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

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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 MAE 177 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](http://www.buffalo.edu/internationaladmissions/get-ready-to-apply/admissions-criteria.html#title_1-1))

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](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


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.

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.

![Diagram of review processes](image)

*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

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.

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

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.

![Figure 1.6. Image of the freshman view of the public flowsheet.](image-url)
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.
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.
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](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](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](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](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](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

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall Semester</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAS 109SL UB Seminar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHE 107LLR Gen Chem for Engineers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTH 144LR College Calculus 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pathway or ENG 105LEC Writing and Rhetoric</td>
<td></td>
<td>Pathway or ENG 105LEC Writing and Rhetoric</td>
</tr>
<tr>
<td></td>
<td>P or CLI</td>
<td>P or CLI</td>
</tr>
<tr>
<td>Total Credits: 14 or 15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M/UBS</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>M/SLI</td>
<td>M/SLI</td>
</tr>
<tr>
<td></td>
<td>M/MQR</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>M</td>
</tr>
</tbody>
</table>
### Sophomore Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Category</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAS 207LR Statics</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE 204LR Thermodynamics 1</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MTH 241LR College Calculus 3</td>
<td>M</td>
<td>4</td>
</tr>
<tr>
<td>PHY 106LR General Physics 2</td>
<td>M</td>
<td>4</td>
</tr>
<tr>
<td>PHY 158LAB General Physics Lab 2</td>
<td>M</td>
<td>1</td>
</tr>
<tr>
<td>MAE 277LEC Intro to ME Practice</td>
<td>M</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits: 18**

<table>
<thead>
<tr>
<th>Spring Semester</th>
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<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 200</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>EAS 206LR Dynamics</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>EAS 206LR Mechanics of Solids</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MTH 306LR Intro Diff Equations</td>
<td>M</td>
<td>4</td>
</tr>
<tr>
<td>Pathway</td>
<td>P</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits: 16**

### Junior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Category</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 377LLB Product Design—CAE Envlm</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE 340LEC Dynamic Systems</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE 335LR Fluid Mechanics</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE 376LLB Applied Math for MAEs</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE 386LEC Enging Materials 1</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>EAS 360LEC STEM Communications</td>
<td>M</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits: 18**

<table>
<thead>
<tr>
<th>Spring Semester</th>
<th>Category</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 311LEC Machines &amp; Mechanisms 1</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE 364LEC Manufacturing Processes</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE 336LEC Heat Transfer</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE 385LAB Enging Materials Lab</td>
<td>M</td>
<td>1</td>
</tr>
<tr>
<td>MAE 334LLB MAE Laboratory I</td>
<td>M</td>
<td>2</td>
</tr>
<tr>
<td>Professional/Sci Track</td>
<td>M</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits: 15**

### Senior Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Category</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 330LAB MAE Lab II</td>
<td>M</td>
<td>2</td>
</tr>
<tr>
<td>MAE 491LEC Design Process &amp; Methods</td>
<td>M/P</td>
<td>3</td>
</tr>
<tr>
<td>MAE Tech Elective</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE Tech Elective</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>Pathway</td>
<td>P</td>
<td>3</td>
</tr>
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</table>

**Total Credits: 14**

<table>
<thead>
<tr>
<th>Spring Semester</th>
<th>Category</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 4941T Design Project</td>
<td>M/P</td>
<td>3</td>
</tr>
<tr>
<td>Applied Math Elective</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>MAE Technical Elective</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>Professional/Sci Track</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>Pathway</td>
<td>P</td>
<td>3</td>
</tr>
<tr>
<td>UBC 399 UB Capstone</td>
<td>CAP</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total Credits: 16**

**Total Credits Required for Degree:** 128
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](http://engineering.buffalo.edu/mechanical-aerospace/undergraduate/programs/accreditation.html)
- The UB Undergraduate Catalog at: [https://catalog.buffalo.edu/academicprograms/mechanical_engineering_bs.html](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

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

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 versions were 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**

<table>
<thead>
<tr>
<th>Program Educational Objective</th>
<th>Required Skills</th>
<th>Specific Skills</th>
<th>Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PEO 1</strong> Career development:</td>
<td>Technical competence in Mechanical engineering and in STEM preparation areas</td>
<td>Solve complex problems</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design, conduct experiments</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering Design</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communicate effectively</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional &amp; Ethical Responsibility</td>
<td>4</td>
</tr>
<tr>
<td><strong>PEO 2</strong> Professional service with integrity:</td>
<td>Social Awareness, Professional Development</td>
<td>Engineering Design</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Function on team</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional &amp; Ethical Responsibility</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communicate effectively</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acquire new knowledge</td>
<td>7</td>
</tr>
<tr>
<td><strong>PEO 3</strong> Addressing important problems:</td>
<td>Use training to solve societal problems</td>
<td>Engineering Design</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Function on team</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communicate effectively</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional &amp; Ethical Responsibility</td>
<td>4</td>
</tr>
</tbody>
</table>
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 through 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.

<table>
<thead>
<tr>
<th>Course Names</th>
<th>Outcomes 1-7</th>
<th>1 = Content introduced in the course</th>
<th>2 = Content practiced in the course</th>
<th>3 = Content mastered in the course</th>
<th>Courses selected for evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instructor Responsible</td>
<td>Armstrong</td>
<td>Kwon, Miao, Dinh</td>
<td>Armstrong</td>
<td>Trinkle</td>
</tr>
<tr>
<td>Year 1</td>
<td>1</td>
<td>an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Year 1</td>
<td>2</td>
<td>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, economic, environmental, and economic factors</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Year 1</td>
<td>3</td>
<td>an ability to communicate effectively with a range of audiences</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Year 2</td>
<td>4</td>
<td>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</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Year 2</td>
<td>5</td>
<td>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</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Year 3</td>
<td>6</td>
<td>an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Year 3</td>
<td>7</td>
<td>an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
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 $\geq 70\%$ 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**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Very little</th>
<th>some</th>
<th>Quite a bit</th>
<th>Very much</th>
<th>Sum of quite a bit plus very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00</td>
<td>15.56</td>
<td>44.44</td>
<td>40.00</td>
<td>84.4</td>
</tr>
<tr>
<td>2</td>
<td>4.44</td>
<td>15.56</td>
<td>40.00</td>
<td>40.00</td>
<td>80.0</td>
</tr>
<tr>
<td>3</td>
<td>2.22</td>
<td>13.33</td>
<td>35.56</td>
<td>48.89</td>
<td>84.5</td>
</tr>
<tr>
<td>4</td>
<td>2.22</td>
<td>4.44</td>
<td>40.00</td>
<td>53.33</td>
<td>93.3</td>
</tr>
<tr>
<td>5</td>
<td>0.00</td>
<td>13.33</td>
<td>37.78</td>
<td>48.89</td>
<td>86.7</td>
</tr>
</tbody>
</table>
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 $\geq 70\%$ of students (see A.4 below).

The SES was repeated in 2020 with similar results.

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

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

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

**Table 4-3, Assessment Cycle**

<table>
<thead>
<tr>
<th>Year</th>
<th>Outcomes Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-3</td>
</tr>
<tr>
<td>2</td>
<td>4-5</td>
</tr>
<tr>
<td>3</td>
<td>6-7</td>
</tr>
</tbody>
</table>

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):

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Meets all or nearly all of the criteria</td>
</tr>
<tr>
<td>3</td>
<td>Meets most of the criteria</td>
</tr>
<tr>
<td>2</td>
<td>Meets some of the criteria</td>
</tr>
<tr>
<td>1</td>
<td>Meets few or none of the criteria</td>
</tr>
</tbody>
</table>

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

**Outcomes (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

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>MAE 335</th>
<th>MAE 340</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>83%</td>
<td>94%</td>
</tr>
<tr>
<td>2</td>
<td>81%</td>
<td>79%</td>
</tr>
<tr>
<td>3</td>
<td>79%</td>
<td>90%</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Performance Indicator</th>
<th>MAE 377</th>
<th>MAE 451</th>
<th>MAE 494</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>97%</td>
<td>81%</td>
<td>87%</td>
</tr>
<tr>
<td>2</td>
<td>92%</td>
<td>97%</td>
<td>87%</td>
</tr>
<tr>
<td>3</td>
<td>80%</td>
<td>85%</td>
<td>83%</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Performance Indicator</th>
<th>MAE 334</th>
<th>MAE 338</th>
<th>MAE 494</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100%</td>
<td>83%</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>87.5%</td>
<td>93%</td>
<td>97%</td>
</tr>
<tr>
<td>3</td>
<td>100%</td>
<td>80%</td>
<td>100%</td>
</tr>
</tbody>
</table>

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.
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.

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>MAE 277</th>
<th>MAE 451</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76%</td>
<td>78%</td>
</tr>
<tr>
<td>2</td>
<td>88%</td>
<td>77%</td>
</tr>
<tr>
<td>3</td>
<td>80%</td>
<td>74%</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>MAE 334</th>
<th>MAE 494</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>95%</td>
<td>92%</td>
</tr>
</tbody>
</table>
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: Ardestir 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.

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>MAE 334</th>
<th>MAE 338</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>77%</td>
<td>96%</td>
</tr>
<tr>
<td>2</td>
<td>97%</td>
<td>92%</td>
</tr>
<tr>
<td>3</td>
<td>83%</td>
<td>81%</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>MAE 177</th>
<th>MAE 381</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>92%</td>
<td>94%</td>
</tr>
<tr>
<td>2</td>
<td>88%</td>
<td>95%</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Action</th>
<th>AY 14-15</th>
<th>AY 15-16</th>
<th>AY 16-17</th>
<th>AY 17-18</th>
<th>AY 18-19</th>
<th>AY 19-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>12</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>First ABET retreat for all SEAS Departments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>Dissemination of information learned at ABET IDEAL Workshop</td>
</tr>
<tr>
<td>Date</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>Results</td>
<td>Programs gained better understanding of assessment best practices</td>
</tr>
</tbody>
</table>

### AY 2015-2016

#### Action 1: UB (Administration)

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

#### Action 2: UB (Administration)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Blackstone Launchpad at UB opened its doors.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>To fill recognized need to provide additional resources for students, alumni, faculty and staff to learn about entrepreneurship.</td>
</tr>
<tr>
<td>Date</td>
<td>March 2016</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>

#### Action 3: SEAS (Student Outcomes)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>Previous policy allowed prolonged period of poor performance, which is inconsistent with professional expectations.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>Results</td>
<td>Earlier intervention for poor performance.</td>
</tr>
</tbody>
</table>

#### Action 4: SEAS (Program Educational Objectives)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>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.</th>
</tr>
</thead>
</table>

E002 2020-2021 Self-Study Questionnaire
Some employers had indicated that students were not well prepared to articulate their skills and experiences during an interview.

**Date**: Fall 2015

**Results**: By graduation, students have a 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)**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Development of SEAS online tool to document laboratory spending plans.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basis for Action</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>Fall 2015</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td>Departments are better able to plan laboratory improvements and track associated expenses, leading to improvements in the quality of the laboratory experience for students.</td>
</tr>
</tbody>
</table>

---

**Action 6: SEAS (Program Educational Objectives)**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>New office of STEM Diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basis for Action</strong></td>
<td>Need to improve admission, retention and success of all student populations in SEAS</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>Spring 2016</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td>Diversity Plan developed. SEAS recognized by ASEE as Exemplar recipient of a Bronze Award in 2019.</td>
</tr>
</tbody>
</table>

---

**Action 7: SEAS (Student Outcomes)**

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

---

**Action 8: (Student Outcomes)**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Revision of the BS ME engineering program requirements to accommodate SUNY Seamless Transfer (as described in the Background)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basis for Action</strong></td>
<td>SUNY and State Department of Education requirements</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>Developed over 2015-2016 year, implemented in Fall 2016</td>
</tr>
</tbody>
</table>
## 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)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Revision of transfer admissions policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>Prior policy was vague resulting in some confusion during the admissions process.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2016</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Action 5: SEAS (Student Outcomes)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Responsibility for advisement of intended engineering students transferred to the School of Engineering and Applied Sciences, 410 Bonner Hall.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>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.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2016</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Action 6: SEAS (Student Outcomes)

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

### Action 7: MAE (Student Outcomes)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>MAE 385 Materials Lab—purchase of suite of materials testing systems (Pasco).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>Students were viewing demonstrations instead of being able to conduct experiments themselves.</td>
</tr>
<tr>
<td>Date</td>
<td>2016-2017</td>
</tr>
<tr>
<td>Results</td>
<td>Students were able to perform accurate mechanical tests themselves.</td>
</tr>
</tbody>
</table>
Action 8: MAE (Student Outcomes)

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

Action 9: ME (Student Outcomes)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>MAE 338 Engineering Lab II—developed 1-D heat-conduction experiment in-house.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>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.</td>
</tr>
<tr>
<td>Date</td>
<td>2016-2017</td>
</tr>
<tr>
<td>Results</td>
<td>The new setups provided physically-meaningful results and a more tractable conduction analysis.</td>
</tr>
</tbody>
</table>

AY 2017-2018

Action 1: UB (Administration)

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

Action 2: UB (Administration)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Adoption of University-wide scholarship management system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>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.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2017</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>
### Action 3: UB (Administration)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Implementation of Student Success Collaborative (SSC), a web-based tracking system for staff-based advisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>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</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2017</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Action 4: UB (Program Educational Objectives)

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

### Action 5: SEAS (Program Educational Objectives)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Launch of “Professional Development Blueprint”. This document replaced the earlier Career Development Curriculum.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>Need to provide guidance to students on timeline and available resources for professional development throughout the curriculum.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2017</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Action 6: SEAS (Student Outcomes)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Development of Healthy Engineers pamphlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>Advising staff has observed an increase in the number of students visiting the office because of mental health concerns.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2017</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>
### Action 7: SEAS (Program Educational Objectives)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Addition of minors in Electrical Engineering and Manufacturing.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>SEAS only had one minor which was in computer science.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2017</td>
</tr>
<tr>
<td>Results</td>
<td>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).</td>
</tr>
</tbody>
</table>

### Action 8: SEAS (Program Educational Objectives)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Investment by SEAS in tools to support faculty advisement.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>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.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2017</td>
</tr>
<tr>
<td>Results</td>
<td>Improved access to information improves the advisement process, leaving more time for faculty to discuss extracurricular opportunities and career development etc.</td>
</tr>
</tbody>
</table>

### Action 9: SEAS (Student Outcomes)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>President Tripathi approved establishment of the new Department of Engineering Education within SEAS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>New interdisciplinary department created with the aim to transform the way in which engineering students are educated.</td>
</tr>
<tr>
<td>Date</td>
<td>March 2018</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Action 10: ME (Student Outcomes)

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Replaced Creo (Pro-E) software for CAE in MAE 377 with Solidworks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>Creo customer support was poor, had steep learning curve; it is a less-popular program in industry.</td>
</tr>
<tr>
<td>Date</td>
<td>2018-2019</td>
</tr>
<tr>
<td>Action</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>Action 11: ME (Student Outcomes)</strong></td>
<td><strong>MAE 334 Engineering Lab I</strong>—micro-controllers, sensors, motors, and actuators have been purchased, along with associated software. <strong>Basis for Action</strong> Needed to keep up with the rapid pace of hardware and software advances in controls. <strong>Date</strong> 2017-2018 <strong>Results</strong> Students are now able to study more complex systems of sensors and actuators.</td>
</tr>
<tr>
<td><strong>Action 12: ME (Student Outcomes)</strong></td>
<td><strong>MAE 494 Design Project</strong>—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 <strong>Basis for Action</strong> Provide students with further experience communicating with a range of audiences, in this case a non-technical audience; (SO 3) <strong>Date</strong> 2017-2018 <strong>Results</strong> 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.</td>
</tr>
<tr>
<td><strong>AY 2018-2019</strong></td>
<td><strong>Action 1: SEAS (Student Outcomes)</strong> Academic Review policy revised. Students doing poorly in their first semester at UB are no longer dismissed from the program. <strong>Basis for Action</strong> Many students find adjustment to university very stressful. Eliminating dismissal after the first semester gives students time to “get back on track.” <strong>Date</strong> Spring 2019 <strong>Results</strong> Monitoring the effect of this policy change on first semester students.</td>
</tr>
<tr>
<td><strong>Action 2: SEAS (Student Outcomes)</strong></td>
<td>Administered first school-wide senior exit survey to complement the UB Next placement survey.</td>
</tr>
</tbody>
</table>
### 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)**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>MAE338 Engineering Lab II—purchase of hydrometers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>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.</td>
</tr>
<tr>
<td>Date</td>
<td>2018-2019</td>
</tr>
<tr>
<td>Results</td>
<td>The students now have experience with using hydrometers, and the consistency and accuracy of the experimental results have improved.</td>
</tr>
</tbody>
</table>

**AY 2019-2020**

**Action 1: UB (Student Outcomes)**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>New academic integrity policy adopted together with the formation of a new university-wide Office of Academic Integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>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.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2019</td>
</tr>
<tr>
<td>Results</td>
<td>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</td>
</tr>
</tbody>
</table>

**Action 2: SEAS (Program Educational Objectives)**

<table>
<thead>
<tr>
<th>Action Taken</th>
<th>Administration of WiSE (Women in Science and Engineering) transferred from the College of Arts and Sciences (CAS) to SEAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Action</td>
<td>The majority of students attending programs are from SEAS.</td>
</tr>
<tr>
<td>Date</td>
<td>Fall 2019</td>
</tr>
<tr>
<td>Results</td>
<td>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.</td>
</tr>
</tbody>
</table>
Action 3: SEAS (Student Outcomes)

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

Action 4: ME and AE (Student Outcomes)

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

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 Exit 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.
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.

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 541 Calculus 1</td>
<td>MTH 542 Calculus 2</td>
<td>MTH 206 Diff. Equations</td>
<td>MTH 208 Dynamics</td>
<td>MME 331 Fluid Mechanics</td>
<td>MME 340 Machine Design</td>
</tr>
<tr>
<td>CHE 507 Chemistry 1</td>
<td>CHE 508 Physics 1</td>
<td>EAS 207 Statics</td>
<td>EAS 208 Dynamics</td>
<td>EAS 209 Mechanics of Solids</td>
<td>EAS 230 Engineering Computations</td>
</tr>
<tr>
<td>MME 305</td>
<td>MME 311 Machines 1</td>
<td>MME 312</td>
<td>MAE 320 Heat Transfer</td>
<td>MAE 313</td>
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**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/](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)
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 them 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.

**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

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<th>Course</th>
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<th>Subject Area (Credit Hours)</th>
<th>Maximum Section Enrollment for the Last Two Terms the Course was Offered</th>
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*Add rows as needed to show all courses in the curriculum.*

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**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    |

Minimum Semester Credit Hours: 30 Hours, 45 Hours
Minimum Percentage: 25%, 37.50%
### Professional Practice Track

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1. R: Required, E: Elective, SE: Selected Elective
2. For the Last Two Terms the Course was Offered
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Add rows as needed to show all courses in the curriculum.

**TOTALS-ABET BASIC-LEVEL REQUIREMENTS**

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<th>72</th>
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<td>OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM</td>
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<td>PERCENT OF TOTAL</td>
<td>28.13%</td>
<td>56.25%</td>
<td>15.63%</td>
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Minimum Semester Credit Hours

- 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>
<thead>
<tr>
<th>Faculty Name</th>
<th>Highest Degree Earned-Field and Year</th>
<th>Rank</th>
<th>Type of Academic Appointment</th>
<th>FT or PT</th>
<th>Years of Experience</th>
<th>Level of Activity</th>
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<td>Armstrong, Jason N.</td>
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<td>Lagor, Francis</td>
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<td>Madnia, Cyrus K.</td>
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<td>Mollendorf, Joseph C.</td>
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<td>Rai, Rahul</td>
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<td>Ringuette, Matthew J.</td>
<td>Ph.D. – Aeronautics, 2004</td>
<td>ASC</td>
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<td>Salac, David</td>
<td>Ph.D. – Mechanical Engineering, 2007</td>
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<td>Schifferle, Paul</td>
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<td>A</td>
<td>NTT</td>
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* 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)

<p>| Singh, Tarunraj      | Ph.D. – Mechanical Engineering, 1991 | P | T | FT | 0.5 | 26 | 26 | -- | M | M | L |</p>
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<tr>
<th>Name</th>
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<th>Code</th>
<th>Tenure Status</th>
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<td>Snoeyink, Craig</td>
<td>Ph.D. - Mechanical Engineering, 2012</td>
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<td>Stamm, Jennifer</td>
<td>Ph.D. - Mechanical Engineering, 2015</td>
<td>I</td>
<td>NTT FT 3 15 15</td>
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<td>Wetherhold, Robert C.</td>
<td>Ph.D. – Applied Sciences, 1983</td>
<td>P</td>
<td>T FT 3 37 37 --</td>
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<td>Zheng, Minghui</td>
<td>Ph.D. - Mechanical Engineering, 2017</td>
<td>AST</td>
<td>TT FT 0 3 3</td>
<td>M L L</td>
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</table>

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

<table>
<thead>
<tr>
<th>Faculty Member (name)</th>
<th>PT or FT</th>
<th>Classes Taught (Course No./Credit Hrs.) Term and Year</th>
<th>Program Activity Distribution</th>
<th>% of Time Devoted to the Program</th>
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<td>Armstrong, Jason</td>
<td>FT</td>
<td>Fall 19: MAE 377 (3), MAE 381 (3); S20: MAE 385 Lab 1-8 (1), MAE 485/585 (3)</td>
<td>Teaching: 60; Research or Scholarship: 20; Other: 20</td>
<td>100</td>
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<td>Ball, Zachary</td>
<td>PT</td>
<td>F19: MAE 277 (3); S20: no courses</td>
<td>100</td>
<td>50</td>
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<tr>
<td>Battaglia, Francine</td>
<td>FT</td>
<td>F19: MAE 539 (3); S20: no courses (administrative assignment)</td>
<td>20; 20; 60</td>
<td>100</td>
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<tr>
<td>Bayandor, Javid</td>
<td>FT</td>
<td>F19: MAE 460 (3), MAE 513(3); S20: MAE 400 (3), MAE 600 (3)</td>
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<td>100</td>
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<td>Botta, Eleonora</td>
<td>FT</td>
<td>F19: MAE 502 (3); S20: EAS 208 (3)</td>
<td>40; 40; 20</td>
<td>100</td>
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<td>Burge, Matthew</td>
<td>FT</td>
<td>F19: MAE 335 (3) A, B, MAE 339 Lab 1, 2; S19: MAE 336 (3) A, B</td>
<td>80; 10; 20</td>
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<td>Chen, James</td>
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<td>F19: MAE 422 (3); S20: MAE 631 (3)</td>
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<td>Chung, Deborah</td>
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<td>Crassidis, John</td>
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<td>20; 60; 20</td>
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<td>Dargush, Gary</td>
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<td>DesJardin, Paul</td>
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<td>Salac, David</td>
<td>FT</td>
<td>F19: MAE 204 D, E (3); S20: MAE 432/532 (3), MAE 598 (3); Director of Graduate Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schifferle, Paul</td>
<td>PT</td>
<td>F19: MAE 278 (3); S20: MAE 434 (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singh, Tarunraj</td>
<td>FT</td>
<td>F19: MAE 443/543 (3), MAE 568 (3); S20: MAE 670 (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snoeyink, Craig</td>
<td>FT</td>
<td>F19: MAE 335 C, D (3); S20: no courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stamm, Jennifer</td>
<td>FT</td>
<td>F19: no courses; S20: MAE 364 A, B, C (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetherhold, Robert</td>
<td>FT</td>
<td>F19: MAE 315 (3), MAE 381(3); S20: MAE 316 (3); Director of Undergraduate Studies for ME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zheng, Minghui</td>
<td>FT</td>
<td>F19: MAE 340 (3), MAE 571 (3); S20: no courses</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

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

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/](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.
o 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](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.](image)

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 club 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
  o Open 8 a.m. to 8 p.m. Mon-Fri plus swipe card access
  o Used for undergraduate instruction (EAS199, EAS230, etc.)
  o 41 Dell OptiPlex 7010 Microsoft Windows Systems
  o Dual projectors and an instructor console
• SENS Public Workstation Laboratory – 1018 Furnas Hall
  o Open 8 a.m. to 5 p.m. Mon-Fri plus swipe card access
  o Used for small courses, seminars, ad-hoc lectures, overflow
  o 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
  o 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
  o 68 Dell OptiPlex Systems (790, 9020 AIO and 9030 AIO)
  o Public printer and print release station
  o 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
  o Open 9 a.m.-Midnight Mon-Fri, Noon-8 p.m. Sat, Noon-Midnight Sun
  o 10 Cybrary stations
  o 2 Express stations
  o Public printer and print release station
• Capen 2nd Floor
  o Open 24 hours, seven days a week
  o 52 Cybrary stations and 1 assistive station
  o 20 Express stations
  o Public printer and 2 print release stations
  o Scanner stations
• Capen 3rd Floor
  o Open 24 hours, seven days a week
  o 95 Cybrary stations
  o 41 iMacs
• Clinton Hall Room 114
  o Open 24 hours, seven days a week
  o 13 Cybrary stations and 1 assistive station
  o 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

<table>
<thead>
<tr>
<th>General purpose packages</th>
<th>Specialty Packages administrated by SENS and available to MAE undergraduate students</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Adobe Acrobat Reader</td>
<td>Title</td>
</tr>
<tr>
<td>• Autodesk Products</td>
<td>Purpose</td>
</tr>
<tr>
<td>• Zoom</td>
<td>Class (MAE xxx)</td>
</tr>
<tr>
<td>• WebEx</td>
<td>Arduino IDE</td>
</tr>
<tr>
<td>• Microsoft 365</td>
<td>Software to control microcontrollers/sensors/actuators</td>
</tr>
<tr>
<td>• EndNote (library tool)</td>
<td>MAE 334</td>
</tr>
<tr>
<td>• FileZilla</td>
<td>Autodesk Inventor</td>
</tr>
<tr>
<td>• Flash Player plugins</td>
<td>3-D CAD software; Dynamic simulation</td>
</tr>
<tr>
<td>• Google Chrome</td>
<td>General use; MAE 477</td>
</tr>
<tr>
<td>• iTunes</td>
<td>MATLAB</td>
</tr>
<tr>
<td>• Microsoft built-in firewall</td>
<td>Introductory programming course; Scientific computation in MAE; Calculations and data analysis; Analysis of experimental data</td>
</tr>
<tr>
<td>• Microsoft Office - Enterprise Edition</td>
<td>EAS 230; MAE 376; MAE 334; MAE 338</td>
</tr>
<tr>
<td>• Microsoft Windows 10 (64 bit)</td>
<td>MATLAB Simulink</td>
</tr>
<tr>
<td>• Mozilla FireFox</td>
<td>Data collection in experiments, drive Quanser Hardware</td>
</tr>
<tr>
<td>• OS patching client Programming languages</td>
<td>MAE 334</td>
</tr>
<tr>
<td>• Putty [SSH client]</td>
<td>National Instruments LabVIEW</td>
</tr>
<tr>
<td>• Sun Java JRE</td>
<td>Data collection in experiments</td>
</tr>
<tr>
<td>• UBFS Link</td>
<td>MAE 334</td>
</tr>
<tr>
<td>• WinSCP (sftp)</td>
<td>SOLIDWORKS</td>
</tr>
<tr>
<td>• Microsoft 365</td>
<td>Solid modeling and drawings; structural analysis (FEA) and geometric dimensioning and tolerancing (GD&amp;T); modeling part for use in wind tunnel;</td>
</tr>
<tr>
<td>• Microsoft Office - Enterprise Edition</td>
<td>MAE 177; MAE 377; MAE 339</td>
</tr>
<tr>
<td>• Microsoft Windows 10 (64 bit)</td>
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<tr>
<td>• Autodesk Products</td>
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<td>• Zoom</td>
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<td>• WebEx</td>
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<td>• Microsoft 365</td>
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<td>• FileZilla</td>
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<td>• Flash Player plugins</td>
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<td>• Google Chrome</td>
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<td>• iTunes</td>
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<tr>
<td>• Microsoft built-in firewall</td>
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<td>• Microsoft Office - Enterprise Edition</td>
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<td>• Putty [SSH client]</td>
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<td>• Sun Java JRE</td>
<td></td>
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<tr>
<td>• UBFS Link</td>
<td></td>
</tr>
<tr>
<td>• WinSCP (sftp)</td>
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</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Date</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 1</td>
<td>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.</td>
</tr>
<tr>
<td>March 1</td>
<td>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</td>
</tr>
</tbody>
</table>
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.
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.

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.

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.

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”

<table>
<thead>
<tr>
<th>Undergraduate year</th>
<th>Year of survey</th>
<th>2013</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmen</td>
<td>58.3%</td>
<td></td>
<td>86.8%</td>
</tr>
<tr>
<td>Sophomore</td>
<td>62.6%</td>
<td></td>
<td>83.5%</td>
</tr>
<tr>
<td>Junior</td>
<td>67.3%</td>
<td></td>
<td>87.2%</td>
</tr>
<tr>
<td>Senior</td>
<td>64.5%</td>
<td></td>
<td>81.7%</td>
</tr>
</tbody>
</table>
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

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

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

<table>
<thead>
<tr>
<th>Source</th>
<th>17/18</th>
<th>18/19</th>
<th>19/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>$73 k</td>
<td>$41 k</td>
<td>$224 k</td>
</tr>
<tr>
<td>ICR</td>
<td>$35 k</td>
<td>$33 k</td>
<td>$37 k</td>
</tr>
<tr>
<td>Instructional Support</td>
<td>$992 k</td>
<td>$999 k</td>
<td>$944 k</td>
</tr>
<tr>
<td>Summer tuition revenue share</td>
<td>$103 k</td>
<td>$74 k</td>
<td>$133 k</td>
</tr>
<tr>
<td>(SUTRA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UBF</td>
<td>$35 k</td>
<td>$50 k</td>
<td>$68 k</td>
</tr>
<tr>
<td>IFR</td>
<td>$30 k</td>
<td>$57 k</td>
<td>$166 k</td>
</tr>
<tr>
<td>Total</td>
<td>$1268 k</td>
<td>$1254 k</td>
<td>$1572 k</td>
</tr>
</tbody>
</table>

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

Table 8-3. MAE - Summary of Students and Faculty
Table 8-4. Summary of Laboratory Spending Budget

<table>
<thead>
<tr>
<th>Source</th>
<th>17/18</th>
<th>18/19</th>
<th>19/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>$57,400</td>
<td>$60,100</td>
<td>$45,700</td>
</tr>
<tr>
<td>Department match</td>
<td>$15,800</td>
<td>$15,300</td>
<td>$13,700</td>
</tr>
<tr>
<td>Total</td>
<td>$73,200</td>
<td>$75,400</td>
<td>$59,400</td>
</tr>
</tbody>
</table>

**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>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Source of Funding</th>
<th>Duties</th>
</tr>
</thead>
<tbody>
<tr>
<td>David Love</td>
<td>Director of Administration</td>
<td>State</td>
<td>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)</td>
</tr>
<tr>
<td>Stephen Hart</td>
<td>Facilities Coordinator</td>
<td>State</td>
<td>Responsible for the oversight of space within MAE. Tracking of keys, setting up department labs for research, teaching and instruction.</td>
</tr>
<tr>
<td>Andrew Fogelsonger</td>
<td>Undergraduate Coordinator</td>
<td>State</td>
<td>Provides advisement to undergraduate students. Coordinates the course scheduling and organizes ABET and undergraduate studies committee.</td>
</tr>
<tr>
<td>Rosemary Lombardo</td>
<td>Graduate Coordinator</td>
<td>State</td>
<td>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.</td>
</tr>
<tr>
<td>Marty Fye</td>
<td>Administrative Assistant</td>
<td>State</td>
<td>Primary contact for faculty affairs including appointment paperwork, summer appointment paperwork. Administers the faculty hiring process in conjunction with the hiring committees.</td>
</tr>
<tr>
<td>Marge Hewlett</td>
<td>Senior Staff Assistant</td>
<td>State</td>
<td>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.</td>
</tr>
<tr>
<td>Kelsey Trautwein</td>
<td>Business Analyst</td>
<td>State</td>
<td>Manages Faculty startup and guides new faculty through initial lab set up and student appointment requests. Also assists with department reporting.</td>
</tr>
<tr>
<td>Michael Bellotti</td>
<td>Research Analyst</td>
<td>State</td>
<td>Supports faculty with their research awards and provides administrative support for purchasing, hiring and summer salary appointments. Responsible for research student appointments.</td>
</tr>
<tr>
<td>Dan Cook</td>
<td>Laboratory Technician</td>
<td>State</td>
<td>Supports instruction and research.</td>
</tr>
<tr>
<td>Gary Olson</td>
<td>Laboratory Equipment Designer</td>
<td>State</td>
<td>Supports instruction and research in the Engineering Machine Shop. Reports directly to Dr. Mollendorf, Professor and Director of Engineering Machine Shop.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th></th>
<th>significant coverage</th>
<th>partial coverage</th>
</tr>
</thead>
</table>

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.
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.
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 SYLLABUS
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:

1. Define the limit of a function at a point
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
6. Define derivative and interpret it as the slope of a tangent to the graph of a function

<table>
<thead>
<tr>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW # 1, 2, 3 Midterm 1 Final Exam</td>
</tr>
<tr>
<td>HW #4, 5 Midterm 1 Final Exam</td>
</tr>
<tr>
<td>HW #4, 6, 7, 8</td>
</tr>
<tr>
<td>7. Compute derivatives of polynomial, exponential, logarithmic, trigonometric, and inverse trigonometric functions</td>
</tr>
<tr>
<td>8. Compute derivatives using derivative rules, including the chain rule and implicit differentiation</td>
</tr>
<tr>
<td>9. Use derivatives to compute linear approximations of functions</td>
</tr>
<tr>
<td>10. Find critical points, minima and maxima of a function using its first and second derivatives</td>
</tr>
<tr>
<td>11. Use derivatives to solve optimization problems</td>
</tr>
<tr>
<td>12. Use derivatives to sketch graphs of functions</td>
</tr>
<tr>
<td>13. State the mean value theorem and apply it in computations</td>
</tr>
<tr>
<td>14. Apply L'Hospital's rule to compute limits of functions</td>
</tr>
<tr>
<td>15. Use derivatives to solve practical problems involving rectilinear motion</td>
</tr>
<tr>
<td>16. Find the area of a region bounded by a curve and the x-axis using rectangles and limits</td>
</tr>
<tr>
<td>17. Find the area of a region bounded by a curve and the x-axis using indefinite integrals and the fundamental theorem of calculus</td>
</tr>
<tr>
<td>18. Use integrals to solve practical problems involving rectilinear motion</td>
</tr>
<tr>
<td>19. Choose appropriate methods or models for a given problem, using information from observed or deduced data and knowledge of the system being studied.</td>
</tr>
<tr>
<td>20. Employ quantitative methods, mathematical models, statistics, and/or logic to solve real-world problems beyond the level of basic algebra.</td>
</tr>
<tr>
<td>21. Identify common mistakes and/or limitations in empirical and deductive reasoning, and in mathematical, quantitative, and/or logical problem solving.</td>
</tr>
<tr>
<td>22. Interpret mathematical models, formulas, graphs, and/or tables, to draw inferences from them, and explain these inferences.</td>
</tr>
</tbody>
</table>

**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>
<thead>
<tr>
<th>Course Learning Outcomes</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon successful completion of the course, students will be able to:</td>
<td></td>
</tr>
<tr>
<td>1. Interpret the area enclosed between curves as a definite integral and compute its value</td>
<td>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>
<td>HW #3, 4 Midterm 1 Final Exam</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></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>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>
<td></td>
</tr>
<tr>
<td>6. Compute the length of a curve segment from its parametric representation</td>
<td>HW #7, 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>
<td></td>
</tr>
<tr>
<td>Course Topics:</td>
<td>HW #</td>
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<tr>
<td>--------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td><strong>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</strong></td>
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</tr>
<tr>
<td><strong>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</strong></td>
<td></td>
</tr>
<tr>
<td><strong>10. Distinguish between conditional convergence and absolute convergence of infinite series and be aware of the consequences of reordering terms of a conditionally convergeing infinite series</strong></td>
<td></td>
</tr>
<tr>
<td><strong>11. Decide whether and to what value an infinite geometric series converges</strong></td>
<td></td>
</tr>
<tr>
<td><strong>12. Use comparison, root, ratio, and integral test to investigate whether a given infinite series is convergent</strong></td>
<td></td>
</tr>
<tr>
<td><strong>13. Decide whether an alternating series converges from the limit and monotonic decrease of the sequence of absolute values of its terms</strong></td>
<td></td>
</tr>
<tr>
<td><strong>14. Interpret a converging power series as a function</strong></td>
<td>Final Exam</td>
</tr>
<tr>
<td><strong>15. Compute the derivatives and anti-derivatives of a functions represented by power series</strong></td>
<td></td>
</tr>
<tr>
<td><strong>16. Determine the Taylor series of the nth order and determine an upper bound on its remainder</strong></td>
<td></td>
</tr>
<tr>
<td><strong>17. Manipulate Taylor series by substitution and (anti-)differentiation to obtain expansions for other functions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>18. Choose appropriate methods or models for a given problem, using information from observed or deduced data and knowledge of the system being studied.</strong></td>
<td>HW #1-12</td>
</tr>
<tr>
<td><strong>19. Employ quantitative methods, mathematical models, statistics, and/or logic to solve real-world problems beyond the level of basic algebra.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>20. Identify common mistakes and/or limitations in empirical and deductive reasoning, and in mathematical, quantitative, and/or logical problem solving.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>21. Interpret mathematical models, formulas, graphs, and/or tables, to draw inferences from them, and explain these inferences.</strong></td>
<td></td>
</tr>
</tbody>
</table>

- **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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understand vectors in two- and three-dimensional space and their geometric interpretation</td>
<td>HW #1, Midterm 1, Final Exam</td>
</tr>
<tr>
<td>2. Add vectors and multiply vectors by scalars</td>
<td></td>
</tr>
<tr>
<td>3. Compute dot product and cross product of two vectors and understand the properties of these operations</td>
<td></td>
</tr>
<tr>
<td>4. Write equations of lines and planes in the three-dimensional space</td>
<td>HW #2, Midterm 1, Final Exam</td>
</tr>
<tr>
<td>5. Classify quadratic surfaces based on their equations</td>
<td></td>
</tr>
<tr>
<td>6. Compute derivatives and integrals of vector functions</td>
<td>HW #3, Midterm 1, Final Exam</td>
</tr>
<tr>
<td>7. Compute arc length and curvature of a space curve described by a vector function</td>
<td></td>
</tr>
<tr>
<td>8. Understand and compute velocity and acceleration of a particle moving in the three-dimensional space</td>
<td></td>
</tr>
<tr>
<td>9. Compute limit of a function of several variables at a point</td>
<td>HW #4, 5, 6</td>
</tr>
</tbody>
</table>
10. Verify continuity of functions of several variables
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
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
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
21. Compute line integrals directly, using the fundamental theorem for line integrals, and using Green’s theorem
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:

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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes</th>
<th>Assessment Tools</th>
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</thead>
<tbody>
<tr>
<td>Upon successful completion of the course, students will be able to:</td>
<td></td>
</tr>
<tr>
<td>1. Understand the concept of existence and uniqueness of solutions of a DE</td>
<td>HW #1 Midterm 1 Final Exam</td>
</tr>
<tr>
<td>2. Understand the concept of a general solution, a particular solution and initial conditions</td>
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<tr>
<td>3. Draw slope fields by hand and also by computer using Maple, Matlab, or Mathematica</td>
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<tr>
<td>4. Solve 1st order DEs (both nonlinear and linear) using various techniques: integrating factor, separable DE, substitution method, exact DE</td>
<td>HW #2 Midterm 1 Final Exam</td>
</tr>
<tr>
<td>5. Understand the equilibrium solutions</td>
<td>HW #3 Midterm 1 Final Exam</td>
</tr>
<tr>
<td>6. Draw the phase diagram</td>
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</tr>
<tr>
<td>7. Perform the stability analysis: identify stable points, unstable points, saddle points, and bifurcation points</td>
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</tr>
<tr>
<td>8. Solve 2nd order constant coefficient homogenous DEs</td>
<td>HW #4</td>
</tr>
</tbody>
</table>
### 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
9. Understand the concept of linear independence and determine if functions are linearly independent using Wronskian
10. Understand that linear combinations of two linearly independent solutions give the general solution
11. Solve non-homogeneous 2nd order DEs
12. Use the method of undetermined coefficients to find the particular solution
13. Understand the resonance phenomena
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
17. Rewrite the system of DEs in the matrix form
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
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
24. Set up a power series and the Taylor series of a function
25. Compute the radius of convergence of a power series

<table>
<thead>
<tr>
<th>Midterm 1</th>
<th>Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW #5</td>
<td></td>
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<tr>
<td>Midterm II</td>
<td>Final Exam</td>
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<tr>
<td>HW #7</td>
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<tr>
<td>Midterm II</td>
<td>Final Exam</td>
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<tr>
<td>HW #8</td>
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<tr>
<td>Midterm II</td>
<td>Final Exam</td>
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<tr>
<td>HW #9</td>
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<tr>
<td>Final Exam</td>
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<tr>
<td>HW #10</td>
<td></td>
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<tr>
<td>Final Exam</td>
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</tbody>
</table>
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:

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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Represent systems of linear equations in vector and matrix form</td>
<td>HW #1, 2 Midterm 1 Final Exam</td>
</tr>
<tr>
<td>2. Determine if a system of equations is consistent and whether it has a unique solution</td>
<td></td>
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<tr>
<td>3. Solve systems of linear equations using Gauss-Jordan elimination</td>
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<tr>
<td>4. Perform matrix-vector multiplication and understand how this operation defines a linear transformation between Rn and Rm</td>
<td>HW #3 Midterm 1 Final Exam</td>
</tr>
<tr>
<td>5. Add, multiply, and transpose matrices</td>
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<tr>
<td>6. Determine whether a given matrix is invertible and compute its inverse if it exists</td>
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<tr>
<td>7. State and apply properties of matrix algebra</td>
<td></td>
</tr>
<tr>
<td>8. Recognize which sets of vectors of Rn form a subspace</td>
<td>HW #4 Midterm 1 Final Exam</td>
</tr>
<tr>
<td>9. Find a basis of the null space and the column space of a matrix</td>
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</tr>
<tr>
<td>10. Compute the rank of a matrix and the dimension of the column space of a matrix</td>
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</tr>
<tr>
<td>11. Compute determinants of matrices both by cofactor expansion and by row reduction</td>
<td>HW #5 Midterm 2 Final Exam</td>
</tr>
<tr>
<td>12. Use Cramer's rule to solve systems of equations and to compute inverses of matrices</td>
<td></td>
</tr>
<tr>
<td>13. Compute areas of parallelograms and volumes of parallelepipeds using determinants</td>
<td></td>
</tr>
<tr>
<td>14. Understand relationship between the determinant of a matrix and properties of the linear transformation represented by the matrix</td>
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</tr>
<tr>
<td>15. Understand the axiomatic definition of a vector space and know some examples of vector spaces other than ( \mathbb{R}^n ) (vector space of polynomials, vector space of matrices etc.)</td>
<td>HW #6 Midterm 2 Final Exam</td>
</tr>
<tr>
<td>16. Recognize if a given function between vector spaces is a linear transformation</td>
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<tr>
<td>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</td>
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<tr>
<td>18. Compute bases of some simple vector spaces given a basis of a simple vector space</td>
<td>HW #7 Midterm 2 Final Exam</td>
</tr>
<tr>
<td>19. Compute coordinates of a vector relative to a basis</td>
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<tr>
<td>20. Compute the dimension of a vector space in some simple examples</td>
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<tr>
<td>21. Compute dimensions of various subspaces defined by a matrix using the rank theorem</td>
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<tr>
<td>22. Compute the characteristic polynomial of a matrix, find eigenvalues and eigenvectors of the matrix</td>
<td>HW #8, 9 Final Exam</td>
</tr>
<tr>
<td>23. Determine if a given matrix is diagonalizable and compute its diagonalization</td>
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<tr>
<td>24. Use diagonalization of a matrix to compute its powers</td>
<td>HW #10, 11 Final Exam</td>
</tr>
<tr>
<td>25. Compute the inner product of vectors in ( \mathbb{R}^n )</td>
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<tr>
<td>26. Determine if a set of vectors in ( \mathbb{R}^n ) is orthogonal</td>
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<tr>
<td>27. Compute the projection of a vector onto a subspace</td>
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<tr>
<td>28. Orthogonalize a set of vectors using the Gram-Schmidt process</td>
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<tr>
<td>29. Solve least square problems</td>
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</tr>
<tr>
<td>30. Compute orthogonal diagonalization of symmetric matrix</td>
<td>HW #12 Final Exam</td>
</tr>
<tr>
<td>31. Compute the matrix representing a quadratic form</td>
<td></td>
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</tbody>
</table>

**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:

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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>HW # 1-4 Group works1-2 Quiz 1 Test 1 Lab 1-2 1/3 of credit on final exam</td>
</tr>
<tr>
<td>2. Demonstrate atomic structure theory</td>
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<td>3. Quantitate and utilize atomic mass</td>
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<tr>
<td>4. Identify compounds, mixtures, molecules, ions, and chemical bonds</td>
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<tr>
<td>5. Name chemical compounds</td>
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<tr>
<td>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</td>
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<tr>
<td>7. Characterize reactions in aqueous solution, including: write aqueous reactions, total ionic and net ionic equations, precipitation reactions and solubility rules</td>
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</tbody>
</table>
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

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

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

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

| HW # 5-8 |
| Group works 3-4 |
| Quiz 2 |
| Test 2 |
| Lab 3-4 |
| 1/3 of credit on final exam |

| HW # 8-10 |
| Group works 5 |
| Quiz 3 |
| Lab 5 |
| 2/3 of credit on final exam |
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:
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:

<table>
<thead>
<tr>
<th>Assessment Tools</th>
<th>1. Understand and apply concepts to solve problems using:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labs 2, 3, 6</td>
<td>• matter and measurement</td>
</tr>
<tr>
<td></td>
<td>• atoms, molecules and ions</td>
</tr>
<tr>
<td></td>
<td>• stoichiometry and calculations with chemical formulas and equations</td>
</tr>
<tr>
<td></td>
<td>• reactions in aqueous solution</td>
</tr>
<tr>
<td>2. Describe and calculate quantities for:</td>
<td>Labs 9, 11</td>
</tr>
<tr>
<td></td>
<td>• thermochemical principles</td>
</tr>
<tr>
<td></td>
<td>• gas behavior</td>
</tr>
</tbody>
</table>
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:
2. **Mastering Chemistry,** (included at a discount in the package with the text ISBN above).
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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>Assessment Tools</th>
</tr>
</thead>
</table>
| 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

<table>
<thead>
<tr>
<th>Course Topics:</th>
<th>Problem sets 6-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Solutions and their properties</td>
<td>Laboratory Experiment 23</td>
</tr>
<tr>
<td>2. Chemical kinetics</td>
<td>1/2 of Final Exam</td>
</tr>
<tr>
<td>3. Chemical equilibrium</td>
<td></td>
</tr>
<tr>
<td>4. Aqueous Equilibria: acids and bases</td>
<td></td>
</tr>
<tr>
<td>5. Applications of aqueous equilibria</td>
<td></td>
</tr>
<tr>
<td>6. Thermodynamics: entropy, free energy, and equilibrium</td>
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</tr>
<tr>
<td>7. Electrochemistry</td>
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<tr>
<td>8. Nuclear chemistry</td>
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<tr>
<td>9. Transition elements and coordination chemistry</td>
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<tr>
<td>10. Organic and biological chemistry</td>
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</tr>
</tbody>
</table>
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:
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)

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

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:

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)

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

<table>
<thead>
<tr>
<th>7. The work-kinetic energy theorem. Power.</th>
<th>HW #6 Quizzes Test 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Potential energy, conservative forces. Potential energy curve. Conservation of energy.</td>
<td>HW #7 Quizzes Test 2</td>
</tr>
<tr>
<td>9. System of particles, Center of mass, linear momentum. Collisions, impulse, conservation of linear momentum.</td>
<td>HW #8 Quizzes Test 2</td>
</tr>
<tr>
<td>10. Angular velocity, angular acceleration, rotation with constant angular acceleration. Kinetic energy of rotation, rotational inertia, torque.</td>
<td>HW #9 Quizzes Final Exam</td>
</tr>
<tr>
<td>11. Rolling, angular momentum. Conservation of angular momentum.</td>
<td>HW #10 Quizzes Final Exam</td>
</tr>
<tr>
<td>12. The conditions for equilibrium. Elastic deformation. Stress, strain. Young’s modulus, shear modulus, bulk modulus</td>
<td>HW #11 Quizzes Final Exam</td>
</tr>
</tbody>
</table>
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:

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:

<table>
<thead>
<tr>
<th>Assessment Tools</th>
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<tbody>
<tr>
<td>HW #1</td>
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<tr>
<td>Quizzes</td>
</tr>
<tr>
<td>Exam 1</td>
</tr>
</tbody>
</table>


2. Electric field created by: i) a point charge, and ii) a charge distribution. Electric field lines. Electric dipoles.

3. Electric field flux. Gauss' law. Use of Gauss' law to calculate the electric field in various geometries.


9. Ampere's law, law of Biot-Savart. Magnetic field generated by a straight wire, a solenoid and a toroid coil.


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:

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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>Assessment Tools</th>
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</thead>
<tbody>
<tr>
<td>1. Understand the basic laws of physics as discussed in lecture</td>
<td>Lab reports Exams</td>
</tr>
<tr>
<td>2. Demonstrate skills used to analyze and present experimentally acquired data.</td>
<td>Lab reports Exams</td>
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<tr>
<td>3. Demonstrate familiarity with the use of spreadsheet programs</td>
<td>Lab reports</td>
</tr>
<tr>
<td>4. Predict results of new experimental outcomes</td>
<td>Exams</td>
</tr>
<tr>
<td>5. Demonstrate a variety of measurement techniques</td>
<td>Lab reports Exams</td>
</tr>
<tr>
<td>6. Conduct an experiment related to error analysis</td>
<td>Lab report</td>
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<tr>
<td>7. Conduct an experiment related to free fall</td>
<td>Lab report</td>
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<tr>
<td>8. Conduct an experiment related to projectile motion</td>
<td>Lab report</td>
</tr>
<tr>
<td>9. Conduct an experiment related to Newton's second law of motion</td>
<td>Lab report</td>
</tr>
<tr>
<td>10. Conduct an experiment related to simple harmonic motion</td>
<td>Lab report</td>
</tr>
<tr>
<td>11. Conduct an experiment related to rotational dynamics</td>
<td>Lab report</td>
</tr>
<tr>
<td>12. Conduct an experiment related to electrostatics</td>
<td>Lab report</td>
</tr>
<tr>
<td>13. Conduct an experiment related to electric circuits</td>
<td>Lab report</td>
</tr>
<tr>
<td>14. Conduct an experiment related to DC circuits with resistors and capacitors</td>
<td>Lab report</td>
</tr>
<tr>
<td>15. Conduct an experiment related to Wheatstone bridge</td>
<td>Lab report</td>
</tr>
</tbody>
</table>

**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:

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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes</th>
<th>Assessment Tools</th>
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<tbody>
<tr>
<td>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</td>
<td>HW #1, 2 Exam 1 Final Exam</td>
</tr>
<tr>
<td>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</td>
<td>HW #3 Exam 1 Final Exam</td>
</tr>
<tr>
<td>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</td>
<td>HW #4 Exam 2 Final Exam</td>
</tr>
</tbody>
</table>
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

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

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

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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>3, 7</td>
<td>E-Portfolio, two experiential learning reflections, resume,</td>
</tr>
<tr>
<td>2. Articulate the components of the UB General Education program and the integration of multiple disciplines.</td>
<td>3, 7</td>
<td>Academic plan, academic analysis reflection, pathways, career aspirations reflections</td>
</tr>
<tr>
<td>3. Understand their chosen major or other fields of study and the key concepts that will be explored in those disciplines.</td>
<td>3, 7</td>
<td>Resume, academic plan, academic analysis reflection, Career fair plan, career aspirations reflections</td>
</tr>
<tr>
<td>4. Understand the necessity for writing/communication in university and professional settings.</td>
<td>3</td>
<td>Two experiential learning reflections, resume, career aspirations reflection, academic analysis reflection, about me reflection, Peer assessment</td>
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</tbody>
</table>
5. Initiate use of the E-portfolio and select a thematic framework for the UB General Education program using articulated transfer and UB coursework.

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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

Midterm E-portfolio, Final E-portfolio, two experiential learning reflections, pathways worksheet, Career aspirations reflection
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:

<table>
<thead>
<tr>
<th>Course Learning Outcomes</th>
<th>SOs</th>
<th>Assessment Method</th>
</tr>
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<tbody>
<tr>
<td>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).</td>
<td>1</td>
<td>Alternative Fuels Project Report, Renewable Electric Project Report</td>
</tr>
<tr>
<td>Develop a conceptual model of a real world situation</td>
<td>7</td>
<td>Conceptual Model: Alt Fuels, Renewable Electric</td>
</tr>
<tr>
<td>Develop quantitative metrics, and a decision matrix to facilitate comparison of alternatives</td>
<td>1</td>
<td>Decision Matrix; Alt Fuels, Renewable Electric, in- class quizzes, in-class exercises</td>
</tr>
<tr>
<td>Design a quantitative model based on a conceptual model (identify key variables, identify relationships between variables, identify needed data, and perform necessary calculations)</td>
<td>1</td>
<td>Quantitative Model; Alt Fuels, Renewable Electric, in-class quizzes</td>
</tr>
</tbody>
</table>
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

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</table>

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:

<table>
<thead>
<tr>
<th>Course Learning Outcomes</th>
<th>SOs</th>
<th>Assessment Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analyze simple dc circuits using Ohm’s and Kirchhoff’s laws</td>
<td>1, 7</td>
<td>Exam 1, Final Exam, HW #1, 2, 3</td>
</tr>
<tr>
<td>2. Analyze dc circuits using node-voltage, mesh-current, Thevenin equivalent circuits and superposition</td>
<td>1, 7</td>
<td>Exam 1, Exam 2, Final Exam, HW #4, 5, 6</td>
</tr>
<tr>
<td>3. Analyze RC and RL transient circuits</td>
<td>1, 2, 7</td>
<td>Exam 2, Final Exam, HW #7, 8</td>
</tr>
<tr>
<td>4. Analyze simple ac circuits using phasor analysis and determine the steady-state response of ac circuits</td>
<td>1, 7</td>
<td>Final Exam, HW #9, 10, 11</td>
</tr>
<tr>
<td>5. Perform power calculations in single-phase ac circuits</td>
<td>1, 2, 4, 7</td>
<td>Final Exam, HW #12</td>
</tr>
<tr>
<td>6. Be familiar with logic circuits</td>
<td>1, 7</td>
<td>Final Exam, HW #13</td>
</tr>
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</table>

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

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</tbody>
</table>

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 – 1 hour 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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe problems in which engineers can be involved related to the National Academy of Engineering’s &quot;Grand Challenges&quot; for the future</td>
<td>1, 7</td>
<td>Reflection</td>
</tr>
<tr>
<td>2. Cite approaches that engineers employ in addressing the above problems</td>
<td>1, 7</td>
<td>Reflection</td>
</tr>
<tr>
<td>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</td>
<td>3, 7</td>
<td>Project proposal</td>
</tr>
<tr>
<td>4. Establish personal contact with an SEAS faculty mentor</td>
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</table>

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

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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:
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:

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<thead>
<tr>
<th>Course Learning Outcomes</th>
<th>SOs</th>
<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Calculate the resultant forces and moments in 2D and 3D systems;</td>
<td>1</td>
<td>Homework and Exams</td>
</tr>
<tr>
<td>2. Draw free-body diagrams for particles and rigid bodies;</td>
<td>1</td>
<td>Homework and Exams</td>
</tr>
<tr>
<td>3. Solve particle and rigid body problems using the principle of static equilibrium;</td>
<td>1</td>
<td>Homework and Exams</td>
</tr>
<tr>
<td>4. Analyze 2D and 3D trusses using methods of joints and sections;</td>
<td>1</td>
<td>Homework and Exams</td>
</tr>
<tr>
<td>5. Calculate internal forces in a beam and plot shear-force and bending-moment diagrams;</td>
<td>1</td>
<td>Homework and Exams</td>
</tr>
<tr>
<td>6. Solve problems related to sliding objects using Coulomb’s dry friction theory;</td>
<td>1</td>
<td>Homework and Exams</td>
</tr>
<tr>
<td>7. Locate the center of gravity and the centroid of a given shape/volume;</td>
<td>1</td>
<td>Homework and Exams</td>
</tr>
</tbody>
</table>
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):**

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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:

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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understand the basic physical concepts of dynamics</td>
<td>1</td>
<td>Exams, Assignments, In-class quizzes</td>
</tr>
<tr>
<td>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</td>
<td>1,2</td>
<td>Exams, Assignments, In-class quizzes</td>
</tr>
<tr>
<td>3. Be able to apply Newton’s Laws to particles and rigid bodies to solve problems related to dynamic behavior</td>
<td>1,6,7</td>
<td>Exams, Assignments, In-class quizzes</td>
</tr>
<tr>
<td>4. Apply the methods of work, momentum and energy to particles and bodies associated with dynamic behavior</td>
<td>1,2</td>
<td>Exams, Assignments, In-class quizzes</td>
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Relationship of Course to Student Outcomes (Course Assessment Matrix):

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</table>
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
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:

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:

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<tr>
<th>Course Learning Outcomes</th>
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<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Apply basic understanding of stress-strain behavior of engineering materials to solution of engineering problems;</td>
<td>1</td>
<td>Homework, Exams</td>
</tr>
<tr>
<td>2. Analyze members subjected to axial loading, shear, torsion, bending to determine the state of stress and resulting deformation;</td>
<td>1</td>
<td>Homework, Exams</td>
</tr>
<tr>
<td>3. Design simple members to withstand prescribed loads based on strength and serviceability considerations;</td>
<td>2</td>
<td>Homework, Exams</td>
</tr>
<tr>
<td>4. Apply the concepts of equilibrium and compatibility to analyze statically indeterminate members;</td>
<td>1</td>
<td>Homework, Exams</td>
</tr>
<tr>
<td>5. Calculate principal stresses and strains and transform states of stress/strain to different orientations;</td>
<td>1</td>
<td>Homework, Exams</td>
</tr>
<tr>
<td>6. Draw shear-force and bending-moment diagrams for beams;</td>
<td>1</td>
<td>Homework, Exams</td>
</tr>
<tr>
<td>7. Calculate beam deflections;</td>
<td>1</td>
<td>Homework, Exams</td>
</tr>
<tr>
<td>8. Calculate the critical buckling load for columns.</td>
<td>1</td>
<td>Homework, Exams</td>
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</tbody>
</table>
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):

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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:


• 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)

<table>
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<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
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<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Understand the fundamental constructs used in procedural programming, including variables, data types, arrays, loops, conditionals, functions, data input/output.</td>
<td>1</td>
<td>HW, Quizzes, lab work, Exams</td>
</tr>
<tr>
<td>2. Understand the fundamentals of linear algebra including vector, matrices, determinants, matrix inverse, linear combinations, linear dependence, rank, span and linear system consistency</td>
<td>1</td>
<td>HW, Quizzes, Exams</td>
</tr>
</tbody>
</table>
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

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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:
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)

<table>
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<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
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<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Use statistical methodology and tools in the engineering problem-solving process</td>
<td>1</td>
<td>Exam 1, 3; HW # 1, 9, 10</td>
</tr>
<tr>
<td>2. Compute and interpret descriptive statistics using numerical and graphical technique</td>
<td>1</td>
<td>Exam 1, HW #1</td>
</tr>
<tr>
<td>3. Understand the basic concepts of probability, random variables, probability distributions, and joint probability distributions</td>
<td>1</td>
<td>Exam 2, HW # 2 -6</td>
</tr>
<tr>
<td>4. Compute point estimation of parameters, explain sampling distributions, and understand the central limit theorem</td>
<td>1</td>
<td>Exam 3, HW # 7-8</td>
</tr>
<tr>
<td>5. Construct confidence intervals on parameters for a single sample</td>
<td>1, 4</td>
<td>Exam 3, HW # 9</td>
</tr>
<tr>
<td>6. Test hypothesis about population parameters based on sample data</td>
<td>4, 6</td>
<td>Exam 3, HW # 10</td>
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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:
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)

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<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
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<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Describe major ethical theories</td>
<td>4</td>
<td>Reading responses; case study analysis</td>
</tr>
<tr>
<td>2. Recognize ethically complex situations.</td>
<td>3, 4, 5, 7</td>
<td>Case study analysis; group project; reading responses; journal entries</td>
</tr>
<tr>
<td>3. Describe and evaluate multiple solutions to an ethical problem, including demonstrated knowledge of the major canons of the code of ethics.</td>
<td>3, 4, 5, 7</td>
<td>Case study analysis; group project</td>
</tr>
</tbody>
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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

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
EAS 360 STEM Communications

Credit Hours: 3

Contact Hours: Lecture – Three one-hour lectures per week

Coordinator: Prof Amy Baird,

Textbooks and Other Materials:


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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Methods</th>
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</thead>
<tbody>
<tr>
<td>1. Recognize and produce professional communication in a range of relevant genres, including use of appropriate rhetorical strategies and formal elements.</td>
<td>3</td>
<td>HW, Tests, Individual Project, Team Project</td>
</tr>
<tr>
<td>2. Communicate successfully to a variety of audiences including professional (peers, management) and public audiences, using style and tone appropriate for those audiences.</td>
<td>3</td>
<td>HW, Tests, Individual Project, Team Project</td>
</tr>
<tr>
<td>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</td>
<td>3</td>
<td>HW, Tests, Individual Project, Team Project</td>
</tr>
<tr>
<td>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</td>
<td>3</td>
<td>Individual Project, Team Project</td>
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<tr>
<td>Course Topics</td>
<td>Evaluation Level</td>
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<td>Oral Communication</td>
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<td>Web Page</td>
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<td>Graphs and Charts</td>
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<td>Technical Reports</td>
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<td>Help Files</td>
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<td>Collaborative Writing</td>
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<td>Graphic Design Slides</td>
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<td>Presentation Delivery</td>
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Support Level: 1 = Introduce, 2 = Reinforce, and 3 = Mastery
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)

<table>
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<th>Student Outcomes</th>
<th>Assessment Methods</th>
</tr>
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<tbody>
<tr>
<td>1. Describe their role and contribution to the development of solutions to engineering/applied sciences-related problem(s)</td>
<td>1, 2, 3</td>
<td>Co-op Overview, Interim Journal</td>
</tr>
<tr>
<td>2. Demonstrate their ability to contribute to the development of solutions to engineering/applied sciences-related problem(s)</td>
<td>1, 2</td>
<td>Employer Evaluation, Final Presentation</td>
</tr>
<tr>
<td>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)</td>
<td>1, 2, 7</td>
<td>Interim Journal, Summative Reflection</td>
</tr>
<tr>
<td>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)</td>
<td>3, 4, 5</td>
<td>Interim Journal, Summative Reflection</td>
</tr>
<tr>
<td>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</td>
<td>3, 4, 5</td>
<td>Summative Reflection, Final Presentation</td>
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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:

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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>Student Outcomes</th>
<th>Assessment Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Be able to describe the electrical characteristics of voltage sources, current sources, resistors, inductors, and capacitors.</td>
<td>1</td>
<td>Homework and exams</td>
</tr>
<tr>
<td>2. Be able to use Ohm's law to solve DC and AC circuits appropriately.</td>
<td>1</td>
<td>Homework and exams</td>
</tr>
<tr>
<td>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.</td>
<td>1,2</td>
<td>Homework and exams</td>
</tr>
<tr>
<td>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</td>
<td>1,2</td>
<td>Homework and exams</td>
</tr>
<tr>
<td>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)</td>
<td>1</td>
<td>Homework and exams</td>
</tr>
<tr>
<td>6. Be able to analyze sinusoidal stead-state analysis of RLC circuits</td>
<td>1</td>
<td>Homework and exams</td>
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</table>
Relationship of Course to Student Outcomes (Course Assessment Matrix):

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</table>

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:
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:

<table>
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<tr>
<th>Student Outcomes</th>
<th>Assessment Methods</th>
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<tbody>
<tr>
<td>1. Evaluate the investment worthiness of individual engineering projects by applying time value of money concepts</td>
<td>1</td>
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<tr>
<td>2. Describe how commercial loans and mortgages are structured and calculate interest and principal payments for each</td>
<td>1</td>
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<tr>
<td>3. Compare the investment worthiness of multiple mutually exclusive engineering projects using NPW, AE, and ROR methods</td>
<td>1</td>
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<tr>
<td>4. Understand the role of cost data in short term and production related decision making</td>
<td>1</td>
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<tr>
<td>5. Quantify the impact of depreciation and taxes on engineering projects and business operations</td>
<td>1, 4</td>
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</table>
6. Prepare cash flow statements for engineering projects to facilitate investment worthiness evaluation

7. Describe the complexities of economic analysis in evaluation of service sector and health care related projects.

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

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</table>

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)

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<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Understand and interpret engineering graphics</td>
<td>1, 2, 3, 7</td>
<td>Assignments and Final Project</td>
</tr>
<tr>
<td>2. Utilize SOLIDWORKS to create solid models and engineering drawings.</td>
<td>1, 2, 3, 7</td>
<td>Assignments and Final Project</td>
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Relationship of Course to Student Outcomes (Course Assessment Matrix):

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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)

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<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. To teach students the basic principles of classical thermodynamics.</td>
<td>1</td>
<td>Homework, Quizzes, Project</td>
</tr>
<tr>
<td>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.</td>
<td>1, 7</td>
<td>Homework, Quizzes, Project</td>
</tr>
<tr>
<td>3. To train students in the application of a second law analysis to a thermodynamic system.</td>
<td>1, 7</td>
<td>Homework, Quizzes, Project</td>
</tr>
<tr>
<td>4. To train students to analyze the performance of power, refrigeration, and heat pump cycles.</td>
<td>1, 2, 3, 5, 7</td>
<td>Homework, Quizzes, Project</td>
</tr>
</tbody>
</table>
5. To teach students the basic principles of classical thermodynamics.

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.

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

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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:

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)

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<tr>
<th>Course Learning Outcomes:</th>
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<th>Assessment Tools</th>
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<tr>
<td>Upon successful completion of the course, students will be able to:</td>
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<tr>
<td>1. Understand the role of mechanical engineers in industry and society, and their impact on a global level</td>
<td>1, 2</td>
<td>Homework, Quizzes, Exams</td>
</tr>
<tr>
<td>2. Create appropriate models for engineering systems given the desired outcome</td>
<td>1, 2, 6</td>
<td>Homework, Project</td>
</tr>
<tr>
<td>3. Effectively estimate and evaluate analytical results in a technically rigorous manner, leveraging the appropriate information for the desired outcome</td>
<td>1, 7</td>
<td>Homework, Exams, Project</td>
</tr>
<tr>
<td>4. Make and justify engineering decisions considering technical, global, societal, economic, and environmental factors</td>
<td>2, 3, 4</td>
<td>Project</td>
</tr>
<tr>
<td>5. Effectively communicate your findings across disciplines, including but not limited to business, engineering, manufacturing, legal, etc.</td>
<td>3</td>
<td>Project</td>
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6. Understand and demonstrate the characteristics of professional behavior

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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:


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:

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<th>Course Learning Outcomes</th>
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<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Gain fundamental knowledge of structural elements and stress analysis</td>
<td>1</td>
<td>Series of “active” handouts, HW’s</td>
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<tr>
<td>2. Learn how to design structural elements based on failure and other criteria</td>
<td>2</td>
<td>HW’s, Take-home exam problems</td>
</tr>
<tr>
<td>3. Develop an understanding of how basic programming and numerical methods can be used in structural analysis</td>
<td>7</td>
<td>HW’s, Take-home exam problems, FE project</td>
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Relationship of Course to Student Outcomes (Course Assessment Matrix):

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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:

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)

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<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
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</thead>
<tbody>
<tr>
<td>1. Formulate and solve aircraft structure problems using analytical and numerical methods</td>
<td>1</td>
<td>All HW’s and tests</td>
</tr>
<tr>
<td>2. Design aspects</td>
<td>2</td>
<td>HW and test problems involving uncertainty, “factors of safety”</td>
</tr>
<tr>
<td>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.</td>
<td>7</td>
<td>HW and take home test problems</td>
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Relationship of Course to Student Outcomes (Course Assessment Matrix):

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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


Pre-requisite(s): MAE 340, EAS 209

Co-requisite(s): None

Role in Curriculum: Required (Engineering Topics)

<table>
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<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</td>
<td>1</td>
<td>Workshops, In-class exercises</td>
</tr>
<tr>
<td>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</td>
<td>2</td>
<td>Final Project</td>
</tr>
<tr>
<td>3. Communicate effectively with a range of audiences</td>
<td>3</td>
<td>Final Project Report and Oral Presentation</td>
</tr>
<tr>
<td>4. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives</td>
<td>5</td>
<td>Lab Reports, Final Projects</td>
</tr>
<tr>
<td>5. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions</td>
<td>6</td>
<td>Final Project</td>
</tr>
<tr>
<td>6. Acquire and apply new knowledge as needed, using appropriate learning strategies</td>
<td>7</td>
<td>Final Project</td>
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Relationship of Course to Student Outcomes (Course Assessment Matrix):

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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)

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<tbody>
<tr>
<td>1. Determine pressure changes within manometers</td>
<td>1</td>
<td>Homework, Exam 1</td>
</tr>
<tr>
<td>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</td>
<td>1</td>
<td>Homework, Exam 1, Final exam</td>
</tr>
<tr>
<td>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</td>
<td>1, 7</td>
<td>Homework, Quiz, Exam 2, Final exam</td>
</tr>
<tr>
<td>4. Implement the concept of the control volume and apply conservation of mass and linear momentum principles in modeling and analyzing steady open systems</td>
<td>1</td>
<td>Homework, Quiz, Exam 2, Final exam</td>
</tr>
<tr>
<td>5. Analyze the flow of viscous fluids through pipes and simple piping systems for both laminar and turbulent flows, including minor losses</td>
<td>1, 7</td>
<td>Homework, Quiz, Final exam</td>
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6. Analyze the effects of flow on immersed bodies including the application of the concepts of boundary layers, and lift and drag

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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
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)

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<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Determine the temperature distribution and heat transfer rate in a system</td>
<td>1</td>
<td>Homework, Exams 1 – 3</td>
</tr>
<tr>
<td>2. Solve first order differential equations by applying boundary conditions</td>
<td>1, 7</td>
<td>Homework, Exams 1 – 3</td>
</tr>
<tr>
<td>3. Perform energy balances on control surfaces using multiple modes of heat transfer including conduction, convection and radiation</td>
<td>1</td>
<td>Homework, Exams 1 – 3</td>
</tr>
<tr>
<td>4. Perform finite difference heat transfer analysis</td>
<td>1</td>
<td>Homework, Exam 1</td>
</tr>
<tr>
<td>5. Determine heat transfer coefficients for radiation and convection</td>
<td>1, 7</td>
<td>Homework, Exams 2 – 3</td>
</tr>
<tr>
<td>6. Investigate enhancing heat transfer through geometric configurations</td>
<td>1, 7</td>
<td>Homework, Exams 1 – 3</td>
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Relationship of Course to Student Outcomes (Course Assessment Matrix):

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</table>
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:

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<tr>
<td>1. Work in a team as a team member to create a collaborative environment to achieve goals</td>
<td>5</td>
<td>In all experiments</td>
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<tr>
<td>2. Validate drag coefficient by comparing between the one obtained in experiment and theoretical ones</td>
<td>3, 6</td>
<td>Drag on a sphere experiment</td>
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<tr>
<td>3. Find the viscosity of different fluids and compare with actual values</td>
<td>3, 6</td>
<td>Viscosity measurement experiment</td>
</tr>
<tr>
<td>4. Use different instruments, e.g. manometer, orifice meter, venturimeter, turbine meter, float meter for flow measurement</td>
<td>6</td>
<td>Flow meter calibration experiment</td>
</tr>
<tr>
<td>5. Use modern data acquisition system to collect data for heat exchanger and interpret the data</td>
<td>3, 6</td>
<td>Heat exchanger experiment</td>
</tr>
<tr>
<td>6. Calculate the heat conduction parameters from data obtained from experiments</td>
<td>6</td>
<td>Transient heat conduction experiment</td>
</tr>
<tr>
<td>7. Solve Uncertainty problem in assignment and in different experiments</td>
<td>1</td>
<td>Uncertainty homework and Drag, Viscosity, and Flowmeter experiments</td>
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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)

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<tr>
<td>1. Apply theoretical concepts from fluid mechanics, heat transfer, and aerodynamics to study the performance of real-world engineering experiments, including airfoil tests</td>
<td>1</td>
<td>Lab experiences and reports</td>
</tr>
<tr>
<td>2. Select test cases for an experiment and approach new experimental design problems based on previous experience</td>
<td>2</td>
<td>Lab experiences and reports</td>
</tr>
<tr>
<td>3. Communicate the results and conclusions clearly and effectively, both written and graphically, in a well-organized and thorough technical report</td>
<td>3</td>
<td>Lab experiences and reports</td>
</tr>
<tr>
<td>4. Select test cases for an experiment and approach new experimental design problems based on previous experience</td>
<td>5</td>
<td>Lab experiences and reports</td>
</tr>
<tr>
<td>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</td>
<td>6</td>
<td>Lab experiences and reports</td>
</tr>
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</table>
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 coupled with appropriate software (e.g. Excel)

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

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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
7. Measuring drag coefficients
8. Reynolds number calculations

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E002 2020-2021 Self-Study Questionnaire
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)

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<th>Assessment Tools</th>
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<tbody>
<tr>
<td>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</td>
<td>1, 2, 6, 7</td>
<td>HW’s, quizzes, tests, and/or final exam</td>
<td></td>
</tr>
<tr>
<td>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</td>
<td>1, 2, 3, 4, 6, 7</td>
<td>HW’s, quizzes, tests, and/or final exam</td>
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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:
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)

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<th>Assessment Tools</th>
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<tr>
<td>1. Understand advanced analytical dynamics concepts</td>
<td>1, 5</td>
<td>Tests, assignments</td>
</tr>
<tr>
<td>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</td>
<td>1</td>
<td>Tests, assignments</td>
</tr>
<tr>
<td>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</td>
<td>1, 5, 7</td>
<td>Tests, assignments</td>
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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)

<table>
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<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
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</thead>
<tbody>
<tr>
<td>1. Identify the various capabilities and limitations of the many manufacturing processes</td>
<td>1</td>
<td>Assignments, Quizzes, Exams, Projects</td>
</tr>
<tr>
<td>2. Describe various manufacturing techniques and distinguish the appropriate process for given scenarios</td>
<td>1</td>
<td>Assignments, Quizzes, Exams, Projects</td>
</tr>
<tr>
<td>3. Propose design modifications considering the various capabilities and limitations of the manufacturing processes</td>
<td>2, 4, 5, 7</td>
<td>Projects</td>
</tr>
<tr>
<td>4. Evaluate and justify which manufacturing methods are suitable for fabricating a given product</td>
<td>1, 4, 7</td>
<td>Assignments, Quizzes, Exams, Projects</td>
</tr>
<tr>
<td>5. Design a unique product that considers their ethical responsibilities and realistic constraints</td>
<td>2, 4, 5</td>
<td>Projects</td>
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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)

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<tr>
<td>Upon successful completion of the course, students will be able to:</td>
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<tr>
<td>1. Understand and apply Geometric Dimensioning &amp; Tolerancing (GD&amp;T) in accordance with ASME standards</td>
<td>1, 2, 3, 7</td>
<td>Assignments, quizzes, and projects</td>
</tr>
<tr>
<td>2. Utilize commercial Finite Element Analysis (FEA) software to perform structural analysis on components and assemblies</td>
<td>1, 2, 3, 7</td>
<td>Assignments, quizzes, and projects</td>
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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:


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)

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<tr>
<td>1. Understand the internal structure of a material and how it impacts the behavior of the material</td>
<td>1</td>
<td>Exams</td>
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<tr>
<td>2. Understand how the internal structure of a material can be controlled by processing to alter the material properties</td>
<td>1</td>
<td>Exams</td>
</tr>
<tr>
<td>3. Perform a literature survey on an advanced material topic and disseminate the results in a term paper</td>
<td>3, 7</td>
<td>Term paper</td>
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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:


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)

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<tr>
<td>1. Perform standardized tests to determine material properties</td>
<td>6, 7</td>
<td>Labs 1 &amp; 2</td>
</tr>
<tr>
<td>2. Understand how a material’s property can be adjusted via processing, such as: cold work, hot work, heat treatment, adjusting cooling rate, etc.</td>
<td>1</td>
<td>Labs 3, 5, &amp; 6</td>
</tr>
<tr>
<td>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.</td>
<td>6</td>
<td>Lab 4</td>
</tr>
<tr>
<td>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.</td>
<td>3</td>
<td>Labs 1 – 6</td>
</tr>
<tr>
<td>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.</td>
<td>1</td>
<td>Labs 1 – 6</td>
</tr>
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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
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 Historical Perspective, 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)

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<tr>
<td>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</td>
<td>1, 2</td>
<td>Homework, Midterm</td>
</tr>
<tr>
<td>2. Calculate the effect of area change, shaft work, heat addition, mass addition and friction on flow states in a compressible channel flow</td>
<td>1, 6</td>
<td>Homework</td>
</tr>
<tr>
<td>3. Characterize quantitatively the behavior of velocity and density non-uniformities in an unsteady compressible flow including their evolution in fluid system components</td>
<td>7</td>
<td>Homework, Midterm, Final</td>
</tr>
<tr>
<td>4. Estimate the lift and drag for basic aerodynamic shapes in compressible, inviscid flows</td>
<td>6, 7</td>
<td>Homework, Final</td>
</tr>
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Relationship of Course to Student Outcomes (Course Assessment Matrix):

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</table>
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)

<table>
<thead>
<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
<th>SOs</th>
<th>Assessment Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</td>
<td>1</td>
<td>Homework, Exam</td>
</tr>
<tr>
<td>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.</td>
<td>2</td>
<td>Final Project</td>
</tr>
<tr>
<td>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.</td>
<td>4</td>
<td>Final Project</td>
</tr>
<tr>
<td>4. Acquire and apply new knowledge as needed, using appropriate learning strategies</td>
<td>7</td>
<td>Homework</td>
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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:


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)

<table>
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<tr>
<th>Course Learning Outcomes: Upon successful completion of the course, students will be able to:</th>
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<tbody>
<tr>
<td>1. Understand the physical mechanisms underlying the aerodynamics of airfoils and wings</td>
<td></td>
<td>Homework, Exams, Projects</td>
</tr>
<tr>
<td>2. Apply the appropriate governing equations and assumptions to analyze airfoils and wings, and obtain aerodynamic forces and moments</td>
<td></td>
<td>Homework, Exams, Projects</td>
</tr>
<tr>
<td>3. Identify the effects of parameters such as airfoil shape, wing aspect ratio, and compressibility on performance</td>
<td></td>
<td>Homework, Exams, Projects</td>
</tr>
<tr>
<td>4. Incorporate aspects such as fuel efficiency and cost into performance calculations, to consider environmental and economic factors</td>
<td>2, 4</td>
<td>Projects</td>
</tr>
<tr>
<td>5. Have an introductory knowledge of the experimental facilities and methods used to measure airfoil characteristics</td>
<td></td>
<td>Homework, Exams</td>
</tr>
<tr>
<td>6. Have an introductory understanding of the computational methods used to analyze airfoils and wings</td>
<td></td>
<td>Projects</td>
</tr>
<tr>
<td>7. Produce an aerodynamic design to meet specified requirements and constraints, including environmental and economic considerations, using the skills identified above</td>
<td>2, 4</td>
<td>Projects</td>
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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:

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:

<table>
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<tr>
<th>Course Learning Outcomes</th>
<th>SOs</th>
<th>Assessment Tools</th>
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<tbody>
<tr>
<td>1. Apply orbital and attitude equations of motion to formulate practical spacecraft mission requirements</td>
<td>1</td>
<td>Project 1 and 2</td>
</tr>
<tr>
<td>2. Draw conclusions on the usefulness of orbital dynamics and coordinate frames to interpret solutions</td>
<td>6</td>
<td>Home 3, 4, and 6</td>
</tr>
<tr>
<td>3. Understand and apply knowledge of the theory behind orbital and attitude equations of motion to solve new problems</td>
<td>7</td>
<td>Test 1 and 2</td>
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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:


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)

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<tr>
<th>Course Learning Outcomes</th>
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<tbody>
<tr>
<td>Upon successful completion of the course, students will be able to:</td>
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<tr>
<td>1. Derive the nonlinear equations of motion for an aircraft through application of Newton’s Laws and the analysis of forces and moments from thrust, aerodynamic interactions, and gravity.</td>
<td>1</td>
<td>HW 1, HW 2 Test 1, Final</td>
</tr>
<tr>
<td>2. Describe aircraft attitude in terms of Euler angles and quaternions.</td>
<td>1</td>
<td>HW 2, HW 3, Test 1, Final</td>
</tr>
<tr>
<td>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.</td>
<td>1</td>
<td>HW 4, Test 2, Final Exam</td>
</tr>
</tbody>
</table>
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

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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:

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:

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<tbody>
<tr>
<td>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,</td>
<td>1, 2, 4</td>
<td>Memos/Exam 1/HW 1</td>
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E002 2020-2021 Self-Study Questionnaire
environmental, and economic factors by converting the customer needs to design specifications.

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<tr>
<th>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.</th>
<th>2</th>
<th>Memos</th>
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<tbody>
<tr>
<td>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.</td>
<td>2</td>
<td>HW 2, 3, 4/Exam 2</td>
</tr>
<tr>
<td>4. Communicate intermediate and final designs clearly and effectively in written and oral formats</td>
<td>3</td>
<td>Oral presentations/Memos</td>
</tr>
<tr>
<td>5. To teach students the basic principles of classical thermodynamics.</td>
<td>1</td>
<td>Homework, Quizzes, Project</td>
</tr>
<tr>
<td>6. Understand the characteristics of successful design teams. Use some scheduling and planning tools, principles, and behaviors that promote the effectiveness of a team.</td>
<td>5</td>
<td>Memos</td>
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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)

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<tbody>
<tr>
<td>1. Work with a diverse group to complete a unified project</td>
<td>5</td>
<td>Progress reports</td>
</tr>
<tr>
<td>2. Present technical work through oral and written communications</td>
<td>3</td>
<td>Design reviews, proposal/final report/Elevator pitch video</td>
</tr>
<tr>
<td>3. Provide project updates and resolve technical issues using a web-based communication platform</td>
<td>6, 7</td>
<td>Progress reports</td>
</tr>
<tr>
<td>4. Perform an engineering development project that is cognizant of health, safety, and welfare as well as global, cultural, social, environmental, and economic factors</td>
<td>2, 4</td>
<td>Final report</td>
</tr>
<tr>
<td>5. An understanding of professional and ethical responsibility</td>
<td>4</td>
<td>Progress reports/final report</td>
</tr>
<tr>
<td>6. Identify, formulate and solve problems related to an engineering project</td>
<td>1</td>
<td>Proposal/final report</td>
</tr>
<tr>
<td>7. Apply mathematics, science and engineering skills to a real-world problem</td>
<td>1</td>
<td>Final report</td>
</tr>
<tr>
<td>8. Use experimental, numerical and analytical techniques to conceive solutions to engineering problems</td>
<td>1, 7</td>
<td>Final report</td>
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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)

<table>
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<th>Assessment Tools</th>
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</thead>
<tbody>
<tr>
<td>1. Articulate connections across different academic disciplines and perspectives</td>
<td></td>
<td>ePortfolio</td>
</tr>
<tr>
<td>2. Adapt and apply skills, abilities, theories or methodologies acquired in one situation to new situations.</td>
<td>7</td>
<td>ePortfolio</td>
</tr>
<tr>
<td>3. Connect relevant experiences and academic knowledge.</td>
<td></td>
<td>ePortfolio</td>
</tr>
<tr>
<td>4. Demonstrate an evolving sense of self as learner.</td>
<td>7</td>
<td>Final ePortfolio</td>
</tr>
<tr>
<td>5. Integrate different forms of communication to enhance meaning (prose, sound, visual media)</td>
<td>3</td>
<td>ePortfolio</td>
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</table>
6. Apply your understanding of digital citizenship to create an academic capstone portfolio.

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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, 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

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

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

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
- 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
- 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

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., 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.

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
- Inventor of the Month, Virginia Tech Office of the Vice President for Research May 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

10. Briefly list the most recent professional development activities
1. Name: **Eleonora M. Botta**

2. Education
   - Ph.D., Mechanical Engineering, McGill University, Montreal, Canada, 2013 - 2017
   - 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
   - McGill Engineering Doctoral Award (MEDA). Faculty of Engineering, McGill University, 2013 - 2016

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

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

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

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

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

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:**


**FULL-LENGTH CONFERENCE ARTICLES:**


**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 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.
7. Honors and awards
   - 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.

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.

9. Briefly list the most important publications and presentations from the past five years

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
   − 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 InformationFusion
     (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 Distinguished Professor, '19
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
   – 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

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
– 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)

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)
   - 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

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)
   - 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
9. Briefly list the most important publications and presentations from the past five years

10. Briefly list the most recent professional development activities
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
   - 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
− 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

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, MAEPh.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)
   - 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)

9. Briefly list the most important publications and presentations from the past five years

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)**
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


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)
   – 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
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
   - 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
   - An Adaptive Mathematical Framework for Scalability in Microgrid Modeling, Sustainability Summit, Xavier University, Bhubaneswar, Odisha, India, February 9–10, 2018

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).
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.
   - 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, NSF-IRES, 2013, 2015, 2017

9. Most important publications and presentations from the past five years

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
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 Internationale Francophone 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 Programming 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 accommodate was given in The 8th Annual Low Carbon Earth Summit, Qingdao, China, October 23-25, 2018.

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

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.
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

5. Certifications or professional registrations

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
9. Briefly list the most important publications and presentations from the past five years


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) Community of 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

10. Briefly list the most recent professional development activities
   - 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.
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.
   - 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
   Invited Book Chapter:

   Journal Articles:

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

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.
− “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
   - 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
   - Graduate Committee, 2012
   - Coordinator of Biomechanical Engineering, 2002-2009
   - Hosting Women in Science and Engineering (WISE) camp for incoming freshmen (a program for females in STEM, Aug 21-22, 2014

9. Briefly list the most important publications and presentations from the past five years

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
   - 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

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 ‘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.

9. Briefly list the most important publications and presentations from the past five years

10. Briefly list the most recent professional development activities
None
1. Name: **D. Joseph Mook**

2. Education
   - 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
   - Thai Nguyen University of Technology, Mechanical Engineering, Visiting Professor, 2011, full-time
   - Universite de Technologie de Compiègne, 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
   - 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

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)
9. Briefly list the most important publications and presentations from the past five years

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

9. Briefly list the most important publications and presentations from the past five years

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, 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)

8. Service activities
   − Member, AIAA Fluid Dynamics Technical Committee (FDTC, Feb. 2019–present).
− Member, AIAA FDTC Awards Committee (Oct. 2019–present).
− 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).

9. Recent Publications/Presentations (Bold: grad students/postdocs; italicized: undergrads)

10. Most recent professional development activities
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.
9. Briefly list the most important publications and presentations from the past five years

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
   - 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


10. Briefly list the most recent professional development activities


- Participated in Faculty Development Program, Office of Teaching Effectiveness, UB, Aug. 15, 1994.


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 Society of Mechanical Engineers, 2005-2017
   - 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 “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., 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
    - 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)

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
- J. William Fulbright Fellow, University of Kaiserslautern (Institut für Verbundwerkstoffe), Fall 1997-Spring 1998.
- Associate Fellow of AIAA (1996).
- 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

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
- CSE Explore 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**


**Presentations**

- “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.

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Course</th>
<th>Location</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estes, Raihamian</td>
<td>MAE 334</td>
<td>810/811 Furnas</td>
<td>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);</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Khan, Sabato</td>
<td>MAE 338</td>
<td>214/216 Jarvis</td>
<td>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.</td>
</tr>
<tr>
<td>Armstrong</td>
<td>MAE 385</td>
<td>618 Furnas</td>
<td>MTS 810 servo-hydraulic mechanical testing machine United electro-mechanical testing machine Metallograph</td>
</tr>
<tr>
<td></td>
<td></td>
<td>619 Furnas</td>
<td>Heat-treatment furnaces; Charpy impact tester Rotating beam fatigue testers</td>
</tr>
<tr>
<td>Course</td>
<td>Laboratory Area</td>
<td>Equipment/Equipment Types</td>
<td></td>
</tr>
<tr>
<td>------------</td>
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<td></td>
</tr>
<tr>
<td>Burge/Ringuette</td>
<td>620 Furnas</td>
<td>Metallurgical mounting and polishing equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>621 Furnas</td>
<td>Hardness testers; PASCO Materials Testing Systems w/laptops Table-top rolling mills</td>
<td></td>
</tr>
<tr>
<td>MAE 339</td>
<td>214 Jarvis</td>
<td>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)</td>
<td></td>
</tr>
<tr>
<td>equipment category</td>
<td>description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>wind tunnel</td>
<td>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</td>
<td></td>
<td></td>
</tr>
<tr>
<td>water channel</td>
<td>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</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tunnel</td>
<td>10ft Drop Tunnel with vacuum pump/pedestal; High-Speed Camera</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cameras</td>
<td>(3) FLIR E60 Cameras</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIV system</td>
<td>2C-2D PIV System (532nm Laser, Sheet Optics, CMOS Camera, Timing card)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Council Members</th>
<th>Council Members</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Michael J. Cadigan, BS’79 Chair</strong></td>
<td>Patrick F. Abrami, BS’72, MS’75</td>
</tr>
<tr>
<td>Senior Vice President, Global Sales and Business Development, ASICS Business Unit Global Foundries</td>
<td>Consultant</td>
</tr>
<tr>
<td><strong>Russell L. Agrusa, BS’76</strong></td>
<td>Paul Ameis, BS’94</td>
</tr>
<tr>
<td>Founder, President and CEO, ICONICS, Inc.</td>
<td>General Manager, Lockport VanDeMark</td>
</tr>
<tr>
<td><strong>Ron Benezkowski, BS’82</strong></td>
<td>David Cadigan, BS’08</td>
</tr>
<tr>
<td>Vice President-Engineering, Moog, Inc., Space and Defense Group</td>
<td>Computer Hardware Engineer, IBM</td>
</tr>
<tr>
<td><strong>James Chou, BS’84</strong></td>
<td>Dennis Elsenbeck, BS 96</td>
</tr>
<tr>
<td>Chief Technology Officer, Kabbage, Inc.</td>
<td>Head of Energy and Sustainability, Energy Consulting Services, Phillips Lytle LLP</td>
</tr>
<tr>
<td><strong>Judy Feldmen</strong></td>
<td>Robert Girardi, BS’90, MBA’92</td>
</tr>
<tr>
<td>Executive Vice President, Chief Information Officer, Value Centric</td>
<td>President and CEO, SofTrek, retired</td>
</tr>
<tr>
<td><strong>Karianne Gomez, BS’00</strong></td>
<td>Robert G. Harrison, P.E., BS’83</td>
</tr>
<tr>
<td>Vice President of Strategic Value, Network of Executive Women</td>
<td>Vice President of Engineering and Construction, Transmission Developers, Inc.</td>
</tr>
<tr>
<td><strong>Cynthia A. Hoover, PhD’95</strong></td>
<td>Rob Jacoby, MS’80</td>
</tr>
<tr>
<td>Executive Director, Linde</td>
<td>Consultant to the Energy Industry</td>
</tr>
<tr>
<td><strong>Ashok Jain</strong></td>
<td>Joe Kessler, P.E., BS’93, ME’00, MBA’10</td>
</tr>
<tr>
<td>Vice President, Systems Management and Engineering, Safran</td>
<td>Chief Operating Officer, New York Power Authority</td>
</tr>
<tr>
<td><strong>Anil Kshirsagar, MS’77, MBA’79 Executive Chair, CAPIOT Software, Inc</strong></td>
<td>Gina Lee-Glauser, BS’82, MS’88</td>
</tr>
<tr>
<td><strong>Jeff Markin, BS’80</strong></td>
<td>Vice President for Research and Scholarship; Provost Office at Clarkson University</td>
</tr>
<tr>
<td>Chief Operating Officer, eHealth Technologies</td>
<td><strong>Susan R. Nowicki</strong></td>
</tr>
<tr>
<td><strong>Director of Engineering, Northrop Grumman Amherst Systems</strong></td>
<td><strong>Ashish Shah, MS’89, PhD’93 Vice President of Research and Development, Viant, Inc.</strong></td>
</tr>
<tr>
<td><strong>Alice Smith</strong></td>
<td><strong>Edward C. Morris, P.E., BS’73</strong></td>
</tr>
<tr>
<td>Joe W. Forehand/Accenture Distinguished Professor of the Industrial and Systems Engineering Department, Auburn University</td>
<td>President, ECM Management Consultants, LLC</td>
</tr>
<tr>
<td><strong>Jonathan Watts, P.E., BS’00, BS’03 Vice President, Watts Architecture &amp; Engineering DPC</strong></td>
<td><strong>Stephen E. Still, BS’76</strong></td>
</tr>
<tr>
<td><strong>Stephen E. Still, BS’76</strong></td>
<td>Retired. Former co-founder and consultant, Seabury Airline Planning Group LLC</td>
</tr>
<tr>
<td><strong>Gary &amp; Sherron Kalbach Chair in Business Administration and Professor of Operations and Information Technology Management, University of California, Berkeley</strong></td>
<td><strong>Candace Yano</strong></td>
</tr>
</tbody>
</table>

**Figure D-1.** University at Buffalo Organizational Chart
Figure D-2. SEAS Undergraduate Educational Organization
## SEAS Leadership

<table>
<thead>
<tr>
<th>Unit</th>
<th>Name, Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>School of Engineering and Applied Sciences</td>
<td>Kemper Lewis, Dean</td>
</tr>
<tr>
<td>Undergraduate Education</td>
<td>Jeffrey Errington, Associate Dean</td>
</tr>
<tr>
<td>Graduate Education and Research</td>
<td>Shambhu Upadhyaya, Associate Dean</td>
</tr>
<tr>
<td>Faculty Affairs and Diversity</td>
<td>Rajan Batta, Associate Dean</td>
</tr>
<tr>
<td>Student Affairs and Accreditation</td>
<td>Christine Human, Associate Dean</td>
</tr>
</tbody>
</table>

### Academic Departments

- Biomedical  
  - Albert Titus, Chair
  - Mark Swihart, Chair
- Chemical and Biological  
  - Joseph Atkinson, Chair
  - Chunming Qiao, Chair
- Civil, Structural and Environmental  
  - Jonathan Bird, Chair
  - Carl Lund, Chair
- Computer Science and Engineering  
  - Victor Paquet, Chair
- Electrical  
  - Krishna Rajan, Chair
- Engineering Education  
  - Francine Battaglia, Chair
- Industrial and Systems  
- Materials Design and Innovation  
- Mechanical and Aerospace
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.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Responsible Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>College of Arts and Sciences</td>
<td>Robin Schulze, Dean</td>
</tr>
<tr>
<td><strong>Academic Departments</strong></td>
<td></td>
</tr>
<tr>
<td>- Biological Sciences</td>
<td>Paul Gollnick, Professor and Chair</td>
</tr>
<tr>
<td>- Chemistry</td>
<td>David F. Watson, Professor and Chair</td>
</tr>
<tr>
<td>- Geography</td>
<td>Chris P. S. Larsen, Professor and Chair</td>
</tr>
<tr>
<td>- Geology</td>
<td>Beata Csatho, Professor and Chair</td>
</tr>
<tr>
<td>- Geology</td>
<td>Gino Biondini, Professor and Chair</td>
</tr>
<tr>
<td>- Mathematics</td>
<td>Sambandamurthy Ganapathy, Professor and Chair</td>
</tr>
<tr>
<td>- Physics</td>
<td></td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Responsible Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Integrity</td>
<td>Kelly Ahuna, Director</td>
</tr>
<tr>
<td>Accessibility Resources</td>
<td>Randy Borst, Director</td>
</tr>
<tr>
<td>Blackstone LaunchPad by Techstars</td>
<td>Hadar Borden, Director</td>
</tr>
<tr>
<td>Career Services</td>
<td>Arlene Kaukus, Director</td>
</tr>
<tr>
<td>Center for Excellence in Writing</td>
<td>Rhonda Reid, Director</td>
</tr>
<tr>
<td>Center for Education Innovation</td>
<td>Christine Kroll, Assistant Vice Provost and Director</td>
</tr>
<tr>
<td>Cora P. Maloney Center</td>
<td>Shanna Crump-Owens, Director</td>
</tr>
<tr>
<td>Counseling Services and Wellness</td>
<td>Sharon Mitchell, Senior Director</td>
</tr>
<tr>
<td>Educational Effectiveness</td>
<td>Carol Van Zile-Tamsen, Assistant Vice Provost and Director</td>
</tr>
<tr>
<td>Experiential Learning Network</td>
<td>Mara Huber, Associate Dean, Undergraduate Research and Experiential Learning</td>
</tr>
<tr>
<td>International Admissions</td>
<td>Steven Shaw, Assistant Vice Provost and Director</td>
</tr>
<tr>
<td>International Student Services</td>
<td>Katie Tudini, Director</td>
</tr>
<tr>
<td>Math Place (Tutoring)</td>
<td>Angela Samul, Coordinator</td>
</tr>
<tr>
<td>Student Conduct and Advocacy</td>
<td>Elizabeth Lidano, Director</td>
</tr>
<tr>
<td>Study Abroad Programs</td>
<td>Mary Odrzywolski, Director</td>
</tr>
<tr>
<td>Tutoring and Academic Support Services</td>
<td>Vivian Jimenez, Interim Director</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Enrollment Year</th>
<th>Total Undergrad</th>
<th>Degree Awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
</tr>
<tr>
<td>Current Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-20</td>
<td>FT</td>
<td>132</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>PT</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1 year prior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to current</td>
<td>FT</td>
<td>113</td>
<td>176</td>
</tr>
<tr>
<td>year</td>
<td>PT</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2 years prior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to current</td>
<td>FT</td>
<td>135</td>
<td>157</td>
</tr>
<tr>
<td>year</td>
<td>PT</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3 years prior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to current</td>
<td>FT</td>
<td>92</td>
<td>167</td>
</tr>
<tr>
<td>year</td>
<td>PT</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4 years prior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to current</td>
<td>FT</td>
<td>110</td>
<td>140</td>
</tr>
<tr>
<td>year</td>
<td>PT</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

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.

1Enrollment year based upon credit hours completed, 1\textsuperscript{st}: 0-29 hours, 2\textsuperscript{nd}: 30-59 hours, 3\textsuperscript{rd}: 60-89 hours, 4\textsuperscript{th}: > 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: **2019**

<table>
<thead>
<tr>
<th>Personnel Category</th>
<th>FT</th>
<th>PT</th>
<th>FTE²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative²</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Faculty (tenure-track)³</td>
<td>32</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Other Faculty (excluding student Assistants)</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Student Teaching Assistants⁴</td>
<td>43</td>
<td>77</td>
<td>81.5</td>
</tr>
<tr>
<td>Technicians/Specialists</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Office/Clerical Employees</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Others⁵</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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
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.
Advising Notes

Campus transfer path requirements are required technical (not General Education) classes selected based on the intended transfer institution. Each four-year institution 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 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.
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

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**

<table>
<thead>
<tr>
<th>Major</th>
<th>Overall GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace, Computer, and Mechanical Engineering; Computer Science (BA and BS); Bioinformatics and Computational Biology</td>
<td>2.8</td>
</tr>
<tr>
<td>Biomedical, Chemical, Civil, Electrical, Environmental, and Industrial Engineering, Engineering Physics</td>
<td>2.5</td>
</tr>
</tbody>
</table>

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 Approved 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.

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.

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.

<table>
<thead>
<tr>
<th>Test Type</th>
<th>University Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOEFL (IBT) (including MyBest scores)</td>
<td>70</td>
</tr>
<tr>
<td>TOEFL (PBT)</td>
<td>523</td>
</tr>
<tr>
<td>IELTS</td>
<td>6.0</td>
</tr>
<tr>
<td>PTE</td>
<td>50</td>
</tr>
<tr>
<td>ACT (English and Reading)</td>
<td>18</td>
</tr>
<tr>
<td>SAT I ERWS</td>
<td>500</td>
</tr>
<tr>
<td>Duolingo English Test (DET)</td>
<td>105</td>
</tr>
<tr>
<td>*for students currently living in China</td>
<td></td>
</tr>
<tr>
<td>Other recognized tests</td>
<td>Learn about other tests for freshman applicants</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
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</tr>
<tr>
<td>PTE</td>
<td>50</td>
</tr>
<tr>
<td>ACT</td>
<td></td>
</tr>
</tbody>
</table>

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.

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
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

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.
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**

<table>
<thead>
<tr>
<th>Status</th>
<th>Fall or Spring Semester Performance</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Standing</td>
<td>CTGPA ≥ 2.0 and STGPA ≥ 2.0</td>
<td>Good Standing</td>
</tr>
<tr>
<td></td>
<td>CTGPA ≥ 1.4 and STGPA &lt; 2.0</td>
<td>Probation</td>
</tr>
<tr>
<td></td>
<td>CTGPA &lt; 2.0 and STGPA &gt; 2.0</td>
<td>Probation</td>
</tr>
<tr>
<td></td>
<td>CTGPA &lt; 1.4 and STGPA &lt; 2.0 and first semester at UB</td>
<td>Probation</td>
</tr>
<tr>
<td></td>
<td>CTGPA &lt; 1.4 and STGPA &lt; 2.0 and more than one semester at UB</td>
<td>Dismissal</td>
</tr>
<tr>
<td>Probation</td>
<td>CTGPA ≥ 2.0 and STGPA ≥ 2.0</td>
<td>Good Standing</td>
</tr>
<tr>
<td></td>
<td>CTGPA ≥ 2.0 and STGPA &lt; 2.0</td>
<td>Probation</td>
</tr>
<tr>
<td></td>
<td>CTGPA &lt; 2.0 and STGPA ≥ 2.0</td>
<td>Probation</td>
</tr>
<tr>
<td></td>
<td>CTGPA &lt; 2.0 and STGPA &lt; 2.0</td>
<td>Dismissal</td>
</tr>
</tbody>
</table>
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

Students 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 
\[(30 \times 2.5 - 30 \times 2.2) = 9\]

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
\[(30 \times 2.8 - 30 \times 2.2) = 18\]

<table>
<thead>
<tr>
<th>UB Semester</th>
<th>Maximum Admission QP Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not Reviewed</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

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 Colleges
- SASC-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.

Published: May 27, 2020 15:19:57
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
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.

Published: May 27, 2020 15:19:57
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

Published: May 27, 2020 15:19:57
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.

Published: May 27, 2020 15:19:57
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.

Published: May 27, 2020 15:19:57
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.

Published: May 27, 2020 15:19:57
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

Search Equivalency by Course

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.
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.
Campus transfer path requirements are required technical (not General Education) classes selected based on the intended transfer institution. Each four-year institution 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 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)
Professional Development Blueprint

The **Professional Development Blueprint** is a co-curricular roadmap focused on career preparation for undergraduate applied science and engineering students.

### ▼ EXPLORATION

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review the credentials and specializations of faculty and industry professionals.</td>
<td>Review research articles on topics of interest.</td>
<td>Explore graduate schools and prepare for required standardized admissions tests.</td>
<td>Continue to explore the cost of living, job market, and average salary in geographic areas of interest.</td>
</tr>
<tr>
<td>Explore SEAS clubs/organizations and attend general meetings for those that interest you.</td>
<td>Attend the Celebration of Academic Excellence.</td>
<td>Attend seminars to keep abreast of current research, projects and developments in your discipline.</td>
<td>Observe an MS thesis or PhD dissertation defense presentation.</td>
</tr>
<tr>
<td>Research study abroad opportunities.</td>
<td>Explore entrepreneurship resources.</td>
<td>Attend the spring Graduate Student Poster Competition.</td>
<td></td>
</tr>
</tbody>
</table>

### ▼ CONNECTIONS

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sign up for Engineering Small Groups.</td>
<td>Attend a networking workshop.</td>
<td>Develop a relationship with a faculty advisor.</td>
<td>Attend technical society meetings to network with professionals in your field.</td>
</tr>
<tr>
<td>Volunteer in the community through Saturdays of Service.</td>
<td>Register for the Real Experience and Leadership Mentoring Program (REALM).</td>
<td>Identify and meet a career mentor through the UB Career Connector Network.</td>
<td>Join groups on LinkedIn related to topics or careers of interest.</td>
</tr>
<tr>
<td>Attend the spring Senior Design Expo.</td>
<td>Research professional technical societies related to your discipline and interview current members.</td>
<td>Join a technical society related to your discipline.</td>
<td>After graduation, stay in touch with UB through UB Connect and LinkedIn.</td>
</tr>
</tbody>
</table>

### ▼ EXPERIENCE

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
### ▼ CAREER FUNDAMENTALS

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pursue self-led hands-on tinkering modules to develop technical skills.</td>
<td>Participate in engineering intramurals, short-term extra-curricular projects completed in small groups.</td>
<td>Participate in a CURCA research project at UB or spend the summer at an REU site.</td>
<td>Continue internships, research, and other projects or find a student assistant/grader position.</td>
</tr>
<tr>
<td>Learn about professional communication and etiquette.</td>
<td>Attend a LinkedIn workshop.</td>
<td>Polish your interviewing skills by doing a practice interview session with Career Services.</td>
<td>Search for job opportunities at the fall STEAM UP job and internship fair.</td>
</tr>
<tr>
<td>Participate in a time management workshop.</td>
<td>Attend a job and internship search strategy workshop.</td>
<td>Update your resume as you master new skills, projects, and experiences.</td>
<td>Apply to graduate schools and/or graduate fellowships.</td>
</tr>
<tr>
<td>Create a resume and set up a student profile on Bullseye.</td>
<td>Make an appointment for a resume, cover letter, and LinkedIn profile review prior to applying for an internship.</td>
<td>Learn about the requirements for Professional Engineer Licensure.</td>
<td>Register to take the Fundamentals of Engineering Exam.</td>
</tr>
<tr>
<td>Observe the fall STEAM UP job and internship fair.</td>
<td>Engage in a leadership or communication workshop.</td>
<td></td>
<td>Learn how to manage multiple job offers and negotiate your salary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Take a professional oath during the Pledge to Professionalism ceremony.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Complete the UB First survey in the fall following graduation.</td>
</tr>
</tbody>
</table>

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

Published: May 27, 2020 15:19:57
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.

Published: May 27, 2020 15:19:57
<table>
<thead>
<tr>
<th>ALP Test</th>
<th>Credit Award</th>
<th>UB Course Articulation and Comments</th>
<th>Required Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spanish</td>
<td>6</td>
<td>SPA210 How to Read a Spanish Text  + SPA313 Advanced Grammar</td>
<td>4, 5</td>
</tr>
<tr>
<td>Spanish</td>
<td>6</td>
<td>SPA208 Spanish Conversation and Composition  + SPA210 How to Read a Spanish Text</td>
<td>3</td>
</tr>
<tr>
<td>Spanish</td>
<td>0</td>
<td>Contact Spanish Language Program Director for placement, <a href="http://www.rll.buffalo.edu">www.rll.buffalo.edu</a></td>
<td>2, 1</td>
</tr>
</tbody>
</table>
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.

Published: May 27, 2020 15:19:57
### 2020-2021 Advanced Placement (AP) Exam Articulation

<table>
<thead>
<tr>
<th>HUB AP Code</th>
<th>AP Exam</th>
<th>Score</th>
<th>UB Course Articulation</th>
<th>Cr. Hrs</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARH</td>
<td>Art: Art History</td>
<td>3</td>
<td>APC999TR</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>ARH</td>
<td>Art: Art History</td>
<td>4, 5</td>
<td><strong>AH101LR</strong> + <strong>AH102LR</strong></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>ASD</td>
<td>Art: Studio Art: Drawing Portfolio</td>
<td>3</td>
<td>APC999TR</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>ASD</td>
<td>Art: Studio Art: Drawing Portfolio</td>
<td>4, 5</td>
<td>ART999TRSAE</td>
<td>6</td>
<td>Studio Art elective credit for Art majors. Only 6 credits of AP Studio Art will be accepted toward Art major requirements</td>
</tr>
<tr>
<td>A2D</td>
<td>Art: Studio Art: 2D Design Portfolio</td>
<td>3</td>
<td>APC999TR</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>A2D</td>
<td>Art: Studio Art: 2D Design Portfolio</td>
<td>4, 5</td>
<td>ART999TRSAE</td>
<td>6</td>
<td>Studio Art elective credit for Art majors. Only 6 credits of AP Studio Art will be accepted toward Art major requirements</td>
</tr>
<tr>
<td>A3D</td>
<td>Art: Studio Art: 3D Design Portfolio</td>
<td>3</td>
<td>APC999TR</td>
<td>6</td>
<td>Studio Art elective credit for Art majors. Only 6 credits of AP Studio Art will be accepted toward Art major requirements</td>
</tr>
<tr>
<td>A3D</td>
<td>Art: Studio Art: 3D Design Portfolio</td>
<td>4, 5</td>
<td>ART999TRSAE</td>
<td>6</td>
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</tr>
<tr>
<td>BY</td>
<td>Biology</td>
<td>3</td>
<td>APC999TR</td>
<td>7</td>
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<tr>
<td>BY</td>
<td>Biology</td>
<td>4</td>
<td><strong>BIO200LLB</strong> + APC 999TR</td>
<td>7</td>
<td>A score of &quot;4&quot; also matches <strong>BIO129-BIO130</strong> (This is intended for non-majors to satisfy the Scientific Literacy &amp; Inquiry Requirement)</td>
</tr>
<tr>
<td>BY</td>
<td>Biology</td>
<td>5</td>
<td><strong>BIO200LLB</strong> + <strong>BIO201LLB</strong></td>
<td>7</td>
<td>A score of &quot;5&quot; also matches <strong>BIO129-BIO130</strong>. (This is intended for non-majors to satisfy the Scientific Literacy &amp; Inquiry Requirement)</td>
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<tr>
<td>MAB</td>
<td>Calculus AB*</td>
<td>3</td>
<td>APC999TR</td>
<td>4</td>
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<tr>
<td>MAB</td>
<td>Calculus AB*</td>
<td>4, 5</td>
<td><strong>MTH141LR</strong></td>
<td>4</td>
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<tr>
<td>MBC</td>
<td>Calculus BC*</td>
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<td>APC999TR</td>
<td>4</td>
<td></td>
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<tr>
<td>MBC</td>
<td>Calculus BC*</td>
<td>4, 5</td>
<td><strong>MTH141LR</strong></td>
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<tr>
<td>CALAB</td>
<td>AB sub score on Calculus BC exam*</td>
<td>3</td>
<td>APC999TR</td>
<td>4</td>
<td></td>
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<tr>
<td>CALAB</td>
<td>AB sub score on Calculus BC exam*</td>
<td>4, 5</td>
<td><strong>MTH141LR</strong></td>
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<tr>
<td>CH</td>
<td>Chemistry</td>
<td>3</td>
<td>APC999TR</td>
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<tr>
<td>CH</td>
<td>Chemistry</td>
<td>4, 5</td>
<td><strong>CHE101LR</strong> + <strong>CHE113LAB</strong> + <strong>CHE102LR</strong> + <strong>CHE114LAB</strong></td>
<td>9</td>
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<tr>
<td>CLC</td>
<td>Chinese</td>
<td>3</td>
<td>APC999TR</td>
<td>6</td>
<td>Equivalent to proficiency for admission to Chinese - Minor</td>
</tr>
<tr>
<td>CLC</td>
<td>Chinese</td>
<td>4, 5</td>
<td><strong>CHI201LEC</strong> + <strong>CHI202LEC</strong></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>CSA</td>
<td>Computer Science A**</td>
<td>3, 4</td>
<td>APC999TR</td>
<td>4</td>
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</tr>
<tr>
<td>CSA</td>
<td>Computer Science A**</td>
<td>5</td>
<td><strong>CSE115LR</strong></td>
<td>4</td>
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<tr>
<td>CSAB</td>
<td>Computer Science AB**</td>
<td>4, 5</td>
<td><strong>CSE113LR</strong> + <strong>CSE114LR</strong></td>
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<td>Exam is no longer offered.</td>
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<td>CSP</td>
<td>Computer Science Principles</td>
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<td>APC999TR</td>
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<td>CSP</td>
<td>Computer Science Principles</td>
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<td><strong>CSE101LLB</strong></td>
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<td>EMA</td>
<td>Economics: Macro</td>
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<td>EMA</td>
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<td>EMI</td>
<td>Economics: Micro</td>
<td>3</td>
<td>APC999TR</td>
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<tr>
<td>EMI</td>
<td>Economics: Micro</td>
<td>4, 5</td>
<td><strong>ECO182LD</strong></td>
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<td>ENGC</td>
<td>English Lang &amp; Comp</td>
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<td><strong>ENG105LEC</strong></td>
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<td>ELC</td>
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<td>APC999TR</td>
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<td>No comparable course or requirement</td>
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<td>ENV</td>
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<td><strong>GEO104LEC</strong></td>
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<td>ENV</td>
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<td>Also matches <strong>EVS118LEC</strong></td>
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<tr>
<td>Code</td>
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<td>Description</td>
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<tr>
<td>FRA</td>
<td>French Language</td>
<td>3</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<td>FRA</td>
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<tr>
<td>FRA</td>
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<tr>
<td>FLA</td>
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<tr>
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<td>GM</td>
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<tr>
<td>GM</td>
<td>German Language</td>
<td>5</td>
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<tr>
<td>GPU</td>
<td>Govt &amp; Politics: US</td>
<td>3</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>GPU</td>
<td>Govt &amp; Politics: US</td>
<td>4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>GPC</td>
<td>Govt &amp; Politics: Comparative</td>
<td>3</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>GPC</td>
<td>Govt &amp; Politics: Comparative</td>
<td>4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>EH</td>
<td>History: European</td>
<td>3, 4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<td></td>
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<tr>
<td>UH</td>
<td>History: US</td>
<td>3</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>UH</td>
<td>History: US</td>
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<td>WH</td>
<td>History: World</td>
<td>3, 4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<td>HGEO</td>
<td>Human Geography</td>
<td>3, 4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>ITALC</td>
<td>Italian</td>
<td>3</td>
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<tr>
<td>ITALC</td>
<td>Italian</td>
<td>4</td>
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<tr>
<td>ITALC</td>
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<tr>
<td>IELAP</td>
<td>International English Language [APIEL]</td>
<td>3</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<td>JAPLC</td>
<td>Japanese</td>
<td>3</td>
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<tr>
<td>JAPLC</td>
<td>Japanese</td>
<td>4, 5</td>
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<tr>
<td>LTL</td>
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<tr>
<td>LTL</td>
<td>Latin: Literature</td>
<td>4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>LTV</td>
<td>Latin: Vergil</td>
<td>3</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>LTV</td>
<td>Latin: Vergil</td>
<td>4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>MSL</td>
<td>Music Literature</td>
<td>3</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>MSL</td>
<td>Music Literature</td>
<td>4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>MST</td>
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<td>3</td>
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<tr>
<td>MST</td>
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<td>4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<tr>
<td>PHB</td>
<td>Physics B</td>
<td>3, 4, 5</td>
<td>Offered only through 2013. Contact Romance Language &amp; Literature for articulation.</td>
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<td>PHCE</td>
<td>Physics C: Elec &amp; Magnetism</td>
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Please contact the Romance Language & Literature department for exact articulation.
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.

Published: May 27, 2020 15:19:57
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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<td>English Composition without Essay</td>
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<tr>
<td>Freshman College Composition</td>
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**RETIRE EXAMS**

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<td>Trigonometry</td>
<td>3</td>
<td>CPC999TR</td>
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</table>

**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.

Published: May 27, 2020 15:19:57
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<td>Auditing I</td>
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Glossary: 
NOC - No Comparable Course
DNT999TR - General Elective Credit
HIS999TRMOD – Modern Europe Requirement
SSC999TRHSN – Intermediate Requirement for Human Services

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).

Published: May 27, 2020 15:19:57
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.

Published: May 27, 2020 15:19:57
## GCE A-Level Exam Articulation

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.

### GCE A-Level Examinations

<table>
<thead>
<tr>
<th>GCE A-Level Examinations</th>
<th>Test #</th>
<th>Credit</th>
<th>UB Course Articulation and Comments</th>
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<td>Accounting, AS Level</td>
<td>9706</td>
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<td>Accounting, A Level</td>
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<td>Accounting, Principles of -- A Level</td>
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<td>Applied Information and Communication</td>
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<td>Mathematics &amp; Statistics, AS Level</td>
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<td>Politics and Government, A Level</td>
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<td>Portuguese, A Level</td>
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<td>Shona, A Level</td>
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<td>Theatre Studies and Drama, A Level</td>
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<td>Thinking Skills, AS</td>
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<td>Translation (Chinese), A H2 Level</td>
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<tr>
<td>Turkish, AS Level</td>
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<td>Turkish, A Level</td>
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<tr>
<td>Urdu, A Level</td>
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<tr>
<td>West Africa Traditional Religion, A Level</td>
<td>6</td>
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</table>

**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).

Published: May 27, 2020 15:19:57
## Global Assessment Certificate Exam Articulations

<table>
<thead>
<tr>
<th>Exam Code</th>
<th>GAC Exam Title</th>
<th>Credit Award</th>
<th>UB Course Articulation</th>
<th>Required Min Score</th>
<th>Comments</th>
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<tbody>
<tr>
<td>GAC005</td>
<td>Computing I: Introduction to Computing for Academic Study</td>
<td>3</td>
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<tr>
<td>GAC006</td>
<td>Business, Science and Social Science I: Communication Skills</td>
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<td>GAC010</td>
<td>Mathematics II: Probability, Statistics &amp; Finance</td>
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<td>Computing II: Data Management</td>
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<td>GAC012</td>
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<td>GAC014</td>
<td>Academic English III : Listening and Speaking</td>
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<td>GAC015</td>
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<td>GAC016</td>
<td>Mathematics III: Calculus &amp; Advanced Applications</td>
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<td>GAC017</td>
<td>Computing III: Digital Communication</td>
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<td>GAC022</td>
<td>Business III: International Business Studies</td>
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<tr>
<td>GAC023</td>
<td>Science III: General Science</td>
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<td>GAC027</td>
<td>Social Science II: Identity and Interaction in Society</td>
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<td>GAC028</td>
<td>Social Science III: Research Skills and Global Issues</td>
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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.
# 2019 – 2020 International Baccalaureate (IB) Exam Articulation

<table>
<thead>
<tr>
<th>IB Exams</th>
<th>Credit</th>
<th>UB Course Articulation and Comments</th>
<th>Minimum Score</th>
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<tr>
<td>Anthropology, Social and Cultural, HL</td>
<td>6</td>
<td>APY106LEC + IBC999TR</td>
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<tr>
<td>Arabic Language B, HL</td>
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<td>IBC999TR</td>
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<tr>
<td>Visual Arts, HL</td>
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<td>ART999TRSAE + IBC999TR</td>
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<tr>
<td>Biology, HL</td>
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<td>BIO129LEC + BIO129LAB + BIO130LEC + BIO130LAB</td>
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<td>Business &amp; Management, HL</td>
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<td>Business &amp; Organization, HL</td>
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<td>MGG150LEC + IBC999TR</td>
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<tr>
<td>Chemistry, HL</td>
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<td>CHE101LR + CHE113LAB + CHE102LR + CHE114LAB</td>
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<tr>
<td>Chinese A1, HL</td>
<td>6</td>
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<td>Chinese B, HL</td>
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<tr>
<td>Classical Languages: Greek, HL</td>
<td>6</td>
<td>GR201LEC + GR202LEC</td>
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<td>Classical Languages: Latin, HL</td>
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<td>LAT201LEC + LAT202LEC</td>
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<td>Computer Science, HL</td>
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<tr>
<td>Dance, HL</td>
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<tr>
<td>Design Technology, HL</td>
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<tr>
<td>Economics, HL</td>
<td>7</td>
<td>ECO181LD + IBC999TR</td>
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<td>English A2, HL</td>
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<td>ENG999TR200 + IBC999TR</td>
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<td>Environmental Systems</td>
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<td>Filipino Language A2, HL</td>
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<td>Film, HL</td>
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<tr>
<td>French A2, HL</td>
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<td>French B, HL</td>
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<td>Geography, HL</td>
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<td>Hindi B, HL</td>
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<tr>
<td>History of Africa, HL</td>
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<tr>
<td>History of Americas, HL</td>
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<tr>
<td>History of East/Southeast Asia and Oceania, HL</td>
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<td>(HIS181LR* or HIS182LR*) + HIS999TRAAL*</td>
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<tr>
<td>History of Europe, HL</td>
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<td>HIS999TRMOD*</td>
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<td>History of South Asia &amp; The Middle East, HL</td>
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<td>Indonesian A2, HL</td>
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<td>Information Technology in a Global Society, HL</td>
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<td>Islamic History, HL</td>
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<td>Japanese B, HL</td>
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<td>Mongolian A1, HL</td>
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<td>Music, HL</td>
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<td>Psychology, HL</td>
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<td>PSY101LEC + IBC999TR</td>
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<td>Spanish A1, HL</td>
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<td>SPA210LEC + IBC999TR (possible SPA207LEC, consult the Department of Romance Language and Literature)</td>
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<td>Spanish Language B, HL</td>
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<td>Sports, Exercise and Health Science; HL</td>
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<td>Swahili Language B, HL</td>
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<td>Thai Language A2, HL</td>
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<td>Theatre Arts, HL</td>
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<td>Vietnamese Language A1, HL</td>
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<td>World History Topics of the Twentieth Century, HL</td>
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<td>World religions, HL</td>
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* 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

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.
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**

<table>
<thead>
<tr>
<th>First semester at UB:</th>
<th>Must re-take UBS before:</th>
</tr>
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<tbody>
<tr>
<td>Fall 2020</td>
<td>Fall 2021</td>
</tr>
<tr>
<td>Spring 2021</td>
<td>Spring 2022</td>
</tr>
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</table>

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**

<table>
<thead>
<tr>
<th>Column A</th>
<th>AND Column B</th>
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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

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

*ARC 352 and PAS 113 cannot be paired.

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
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.
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 prerequisite 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.

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 158 Physics 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

<table>
<thead>
<tr>
<th>Credits Required for Major</th>
<th>111</th>
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<tbody>
<tr>
<td>Additional Credits Required for UB Curriculum</td>
<td>17</td>
</tr>
<tr>
<td>Additional Credits Required for Electives</td>
<td>0</td>
</tr>
<tr>
<td>Total Credits Required for Degree</td>
<td>128</td>
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</table>
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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