	10	Grade of "A", "B" or "C" = CHE101LR + CHE113LAB + CHE102LR + CHE114LAB Grade of "D" or "E" = ALV999TR
Chinese, A Level – 9609, 9715	9609, 9715	6	CHI342 + ALV999TR
Chinese History, AS Level		3	ALV999TR
Chinese History, A Level		6	ALV999TR
Chinese Language, A H1 Level		3	ALV999TR
Chinese Language (Oral/Aural),H1		3	ALV999TR
Chinese Language & Culture, AS Level	8681	3	CHI490TUT
Chinese Language and Literature,H2		6	ALV999TR
Chinese Literature, A Level		6	CHI311 + CHI322
China Studies in Chinese, H2		6	ALV999TR
China Studies in English, H1		3	ALV999TR
China Studies in English, H2		6	ALV999TR
Classical Arabic, AS Level	8603	5	ALV999TR
Classical Arabic, A Level	9603	10	ALV999TR
Classical Civilization, AS Level	8090	3	ALV999TR
Classical Civilization, A Level	9090	6	ALV999TR
Classical Greek, AS Level	8240	5	ALV999TR
Classical Greek, A Level	9240	10	ALV999TR
Commerce and Finance, A Level		6	ALV999TR
Computer Applications, AS Level		3	CSE101
Computing Studies, AS Level	8105	4	CS 111
Computing Studies, A Level	9105	8	CS 113 + CS 114

GCE A-Level Exam Articulation

Design and Technology, AS Level	8110	3	ALV999TR
Design and Technology, A	9351	6	EAS150 + ALV999TR
Divinity, A level	9011	6	ALV999TR
Economics, A Level	9708	8	Grade of A or B = ECO181 + ECO 182
Economics, A Level	9708	6	Grade of C, D, E = ALV999TR
Economics, A H1 Level		3	ALV999TR
Economics, A H2 Level		8	Grade of A or B = ECO181 + ECO 182
Economics, A H2 Level		6	Grade of C, D, E = ALV999TR
Economics & Business Studies, A Level		6	ALV999TR
Economic & Public Affairs, A Level	9072	6	ALV999TR or Course articulation by interview in Economics Department
Electronics, AS Level		3	EE 101
Engineering Science, A Level		8	PHY101-102 (no labs)
English, A Level - 9002	9002	6	ENG999TR300
English Language & Linguistics, H2		6	ALV999TR
English Literature, Adv Supplementary		3	ENG999TR300
English Literature, A Level	9000, 9003, 9005, 9172, 9173	6	ENG999TR300
English, Use of ; AS Level (HKEA)		0	No credit; results are not acceptable in lieu of TOEFL scores
Environmental Management, AS	8291	6	3 Credits SSC490+ 3 Credits SSC999TRRES, Environmental Resources. (Also waive Natural Sciences Core requirement for GLY 101-102 in the Social Science Interdisciplinary, Environmental Studies Major.)
Ethics & Religious Studies, AS Level		3	ALV999TR
Food Studies		6	ALV999TR
French, AS Level	8195	5	ALV999TR
French, A Level	9195	6	FR 211 + FR 212
General Paper, AS	8001,8004 & 8009	3	ALV999TR
General Paper, A Level		6	ALV999TR
General Paper, A H1 Level		3	ALV999TR
General Studies, A Level	9374	6	ALV999TR
General Studies in Chinese, A H1 Level		3	ALV999TR
Geography, AS	8696	3	ALV999TR , Articulation by Interview in Department
Geography, A Level	9202, 9696	9	GEO101 + GEO102 + GEO103
Geography, A H1 Level		3	ALV999TR , Articulation by Interview in Department
Geography, A H2 Level		9	GEO101 + GEO102 + GEO103
Geometrical and Mechanical Drawing, A Level	9351	6	EAS150 + ALV999TR
German, AS Foreign Language	8683	3	GER337
German, AS Literature	8671	3	GER338
German, A Level	9683	6	GER337 + GER338
Government and Politics, AS Level	8071	3	PSC103
Government and Politics, A Level	9071	6	PSC340+ ALV999TR
Gujarati, A H1 Level		3	ALV999TR
History, Supplementary A Level		3	ALV999TR
History, A Level	9020, 9021	6	ALV999TR
History, A H1 Level		3	ALV999TR
History, A H2 Level		6	ALV999TR
Graphical Communication, A Level	9116	6	ALV999TR
Hindi, A Supplemental	8620	3	ALV999TR
Hindi, A Level	9620	6	ALV999TR
Islamic Law, A Level		6	ALV999TR
Islamic Theology, A Level		6	ALV999TR
Italian, AS Level	8335	5	ALV999TR
Italian, A Level	9335	10	ALV999TR
Japanese, A Level	9623	10	ALV999TR
Knowledge and Inquiry, H2		6	ALV999TR
Language & Literature in English, AS Level	8699	3	ENG999TR300
Law, AS Level	8345	3	ALV999TR
Law, A Level	9084	6	PSC215 + SSC999TRLSU
Liberal Studies, AS Level		3	ALV999TR
Literature in English, AS Level	8694	3	ENG999TR300
Literature in English, A Level	9695	6	ENG999TR300
Literature in English, A H1 Level		3	ENG999TR300
Literature in English, A H2 Level		6	ENG999TR300
Malay Language, A H1 Level		3	ALV999TR
Malay Language (Oral/Aural), A H1 Level		3	ALV999TR
Malay Language and Literature, A H2 Level		6	ALV999TR

GCE A-Level Exam Articulation

Malay, A Level		6	ALV999TR
Management of Business, A Level	9368	6	ALV999TR
Applied Mathematics, AS Level		4	ALV999TR
Applied Mathematics, A Level		8	ALV999TR
Mathematics, AS Level	8428	3	ALV999TR
Mathematics, A Level	9232	8	MTH141 OR MTH131 + ALV999TR
Mathematics, A Level	9420, 9421, 9422	8	MTH141 + ALV999TR
Mathematics, A H1 Level		3	ALV999TR
Mathematics, A H2 Level		8	MTH121 + MTH122
Mathematics C, A Level		8	MTH121 + MTH122
Mathematics & Statistics, AS Level		3	STA111
Pure Mathematics, AS Level	8429	4	MTH141
Pure Mathematics, A Level	9423	8	MTH141 + MTH142
Further Mathematics, A Level	9425	12	MTH141 + MTH142 + ALV999TR
Mechanics, A Level	9424	6	ALV999TR
Modern Greek, AS Level	8615	3	GRE195
Modern Greek, A Level	9615	6	GRE196 + ALV999TR
Modern Hebrew, A Level	9617	6	ALV999TR
Music, AS Level	9703, 8663	5	ALV999TR
Music, A Level	9703	10	ALV999TR
Ndebele, A Level	9628	6	ALV999TR
Physical Science, A Level	9273	6	ALV999TR
Physics, AS Level	8702	5	ALV999TR
Physics, A Level	9702	10	PHY101 +PHY151+ PHY102 + PHY152
Physics, A H1 Level		5	ALV999TR
Physics, A H2 Level		10	PHY101 +PHY151+ PHY102 + PHY152
Polish, A Level	9632	6	ALV999TR
Politics and Government, A Level	9080	6	PSC103+ ALV999TR
Portuguese, A Level	9122	10	ALV999TR
Project Work, A H1 Level		3	ALV999TR
Psychology, AS Level		3	ALV999TR or See Psychology Department for possible course articulation
Psychology, A Level		6	PSY101 + ALV999TR
Public Affairs, A level	9073	6	PSC100 + ALV999TR
Religious Studies, A Level	9010	6	RSP213 + ALV999TR
Russian, AS Level	8575	5	ALV999TR
Russian, A Level	9575	10	ALV999TR
Shona, A Level	9639	6	ALV999TR
Sociology, AS Level	8699	3	SOC101
Sociology, A Level	9699	6	SOC101 + ALV999TR
Spanish, AS	8595	3	ALV999TR
Spanish, A Level	9120	6	ALV999TR
Statistics, AS Level	8430	3	ALV999TR
Statistics, A Level	9427	8	STA119 + ALV999TR
Tamil, A Level	9166	6	ALV999TR
Tamil, AH1 Level		3	ALV999TR
Tamil, A H2 Level		6	ALV999TR
Theatre Studies and Drama, A Level	9372	6	ALV999TR or Contact Department of Theatre and Dance for articulation by interview, audition, portfolio review
Thinking Skills, AS		3	PHI115
Translation (Chinese), A H2 Level		6	ALV999TR
Turkish, AS Level	8646	3	ALV999TR
Turkish, A Level	9646	6	ALV999TR
Urdu, A Level	9645	6	ALV999TR
West Africa Traditional Religion, A Level		6	ALV999TR

10/4/2019

Glossary

ALV999TR - A-Level General Elective Credit
ENG999TR300 - 300- Level English Elective Credit
SSC999TRLSU - Advanced Requirement for Legal Studies
SSC999TRRES - Environmental Resources SSC

Global Assessment Certificate (GAC)

An official score report from ACT Education Solutions showing a minimum score of 70 and considered university-level by UB will guarantee credit will be awarded. In some cases, credit awarded may apply toward major, general education requirements, or other university degree requirements. GAC credit awards are listed on UB's Global Assessment Certificate (GAC) (PDF).

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University at Buffalo The State University of New York

Global Assessment Certificate Exam Articulations

Exam Code	GAC Exam Title	Credit Award	UB Course Articulation	Required Min Score	Comments
GAC005	Computing I: Introduction to Computing for Academic Study	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC006	Business, Science and Social Science I: Communication Skills	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC010	Mathematics II: Probability, Statistics & Finance	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC011	Computing II: Data Management	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC012	Business II: Business Studies	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC014	Academic English III : Listening and Speaking	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC015	Academic English III : Reading and Writing	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC016	Mathematics III: Calculus & Advanced Applications	3	MTH141LR	70	
GAC017	Computing III: Digital Communication	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC022	Business III: International Business Studies	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC023	Science III: General Science	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC027	Social Science II: Identity and Interaction in Society	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department
GAC028	Social Science III: Research Skills and Global Issues	3	GAC999TR	70	No comparable course (NOC) has been identified by this UB department

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GLOSSARY

GAC999TR Elective Credit

International Baccalaureate

Students who have completed an IB diploma with a score of 30 or higher will be awarded 30 credits. In some cases, credit awarded may apply toward their UB degree, and according to faculty-approved exam articulation, toward their major and general education requirements. IB diploma holders may contact the Office of the Registrar at 716-645-5698 for information about the evaluation of their IB diploma and exams.

Students who have completed an IB diploma with a score of 29 or less and students who did not complete a diploma are guaranteed credit for higher-level IB exams with scores of “5” or better. In some cases, the credit awarded will apply toward their UB degrees and according to faculty-approved exam articulation, toward their major and general education requirements. Articulation of IB higher-level exams for these students is available on UB’s International Baccalaureate (IB) chart (PDF).

No credit is awarded for IB English language exams taken in a non-native English-speaking country or by a student whose native language is not English. A maximum of 30 credits may be awarded for an IB diploma or IB exams.

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University at Buffalo The State University of New York

2019 – 2020 International Baccalaureate (IB) Exam Articulation

IB Exams	Credit	UB Course Articulation and Comments	Minimum Score
Anthropology, Social and Cultural, HL	6	APY106LEC + IBC999TR	5
Arabic Language B, HL	6	IBC999TR	5
Visual Arts, HL	6	ART999TRSAE + IBC999TR	5
Biology, HL	7	BIO129LEC + BIO129LAB + BIO130LEC + BIO130LAB	5
Business & Management, HL	6	IBC999TR	5
Business & Organization, HL	6	MGG150LEC + IBC999TR	5
Chemistry, HL	10	CHE101LR + CHE113LAB + CHE102LR + CHE114LAB	5
Chinese A1, HL	6	IBC999TR	5
Chinese B, HL	6	IBC999TR	5
Classical Languages: Greek, HL	6	GR201LEC + GR202LEC	5
Classical Languages: Latin, HL	6	LAT201LEC + LAT202LEC	5
Computer Science, HL	8	IBC999TR	5
Dance, HL	6	IBC999TR	5
Design Technology, HL	6	IBC999TR	5
Economics, HL	7	ECO181LD + IBC999TR	5
English A2, HL	6	ENG999TR200 + IBC999TR	5
English A1, HL	6	ENG999TR200 + IBC999TR	5
English B, HL	0	No credit (English language course)	-
Environmental Systems	6	IBC999TR	5
Filipino Language A2, HL	6	IBC999TR	5
Film, HL	6	IBC999TR	5
French A2, HL	6	FR301LEC + FR302LEC	5
French B, HL	6	FR151LEC + FR152LEC (With possible match to FR 211, for 9 credits total, consult Department.)	5
Geography, HL	6	GEO101LEC + GEO102LEC	5
Global Politics, HL	6	IBC999TR	5
Hindi B, HL	6	IBC999TR	5
History of Africa, HL	6	HIS213LEC* + HIS999TRAAL*	5
History of Americas, HL	6	(HIS161LR* or HIS162LR*) + HIS999TRUSH*	5
History of East/Southeast Asia and Oceania, HL	6	(HIS181LR* or HIS182LR*) + HIS999TRAAL*	5
History of Europe, HL	6	HIS999TRMOD*	5
History of South Asia & The Middle East, HL	6	IBC999TR	5
Indonesian A2, HL	6	IBC999TR	5

Information Technology in a Global Society, HL	6	IBC999TR	5
Islamic History, HL	6	IBC999TR	5
Japanese B, HL	8	JPN201LEC + JPN202LEC	5
Korean B, HL	8	KOR201LEC + KOR202LEC	5
Mathematics, HL	8	MTH121LR	5
Mongolian A1, HL	6	IBC999TR	5
Music, HL	6	MUS213LEC + MUS214LEC Non-majors (or see department for placement in major requirements by exam, audition and portfolio review)	7
Music, HL	6	MUS115LEC + MUS116LEC Non-majors (or see department for placement in major requirements by exam, audition and portfolio review)	5 (or 6)
Philosophy, HL	6	PHI256LEC + IBC999TR	5
Physics, HL	13	PHY101LR+ PHY151LAB + PHY102LR + PHY152LAB + IBC999TR	5
Psychology, HL	6	PSY101LEC + IBC999TR	5
Spanish A1, HL	6	SPA210LEC + IBC999TR (possible SPA207LEC, consult the Department of Romance Language and Literature)	5
Spanish Language A2, HL	6	SPA208LEC + SPA210LEC	5
Spanish Language B, HL	6	SPA151LEC + SPA152LEC (possible SPA207LEC for 9 credits total, consult the Department of Romance Language and Literature)	5
Sports, Exercise and Health Science; HL	6	IBC999TR	5
Swahili Language B, HL	6	IBC999TR	5
Thai Language A2, HL	6	IBC999TR	5
Theatre Arts, HL	6	TH999TR100	5
Vietnamese Language A1, HL	6	IBC999TR	5
World History Topics of the Twentieth Century, HL	6	IBC999TR	5
World religions, HL	6	IBC999TR	5
* Credit will be given toward appropriate concentration and distribution requirements in the History major or minor but not toward the overall requirement of 12 courses/36 credits hours for completion of the History major			

Glossary:

ART999TRSAE: Studio Elective Credit for Art major

ENG999TR200: 200-level literature course

HIS999TRAAL: Asian/African/Latin Am. area requirement for History

HIS999TRMOD: Modern European Area

HIS999TRUSH: Early History Area

IBC999TR: General Elective Credit

TH999TR100: 100 Level Elective –Theatre Major

Military Credit

Elective credit may be awarded for basic training and for certain approved educational experiences in the armed forces. UB students with military credit should contact the Office of the Registrar at 716-645-5698 for more information.

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UB College Credit Examinations

Students who are enrolled (matriculated) at UB may earn course credit by passing examinations administered by UB academic departments. These exams are comparable to final examinations. Departments determine whether to administer such examinations for their courses. Students applying for these exams must have a minimum overall GPA of 2.0 and cannot be graduating seniors. UB college examination credit will not be awarded for exams that duplicate a college course, or its equivalent, for which a student has previously received credit. UB college examination credit will not be awarded for exams when a student has completed more advanced study beyond the level covered by an exam. Students who wish to determine their eligibility for these examinations should meet with an advisor who can verify their eligibility for exams on the Application for Undergraduate Credit by Examination (PDF). Students must also talk to the academic departments about availability of exams and then follow instructions on the application form. A fee is charged.

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Criterion 1. Students

F. Graduation Requirements

Included policies and documents

- UB Degree Requirements (Section F.1.a)
- UB Curriculum Requirements (Section F.1.c)
- Program Degree Requirements (Section F.1.d)

University Degree Requirements

University Degree Requirements

Students must obtain a minimum of 120 credits whereby at least 30 credits must be completed at UB, per the Academic Residency Requirement policy. In addition, a maximum of the following credit limits are allowed:

- 30 credits of S/U coursework,
- 18 credits of tutorial coursework
- 8 credits of Athletics Activity coursework
- 0 credits of ESL/ULC coursework from among ESL 101, 102, ULC 101, 103, 104, 161, 164, 254
- 6 credits of UE 141

Courses taken beyond the University Undergraduate Limits will not be counted towards the credit required for graduation.

Students must also have a minimum cumulative GPA of 2.000, both at UB and Overall (transfer GPA plus UB GPA).

Students must satisfy all requirements of the UB Curriculum (our general education program) and must fulfill all major requirements.

Students continuously enrolled at UB or on an official Leave of Absence from UB are governed by the university requirements (e.g., UB Curriculum) stated in the catalog in effect at the time of their initial matriculation in the university. For example, students who enter the university in fall 2020 and are continuously enrolled through graduation must meet the baccalaureate degree requirements as stated in this 2020-2021 catalog.

Program Requirements

Students continuously enrolled in a particular degree program (major, minor, or concentration) or on an official Leave of Absence from the program are governed by the requirements of that program as stated in the catalog in effect at the time of their initial entrance into the program. For example, students who are accepted into a major during the fall 2020 semester and are continuously enrolled through graduation must meet the requirements for the major as stated in this 2020-2021 catalog.

Either the university or a program may find it necessary to update requirements for students who have been enrolled in the university or in a program for an extended period.

Breaks in Student Enrollment

Students who leave the university or a major degree program for one or more semesters without an official Leave of Absence are governed by the requirements stated in the catalog in effect at the time of their most recent readmission to the university or to the major program.

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The UB Curriculum

Our Innovative, Student-centered Approach to General Education

The UB Curriculum is a program of core study built around intellectual discovery and integrative learning. It emphasizes critical thinking, ethical reasoning, global learning, and strong communication skills, providing the tools students need to succeed in their professional lives and to meet the responsibilities of citizenship in a diverse and interconnected world. The Program consists of four main components — UB Seminar, Foundations, Pathways and Capstone — and comprises 40 credits of study for all students, irrespective of major. To learn more about each of these components, please visit the UB Curriculum website.

Upon completion of the UB Curriculum students will:

1. Attain and apply knowledge in written, oral and visual communication; mathematics and quantitative reasoning; and natural sciences.
2. Acquire, apply, analyze, evaluate and integrate knowledge from a wide range of disciplines.
3. Attain and apply critical thinking skills to define and solve problems.
4. Demonstrate an understanding of human and cultural diversity within local and global contexts.
5. Acquire the knowledge, skills, technologies, ethical judgment and personal responsibility for effective citizenship, professional leadership, and lifelong learning.

Students completing a degree encompassing the UB Curriculum and major requirements will also have met all the expected learning outcomes for the State University of New York General Education Requirements. SUNY General Education Requirement designations for UB courses may be found at TAURUS.

UB Curriculum Requirements

- **UB Seminar**
- **Foundations**
  - Communication Literacy I
  - Communication Literacy II
  - Mathematical and Quantitative Reasoning
  - Scientific Literacy & Inquiry
  - Diversity in the United States
- **Pathway Courses**
- **UB Capstone**

UB Seminar

Complete any academic department's UB Seminar course numbered 199.

The following students should complete any academic department's UB Seminar course numbered 198:

- Transfer students entering UB with 45 or more credits from an accredited domestic institution.
- Reentering students who have completed 45 credits or more of coursework (either transfer or UB credits) prior to their reentry to UB.
- Reentering students who have completed one of the following courses prior to fall 2016: CAS 101, CPM 101, CPM 203, EAS 140, HON 102, UBE 101, UBE 102(Leadership House section only), UE 101, UE 140, or UE 141.

All students are required to complete their UB Seminar during their first semester of enrollment. Students who resign or fail the UB Seminar may not be able to retake the course during the fall or spring semester, per the Course Enrollment Control Policy.

Any student who fails, resigns, or withdraws from the UB Seminar in their first semester at UB must complete it within one year of their start at UB.

Retaking UB Seminar

First semester at UB:	Must re-take UBS before:
Fall 2020	Fall 2021
Spring 2021	Spring 2022

Communication Literacy I

Complete ENG 105.

Students may fulfill this requirement based on UB evaluation of AP English Language and Composition, SAT, or ACT test scores. Based on TOEFL or IELTS scores, some students may be required to complete ENG 100 as a prerequisite to ENG 105.

Communication Literacy II

Complete one course from the list below. Some of the approved Communication Literacy II courses also serve as a major requirement (indicated with an asterisk).

- AAS 320: Research Methods*
- AMS 364: Research Methods*
- APY 408: Ethnographic Field Methods
- BIO 387: Communicating in Biology
- BIO 487: Honors Research Methods

- CL 205: Heroes
- CL 209: Writing Across the Curriculum: Classics
- COM 300: Written Communications
- DMS 413: Filmic Text: Color & the Moving Image
- DMS 480: Social Media & Networks
- EAS 360: STEM Communications*
- END 350: Environmental Design Workshop 1*
- ENG 202: Technical Communication
- ENG 204: Writing about the Environment
- ENG 205: Writing for Change
- ENG 207: Introduction to Writing Poetry and Fiction
- ENG 208: Writing about Literature
- ENG 209: Writing about Science
- ENG 210: Professional Writing
- ENG 212: How to Write Like a Journalist
- ENG 285: Writing in the Health Sciences
- FR 343: Advanced Communication for Students of French*
- GLY 206: Geological Mapping Techniques and Communication*
- HIS 301: Historical Writing
- ITA 322: Advanced Communication for Students of Italian*
- JDS 203: Money & Ethics
- JDS 385: Maimonides: The Guide of the Perplexed
- JDS 396: Science and Politics in Jewish Thought
- LAI 301: Composing in Human Sciences
- LIN 356: Introduction to Contemporary Theories of Metaphor
- MGG 303: Communication Literacy for Business*
- MT 426: Technical Communications for the Scientific Professional*
- NSG 348: Evidence Based Practice and Nursing Research*
- PHC 330/331: Case Studies in Pharmaceutical Sciences and Pharmaceutical Sciences Writing Lab*
- PHI 301: Writing Philosophy
- PSY 295: Communicating for Psychological Sciences
- SOC 421: Writing Sociologically
- SPA 314: Advanced Communication for students of Spanish*
- SSC 230: Communicating for Health and Human Service Professionals*
- TH 201: Script Analysis*
- TNS 209: Writing Human and Social Diversity
- TNS 210: Writing Across Cultures

Mathematical & Quantitative Reasoning

Complete one course from the following list:

Recommended Courses for Students Who Are Not Meeting a Specific Requirement of a Major

- CSE 111: Great Ideas in Computer Science 1
- LAI 111: Math Reasoning and Communication

- MTH 101: Introduction to Contemporary Mathematics
- STA 119: Statistical Methods
- ULC 148: Intermediate Algebra and Trigonometry
- CEP 207: Introduction to Statistics and Computing

Additional Courses that Satisfy the Mathematical & Quantitative Reasoning Requirement

- GEO 211: Univariate Statistics in Geography
- MGQ 201: Introduction to Statistics for Analytics
- MTH 115: Survey of Algebra and Trigonometry
- MTH 121: Survey of Calculus and Its Applications 1
- MTH 122: Survey of Calculus and Its Applications 2
- MTH 131: Math Analysis for Management
- MTH 141: College Calculus 1
- MTH 142: College Calculus 2
- MTH 153: Honors Calculus 1
- MTH 154: Honors Calculus 2
- NSG 295: Statistics for Health Care
- PHI 215: Symbolic Logic
- PSC 408: Basic Statistics for Social Science
- PSY 207: Psychological Statistics
- SOC 294: Basic Statistics for Social Sciences

Scientific Literacy & Inquiry

Students must complete at least 7 credits, including at least one credit of laboratory, from the following chart. Laboratory courses must be from the same subject area as one of the completed lecture courses.

Scientific Literacy & Inquiry

Column A	AND Column B

2 lecture courses required:

- ARC 352LEC*
- BIO 129LEC
- BIO 130LEC
- BIO 200 (Lab included)
- BIO 201
- CHE 101
- CHE 102
- CHE 105 (Lab included)
- CHE 107
- CHE 108
- ES 207 (Lab included)
- GEO 101
- GEO 104
- GEO 106
- GLY 101
- GLY 102
- GLY 103
- NTR 108
- NTR 109
- PAS 113 (Lab included)*
- PHY 101
- PHY 102
- PHY 107
- PHY 108
- PHY 117
- PHY 118
- PHY 121

*ARC 352 and PAS 113 cannot be paired.

1 lab course required:

- ARC 352LAB
- BIO 129LAB
- BIO 130LAB
- BIO 211LAB
- CHE 113
- CHE 114
- CHE 127 & CHE 128
- GEO 105
- GLY 105
- NTR 110
- PHY 123
- PHY 151
- PHY 152
- PHY 158
- Any lecture course from Column A that indicated "Lab included"

Diversity in the United States

Complete at least one course from the following list. The course used to complete the Diversity in the United States requirement may also be used to fulfill another UB Curriculum requirement if that course also fulfills another UB Curriculum requirement as outlined in this catalog.

Pathways

Complete one Thematic AND one Global Pathway from the list of approved topics.

For the Global and Thematic Pathways, complete one course from each list within the chosen Topic. Each Pathway must include at least 9 credits or 3 courses. If a language is elected for the Global Pathway, some topics may only include 2 courses to satisfy the 9 credit requirement.

Except for the language Topics in the Global Pathway, each Pathway must include courses from at least 2 different subjects. For example, all 3 Thematic Pathway courses may not be from Psychology (course subject: PSY).

When completing each Pathway, students are required to cover at least 2 different UB Areas. If a course is designated as fulfilling more than one UB Area, students may use that course to satisfy only one of those UB Areas.

The UB Areas include:

- Arts
- Civilization & History
- Humanities
- Languages
- Social Sciences

The Thematic Pathway courses should cover 2 different UB Areas than those covered by the Global Pathway. Thus, students need to complete at least 4 different UB Areas via their Pathways courses.

Students must use the Path Finder to select their Pathway courses. Students are encouraged to do so early in their careers in consultation with their Academic Advisor. If a student selects a particular Pathway via the Path Finder but then fulfills a different series of courses, s/he must update his/her selection in the Path Finder.

Transfer students may use transfer coursework that fulfills a UB area. Transfer students will be able to view such coursework in their Path Finder.

UB Capstone

Complete UBC 399. All other UB Curriculum components must be complete or in progress in order to enroll in the UB Capstone. UB Seminar is a prerequisite to UBC 399 and therefore cannot be taken concurrently. The Capstone will require reflection on all components of the UB Curriculum. Any student enrolled in UBC 399 who does not meet the enrollment requirements will be dropped from the course.

General Education Policies

Students entering prior to fall 2016 should reference the General Education Requirements in the Undergraduate Catalog from the year of their matriculation at the University at Buffalo. Students who entered UB's Singapore Institute of Management prior to fall 2017 will adhere to the General Education Requirements in the 2015-2016 Undergraduate Catalog.

Students entering or reentering UB who have previously earned a bachelor's degree from an accredited US college or recognized foreign institution will not be required to complete the UB Curriculum when earning their subsequent degree.

Reentering Students

Reentering students may be allowed to graduate under the general education program in effect during their previous enrollment at UB if one of the two following conditions has been met. They may do so by submitting a General UBC Petition Form.

- If a student's previous catalog year is 2002-2015, and his/her course requirements for the UB General Education program that was in place at the time of his/her previous entry have already been completed, he or she may graduate with the original General Education requirements.
- If a student's previous catalog year was 2002-2015, and s/he was within 3 courses of completion of the previous general education course requirements when s/he was last enrolled at UB, s/he may complete the remaining courses and graduate with the previous general education program.

Reentering students whose initial catalog year pre-dates 2002 will adhere to the general education program that is active at the time of their reentry regardless of the number of courses completed prior to their break in attendance. Students should review their previous coursework with an academic advisor for potential application to the UB Curriculum via course substitution. A Pre-2002 Curriculum Mapping Form should be submitted for these requests.

Course Applicability

With the exception of the Diversity Learning requirement, a given course may be applied toward only one UB Curriculum requirement.

Courses in which the student opts for S/U grading may not be used to satisfy UB Curriculum requirements.

Internship, independent study, undergraduate teaching, experiential learning, and other courses not based on classroom experiences may not be used to meet UB Curriculum requirements.

Curriculum requirements.

Transfer Coursework and Test Credit

Transfer courses from accredited institutions and other alternative credits that articulate directly to the specified courses listed for each respective UB Curriculum requirement may be used to fulfill that particular requirement.

SUNY has established minimum General Education requirements for campuses across the SUNY system. Students should understand that meeting SUNY General Education requirements at other campuses does not mean that they have completed the UB Curriculum.

A SUNY General Education Transcript Addendum (GETA) will be accepted as meeting the relevant UBC requirement, regardless of the direct course it articulates to at UB, if the GETA is earned prior to matriculation (for new students) or re-matriculation (for reentering students) at the University at Buffalo. For such students, SUNY GETAs will apply to the UB Curriculum as follows:

- Basic Communication will fulfill the Communication Literacy 1 requirement.
- Mathematics will fulfill the Math and Quantitative Reasoning requirement.
- Natural Sciences will fulfill one lecture course of the Scientific Literacy and Inquiry requirement. (Articulated courses may be used to fulfill the remainder of this requirement.)
- American History, Arts, Foreign Language, Humanities, Other World Civilizations, Social Sciences, and Western Civilization may be used to fulfill 2 of the 3 courses required for the Thematic or Global Pathway. (Articulated courses may be used to fulfill the remainder of this requirement.)

When courses are taken elsewhere while a student is matriculated at UB, only the direct course articulation will apply to the UBC/General Education requirement. GETAs earned by UB students during their matriculation at UB will not be applied. This includes (but is not limited to) GETAs earned at other institutions via cross registration, while on Leave of Absence, or during summer or winter sessions of an academic year during which the student is an active UB student.

UB students transferring to other SUNY schools will be awarded a SUNY GETA as follows:

- Communication Literacy 1 fulfills Basic Communication.
- Math and Quantitative Reasoning fulfills Mathematics.
- The first lecture course for Scientific Literacy and Inquiry fulfills Natural Sciences.
- Pathways and Diversity Learning courses fulfill American History, Arts, Foreign Language, Humanities, Other World Civilizations, Social Sciences, and/or Western Civilization.

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Completing the Mechanical Engineering BS Program

Academic Requirements

Students seeking an undergraduate degree from the School of Engineering and Applied Sciences must have a minimum GPA of 2.000 in technical classes (engineering, math, and science classes). To maintain academic standards and determine eligibility for continued enrollment, the School of Engineering and Applied Sciences reviews the academic records of all students in an approved undergraduate SEAS major. This academic review is conducted at the end of each fall and spring semester.

View the School of Engineering and Applied Sciences Academic Review Policy

Academic Advice

Advisement tools available for our students:

- **Course Flowsheets:** These interactive online flowsheets will highlight pre-requisite and co-requisite courses to help identify which courses must be completed. See the Course Prerequisite Policy for details.
- **Changing Majors within the School of Engineering and Applied Sciences**: Students may change majors and minors within the School of Engineering and Applied Sciences if they meet the relevant criteria. Students should submit the Major/Minor Change Application before the appropriate deadline. View School of Engineering and Applied Sciences Major/Minor Change Information.
- **UB Curriculum Pathway Selection:** Pathways are a central component of the UB Curriculum. Students are required to complete both a Global and Thematic pathway. Each pathway requires a minimum of 9 credit hours, typically satisfied by completing three courses of three or more credit hours. View Pathway Information for Engineering and Computer Science Students.

Transfer Credit Policy

Transfer students must first apply to the university and meet the university transfer admission requirements. SUNY Seamless Transfer is a SUNY-wide program intended to make transferring to UB and other SUNY Schools simple and efficient. Information about the Transfer Path for this major can be found on the SUNY website. Students are encouraged to contact their academic advisor or department to discuss how their coursework will apply to their degree.

Transfer students who have completed an engineering science program at a community college or the first three years of a 3+2 program at a four-year college can typically expect to enter the third year of an engineering program at the University at Buffalo. Graduates of technology programs receive limited transfer credit and can expect three to four years of study at the university to complete the requirements.

Residency Requirement

Students seeking an undergraduate engineering degree from the School of Engineering and Applied Sciences must complete 30 undergraduate credit hours of junior/senior level courses required in their major at the University at Buffalo.

Prerequisite Courses

Please see the School of Engineering and Applied Science admissions policies listed above.

Required Courses

CHE 107 General Chemistry for Engineers
EAS 199 Engineering Principles
EAS 202 Engineering Impact On Society
EAS 207 Statics
EAS 208 Dynamics
EAS 209 Mechanics of Solids
EAS 230 Engineering Computations
EAS 360 STEM Communications
EAS 200 EE Concepts/Non-majors or EE 202 Circuit Analysis
MAE 177 Introduction to Engineering Drawing and CAD
MAE 204 Thermodynamics
MAE 277 Introduction to Mechanical Engineering Practice
MAE 311 Machines and Mechanisms
MAE 334 MAE Laboratory
MAE 335 Fluid Mechanics
MAE 336 Heat Transfer
MAE 338 MAE Laboratory II
MAE 340 Dynamic Systems
MAE 364 Manufacturing Processes
MAE 376 Applied Math for MAE
MAE 377 Product Design in a CAE Environment
MAE 381 Engineering Materials
MAE 385 Engineering Materials Laboratory
MAE 451 Design Process and Methods
MAE 494 Design Project
MTH 141 Calculus 1
MTH 142 Calculus 2
MTH 241 Calculus 3

MTH 306 Differential Equations
PHY 107 General Physics 1
PHY 108 General Physics 2/PHY 158Physics 2 Lab
One applied math elective
Three MAE technical electives
Two courses from either Professional Practice Track or Science and Math Track

**A maximum of 6 total credits are permitted from all of the courses EAS 496, MAE 496, MAE 498, and MAE 499 combined.

Electives and Course Groupings

Students will elect to take either the Professional Practice track or the Science and Mathematics track; mixing of tracks is not permitted. The Professional Practice track has a series of courses drawn from different departments across the university and stresses disciplines such as professional communication, economics and business, the environment, and similar. Some courses may require force registration through the department offering the course. Please contact that department directly. The Science and Mathematics track increases the exposure of the student to these areas over and above the usual requirements for the BSME degree, and may be useful for students who are considering Graduate Studies (MS, PhD).

MAE Technical Electives (TEs)

Any 300/400 level 3-credit course in MAE that is not a required course qualifies as an MAE technical elective. Any exemption from this three-course requirement must be approved in advance by the director of undergraduate studies. Any course that substantially duplicates the material presented in another course that is being counted toward the degree cannot be used to satisfy the TE requirement.

Applied Math Elective

- EAS 305 or MTH 411** Applied Probability or Probability Theory
- CIE 308 Engineering Statistics
- MAE 425 Spacecraft Dynamics and Control
- MAE 428 Analytical Methods
- MTH 309 Introductory Linear Algebra
- MTH 411 Probability Theory
- MTH 417 Survey of Multivariable Calculus
- MTH 418 Survey of Partial Differential Equations

**cannot take both under any circumstances

Professional Practice Track

- CIE 303 Geodesy, GPS, and GIS
- CIE 340 Environmental Engineering
- COM 317 Business/Professional Communication
- EAS 496 Engineering Co-op
- ECO 405 Microeconomic Theory
- ECO 406 Topics in Microeconomics
- ECO 469 Industrial Organization
- ECO 470 Economics of Regulation
- GEO 333 International Trade
- GEO 334 International Environments and Commercial Problems
- IE 320 Engineering Economy
- IE 323 Human Factors in Systems Design
- IE 326 Planning for Production
- MAE 434 Aircraft Design
- MGO 365 Technology Entrepreneurship
- MGO 463 Entrepreneurship Lab
- MAE 496 Engineering Internship

Science and Mathematics Track

- BIO 200 Evolutionary Biology
- BIO 201 Cell Biology & BIO 211 Cell Biology Lab
- CHE 108 General Chemistry for Engineers
- CHE 201 Organic Chemistry
- EAS 305 or MTH 411** Applied Probability or Probability Theory
- PHY 207 General Physics III
- PHY 301 Intermediate Mechanics I
- PHY 302 Intermediate Mechanics II
- PHY 403 Electricity and Magnetism I
- PHY 405 Thermal and Statistical Physics I
- All MTH 300/400-level courses except MTH 337, MTH 399, MTH 437, MTH 438, and MTH 49X courses.

**cannot take both under any circumstances

Total Credit Hours Required

Total credit hours required for the Mechanical Engineering BS degree

Credits Required for Major	111
Additional Credits Required for UB Curriculum	17
Additional Credits Required for Electives	0
Total Credits Required for Degree	128

Students should consult with an academic advisor to determine how any transfer or exam credit might be utilized in meeting general education, prerequisite, or major requirements.

See Baccalaureate Degree Requirements for general education and remaining university requirements.

Total Credit Hours Required represents the minimum credits needed to complete this program, and may vary based on a number of circumstances. This chart should not be used for financial aid purposes.

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