ABET
Self-Study Report

for the

Electrical Engineering Program

at

Navajo Technical University

Crownpoint, NM

06/26/2017

CONFIDENTIAL

Table of Contents

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

BACKGROUND INFORMATION

A. Contact Information

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B. Program History

The Electrical Engineering program was first implemented at Navajo Technical University (NTU) in the Spring of 2012 with the title "Electronics and Computer Engineering (ECE)". The first NTU Electrical Engineering graduate completed his degree requirements in May 2016.

The original name of the program caused confusion and concern with many of the enrolled students and potential students that were seeking an Electrical Engineering program. A name change and curriculum restructure proposal was developed in 2014. The NTU Board of Trustees and the Higher Learning Commission (HLC) approved the change in name and curriculum to Electrical Engineering in May 2015.

This will be our first general review and are requesting that this review be retroactive by two years as allowed under ABET rules.

Navajo Technical University was chartered by the Navajo Nation in 1979 as the Navajo Skill Center and sought to meet the needs of its unemployed population. After expanding the school's mission, the Center was renamed Crownpoint Institute of Technology in 1985. The college was designated a land grant college in 1994, and in 2006, the Navajo Nation Council approved changing its name to Navajo Technical College. The institution's name was changed once more in 2013 to its current name, Navajo Technical University.

The original ECE program consisted of 136 semester credits with only one elective course. The "Electronics" aspect of the curriculum was heavily tilted toward semiconductors in a time when the semiconductor industry was becoming a significant employer in New Mexico. Many schools in New Mexico built new programs to support the semiconductor industry. Unfortunately, in the years since this sector has steadily laid off most of its New Mexico workforce and the related academic programs have been eliminated due to lack of enrollment.

The curriculum was restructured with a common EE core and 18 credit hours of technical electives providing the option to designate a Concentration by selecting a specific set of technical electives.

The curriculum was revised most recently during summer 2017 to reduce the credit hours from 122 to 120 to conform to national and state mandates in the goal of 120 credit hour baccalaureate programs.

C. Options

The Electrical Engineering degree program requires 120 semester credit hours of which 18 credit hours are technical electives. The program is designed to provide a broad Electrical Engineering foundation with the option for students to select a concentration to focus their degree based on their career plans. These concentrations are listed in Table C-1. The concentrations consist of 18 semester hours of engineering electives selected from a list of technical electives published in the catalog. There are presently three concentrations: Computer Engineering/Digital Systems, Electric Power and Energy Systems, and Manufacturing. A student can also elect to not declare a concentration in which case the student, with the approval of the advisor, selects 18 hours of technical electives from the list published in the catalog.

Table C-1. Electrical Engineering Concentrations

Concentration	EE Technical Electives
1. Computer Engineering/Digital Systems	EE 230, 330, 430, 440, Tech Elective
2. Electric Power & Energy Systems	EE 370, 460, 470, 471, 472, Tech Elective
3. Manufacturing	ENGR 234, 313, IE 235, 363, 413, 483

A Pre-Engineering Certificate program was developed in 2015 through a NSF TCUP award titled NTU Pathways to STEM Careers. The objective of the certificate was to establish a pipeline from American Indian serving high schools in the NTU region to college and onto careers in STEM fields by offering dual credit courses via e-learning methods including Distance education as well as web based learning via the Moodle Learning Management System. The certificate was approved by the NTU Board in November 2015.

The reduction in credit hours in the EE program towards the 120-hour goal during summer 2017 made the certificate incompatible with the EE program. A new Pre-STEM Certificate is in development that will be compatible with all NTU engineering programs and many of the other STEM programs at NTU.

D. Program Delivery Modes

Navajo Tech operates on the Semester system. The present delivery methodology is slanted heavily toward traditional on-campus daytime lecture/laboratory methods with classes only offered 8 am to 4:50 pm Monday through Friday. Most of the courses offered at NTU are scheduled Monday through Thursday. This reflects the reality of a small faculty and the fact that many students must use the Navajo Transit System or other transportation options which effectively only run Monday through Thursday. Friday classes are sometimes difficult to organize because of the lack of public transportation availability on that day.

Other program delivery modes are being developed and utilized as part of the National Science Foundation (NSF) Pathways project to increase the flow of Native American high school students into STEM majors and better serve the Navajo population that is spread over a land area larger than West Virginia. This includes satellite-campus or off-campus delivery using distance and web-based education methods.

The EE program at NTU is utilizing the distance education and web-based learning methods funded through the NSF Pathways project in multiple scenarios:

1. NTU Crownpoint to High Schools: Deliver college-readiness and dual-credit courses to high school students. NTU is teaching an Intermediate Algebra course during fall 2016 to two regional high schools at Wingate and Navajo Pines. The students that pass the fall course with a C or better will be allowed to enroll in Math 121 College Algebra during spring 2017.

2. Telecommuting EE Faculty to NTU Crownpoint: Full-time and/or part-time EE faculty at distance teach courses to classes of on-campus students via telepresence over the internet. This method provides a high-quality and reliable solution to maintaining appropriate faculty staffing in the EE program.

   The first course delivered in this manner was Introduction to Modeling & Simulation during the spring 2016 semester. The course was developed and taught by Dr. Zack Crues a NASA engineer located at the Johnson Space Center in Houston, Texas. Zack first developed the course in partnership with faculty at Salish Kootenai College a Tribal College of the Confederated Tribes of the Flathead Nation located in Montana. Zack used live two-way interactive streaming video-conferencing and computer virtualization technologies to teach the course. The course was a huge success and directly led to four NTU EE students receiving summer internships at NASA JSC where they put the skills acquired in the course to use on actual NASA projects.

3. NTU Crownpoint to NTU Teec Nos Pos and Chinle Arizona campus: Deliver courses from the main campus in Crownpoint to the two satellite campuses in Teec Nos Pos and Chinle, Arizona. To date, no courses have been conducted in this manner. The plan is to offer ENGR-103 Introduction to Engineering to the Chinle campus starting fall semester 2017.

E. Program Locations

The Electrical Engineering program is presently only offered on-site at the Crownpoint, NM campus. NTU has branch campuses in Chinle, AZ and Teec Nos Pos, AZ however there are presently no offerings of EE courses at either branch campus.

We are planning to eventually offer the full EE curriculum through Distance Learning at the Chinle Instructional site and Introduction to Engineering through Distance Learning to several High Schools in New Mexico in conjunction with our Certificate programs. Eventually this will also be offered at the Teec Nos Pos campus, but before that can happen a major upgrade of the internet resources there must be accomplished.

F. Public Disclosure

Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data is posted on the NTU website at:

http://www.navajotech.edu/academics/degree-programs/bachelor-of-science/electrical-engineering

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

The EE Program's accreditation status is currently "in-process". A self-study report was submitted to ABET in November 2016 with an anticipated on-site accreditation visit scheduled for November 1st 2017. The EE Program has graduated two BSEE majors in May 2016 and May 2017.This is our first request for an ABET evaluation of the program.

The objective is to summarize our efforts to update and assess our Electrical Engineering (EE) program educational objectives (PEOs) and student outcomes (SO) and to demonstrate continuous improvement with measurable results. In the past, before NTU applied for the ABET accreditation; we had developed Program Educational Outcomes (PEO) and Student Outcomes. However, in 2016 at the suggestion of our consultant, Dr. Susan Schall, we adopted the standard ABET a-k student outcomes since these were essentially the same as our previous outcomes and this would avoid confusion.

GENERAL CRITERIA

CRITERION 1. STUDENTS

A. Student Admissions

Navajo Technical University has an open admissions policy. Students are considered as officially enrolled in Electrical Engineering after successfully completing one of the following:

1) NTU Pre-Engineering Certificate with a GPA of 2.0 or higher
2) One semester of full-time study (minimum 12 credit hours) with a GPA ≥ 2.5 or higher which includes ENGR-103 Introduction to Engineering
3) One semester of full-time study (minimum 12 credit hours) with a GPA ≥ 2.5 which includes two STEM classes, having previously taken ENGR-103 Introduction to Engineering and passed with a grade of "C" or better

Students may take Electrical Engineering classes at any time since some other programs require classes that are taught within the EE program.

Navajo Technical University Admission Requirements for Bachelor Programs

- Freshman and Transfer students are required to have a cumulative GPA of 2.5 in High School or from the transferring school or will be provisionally admitted into the Bachelor program
- All students must maintain a cumulative GPA of a 2.0 once in the program
- Must not be on academic probation for the first two semesters
- Complete all prerequisites in the degree program
- Complete all General Education requirements and the 100-200 level courses within the first five semesters of the Bachelor Program

B. Evaluating Student Performance

Student performance is monitored by professors in individual classes via pre- and post- tests, homework, quizzes, tests, rubrics and projects. Most engineering classes use a final project so that students can demonstrate the ability to assimilate information from the course and combine it together to demonstrate design knowledge.

Grading Standards:
The letter grade of A, B, C, indicate passing grades; a grade of D, however, is not transferable to another school nor does it allow the student to progress to the next level course in that subject area at NTU. A grade of incomplete (I) is not considered a passing grade and doesn't result in earned credits until converted to an A, B or C.

Grading System:
The following letter grades and grade points are used at NTU:

Table 1.B.1 Grades for NTU Engineering Students

Letter Grade	Precentages	Description	Grade Points
A	90 - 100%	Excellent	4
B	80 - 89.9%	Above Average	3
C	70 - 79.9%	Average	2
D	60 - 69.9%	Below Average	1
F	Less than 60%	Failure	0
I		Incomplete (No Credit)	None
W		Withdrawal	None
AU		Audit	None
CR		Credit by Examination	None
P/F		Pass/Fail	None

Incomplete: An "I" may be issued when unforeseeable circumstances beyond the student's control prevent the student from completing course requirements. Incomplete grades will not be authorized when the student has failed to complete course requirements or has earned a failing grade due to personal negligence. An incomplete grade must be converted to a credit grade by satisfactorily completing the required assignments within the adjusted deadline (arranged between the instructor and student) of the following semester. A student does not have to reregister for the course if completed within the stated deadline. The incomplete grade must be converted by the next semester otherwise the "I" will automatically convert to an "F". The instructor must complete and submit an Incomplete Form to the Registrar's office.

Audit: An Audit (AU) is awarded for class participation and does not indicate proficiency in the subject matter. Course credit is not included in the GPA or cumulative GPA. Forms are available at the Registrar's Office. Audit courses accumulate charges as a regular course. Audit courses are counted towards attempted hours but not eligible for federal student aid.

Credit by Examination: Credit and grade are given upon completion of examination of a course that is challenged by the student. Only a grade of CR is recorded on the student record if the examination is passed with an 80% or higher. Students may not have attempted the course at the university. The responsibility for preparing for these examinations is entirely on the student. The current tuition rate per credit hour applies before examination. The student request for challenging the course may be picked up from the Registrar's Office.

Course Withdrawal: Used for student, instructor and/or administrative withdrawals from a course before the withdrawal deadline date.

Pass/Fail: some courses are graded on a pass/fail basis and will not be included in the computation of the GPA.

C. Transfer Students and Transfer Courses

Transfer Student Admissions
Students must indicate *all* institutions previously attended on their application.

- Official transcripts must be in a sealed envelope and preferably mailed directly from the institution to the NTU Registrar's Office. Institutions that send Electronic Transcripts are to be emailed directly to the Registrar only for it to be official. *Note: Transfer courses are not included in calculating the student's NTU cumulative Grade Point Average (GPA).*
- A Transfer Student who does not have a cumulative grade point average of 2.00 or on academic suspension will be referred to the Academic Counselor to be placed on an academic contract or education plan.

Transfer Credit Evaluation
Credits earned at regionally accredited institutions of higher learning are accepted. Pre-college credits are not transferable. Transfer credit will not be given without an official transcript.

- Transfer credit will be awarded for each college course level in which the student received a grade of "C" or higher.
- A limit of 30 credit hours may be transferred toward an associate degree and a limit of 15 credit hours may be transferred toward a certificate program. Students in the bachelor degree program who request to have their courses transferred will have a limit of 60 credit hours eligible for transfer.
- The courses must be taken within the ten year time limit of admission into the college. Credits over ten (10) years of age are subject to review prior to acceptance toward prerequisites and/or degree requirements in some program areas.

Transfer Credits
Coursework taken at another institution that is accepted and officially transfers as transfer credit by NTU will count as both attempted and completed credit hours toward pace and maximum timeframe. Students who exceed the maximum timeframe can submit a SAP (Satisfactory Academic Progress) Appeal to determine if their aid can be reinstated.

D. Advising and Career Guidance

Advisement

All students enrolling have options to meet with a Program advisor or an Academic Advisor/Counselor

- All certificate and degree seeking students are required to consult with their assigned program advisor before registering for classes. These advisors plan student schedules by following the program checklist and provide guidance throughout their academic enrollment

- New or undecided students may see the First Year Experience Academic Advisors in the Counseling office

Academic Advising

The Academic Counselor coordinates with the First Year Advisor to assist in evaluating student's abilities and interests to develop realistic academic and career goals. Advisement includes educational planning, choosing a major, planning for a certificate, an associate or baccalaureate degree, and planning strategies for academic success. The counselor provides Accuplacer placement test interpretation for appropriate placement in Math and English courses. The counselor works with students placed on academic probation and a student readmitted on academic suspension and places them on contracts to work toward raising their cumulative grade point averages to include support services such as tutoring. The counselor monitors and meets with faculty to assess the progress of the student. The counselor also conducts academic support workshops. Dr. Peter Romine is the official Electrical Engineering (EE) advisor for all electrical engineering students. Some students come to Dr. Peter Romine for advice on class registration and personal matters. Students can also register online for classes.

First Year Experience (FYE)

The First Year Program has been developed to strengthen the retention rate, to improve operational efficiencies and enrollment, and the long-term success of first-year students at Navajo Technical University. The Advisor and Counselor coordinate to meet with first-year students. They evaluate the student's abilities and interests to develop realistic academic and career goals. The FYE staff provides Accuplacer placement testing and interpretation for appropriate placement in math and English courses. Advisement includes educational planning, choosing a major, planning for certificate, associate, or bachelor degree, and planning strategies for academic success. Richelle Henderson is the Career & Academics Advisor for the First Year Experience.

Career Advisement, Job Placement and Internship

Career advisement is offered to provide guidance to students in selecting a career path and a corresponding academic program at NTU. The career advisor uses a computer-based pre-assessment test to evaluate an individual's personality, interests, skills, and aptitude in order to identify his/her career competencies. Students engage in an interactive process that builds self-knowledge and assists them in developing an employment portfolio. We will also assist students in assembling an employment portfolio including a resume, documented accomplishments, pertinent awards and certificates, and a reference list. Dr. Romine also advises students on career paths and plans; his experience in Industry as an engineer and his experience as a professor help students think how to achieve the goals that they have set. The Career and Internship Counselor, Juanita Tom, assists students with career advice and the Job Placement Coordinator, Lemanuel Loley, works with students on finding jobs.

The Electrical Engineering program requires an internship where students have the opportunity to apply practical, job-specific skills in an actual work situation in cooperation with government or businesses in the private and public sectors. Students must complete an internship to qualify for graduation. The student must meet with the faculty advisor to begin the process of submitting documents and officially registering for the course with the Registrar's Office.

E. Work in Lieu of Courses

NTU does not presently accept life experience in lieu of course work. If students have taken a higher level class before, they are allowed to test out of those lower classes or continue where they left off.

Dual Credit

Outstanding high school students can be admitted to NTU prior to high school graduation. Early admissions must be made directly to the Registrar unless otherwise articulated through an agreement with a local high school or school district.

The requirements for Dual Credit or High School admission are:

- Written recommendation from the high school principal/counselor
- Current High school transcript with cumulative GPA as follows:
    - Junior – 3.5 minimum GPA required (or top ¼ of class)
    - Senior – 3.0 minimum GPA required (or top ¼ of class)
- A completed admission application
- Accuplacer test result
- Certificate of Indian Blood (CIB) or an official record of enrollment that indicates membership with a federally recognized Indian Tribe
- Signed NTU Alcohol and Drug Free Policy affidavit
- A signed parental permission form

No student below the junior level of high school will be admitted. An accepted student must follow the same academic guidelines required by the University and must maintain a "C" or better grade in all classes taken at NTU and cannot enroll in more than two (2) classes without special permission. *Note: these students are responsible for payments of tuition and fees.*

Military Credit Evaluation

Military service credit is granted based on recommendation of the American Council of Education's "Guide to the Evaluation of Educational Experiences in the Armed Service" and institutional policies. No credit is granted for military Occupational Specialty (MOS). To apply for military credit, a submitted copy of the DD214 and a copy of any applicable training not listed on the DD214 to the Registrar's Office.

Independent Study

Under unusual or special circumstances a student and instructor of a regular University course may adapt the course to an Independent Study. The arrangement is subject to approval of the

Department Chair and the Dean of Instruction. Registration for an independent study course must be completed and approved no later than the last day of Drop/Add. Department Chairs will determine which courses are eligible for Independent Study. Forms are available at the Registrar's office.

A full time faculty member may supervise and offer an independent study course during a semester or summer session and is restricted to no more than two graduating students. No more than six credits hours may be taken in any one semester.

- The student must agree in writing to a syllabus that outlines the learning objectives, texts, course requirements, evaluation criteria, meeting dates and examination dates for the course. A final assessment or examination is required for independent study courses. However, the role of final examinations for independent study courses may vary based on the intended outcomes for the course. Department Chairs can approve a nontraditional final examination in such cases (e.g., a portfolio of the student's work, a thesis or substantial paper, a take-home examination).
- Students should devote a minimum of three hours each week for each credit hour of independent study, or at least nine hours per week for a three-credit independent study course.
- The student has a term grade point average at least 2.50 from pervious term.
- The student should not be on academic and financial aid probation status during the semester that the student would take the program course through independent study.

F. Graduation Requirements

A Bachelor's degree in Electrical Engineering requires **120** credit hours and is designed for a four-year program of study. Students in the baccalaureate degree programs are required to complete a minimum of 30 credit hours in the upper division, i.e., 300 and 400 level courses before they can graduate. The minimum credit load for a full-time student is 12 credit hours per semester.

a) One year (30 credits) of a combination of college-level math and basic sciences (some with experimental experience) appropriate to the discipline. Electrical programs must contain linear algebra, complex variables, and discrete mathematics.

Course	Title	Credits
MTH 162	Calculus I	4
MTH 163	Calculus II	4
MTH 205	Discrete Math	3
MTH 310	Differential Equations	4
MTH 410	Linear Algebra	3
CHM 120	General Chemistry & Lab	4
PHY 111/121	Algebra or Calculus-based Physics I	4
PHY 112/122	Algebra or Calculus-based Physics II	4
TOTAL		**30**

b) One and one-half years (53 credits) of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.

Course Title	Credits
EE 101 Electrical Engineering Fundamentals I	*3*
ENGR 103 Introduction to Engineering	*3*
EE 102 Electrical Engineering Fundamentals II	*3*
EE 103 Digital Logic Design	*3*
EE 201 Electrical Engineering Fundamentals III	*3*
EE 202 Electrical Engineering Fundamentals IV	*3*
EE 203 Electronics I	*3*
EE 212 Instrumentation I	*2*
EE 301 Signals and Systems	*3*
ENGR-301 Introduction to Modeling and Simulation	*4*
EE 303 Probability & Random Signals	*3*
EE 310 Embedded System Design	*3*
EE 312 Instrumentation II	*2*
EE 313 Summer Internship	*3*
EE 396 Junior Research Project	*3*
EE 406 Computer Networks	*3*
EE 422 Capstone Design I	*3*
EE 423 Capstone Design II	*3*
TOTAL	**53**

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

ENG – 110 Freshman Composition	3
ENG – 111 Composition and Research	3
NAV - 101 or 201 Navajo Language	4
HUM – XXX Humanities Elective	3
SC/BS – XXX Social Sci. or Behavioral Sci. Elective	3
TOTAL	**16**

d) A computer science elective

CS - Elective Computer Programming Elective	3
TOTAL	**3**

e) EE concentration courses
There are presently three concentrations: Computer Engineering/Digital Systems, Electric Power and Energy Systems, and Manufacturing.

Computer Engineering and Digital Systems Electives

ITS 250	Data Structures	3
EE 230	Introduction to VHDL and FPGA	3
EE 330	Computer Organization & Assembly Language Program	3
EE 430	Computer Architecture and Design	3
EE 440	Operating Systems I	3
XXX	Technical Elective (Computer Engineering)	3

Electrical Power & Energy Systems Electives

EE 370	Electrical Machinery	3
EE 460	Electrical Power Plants	3
EE 470	Electric Power Devices	3
EE 471	Power System Analysis	3
EE 472	Power Electronics & Power Management	3
XXX	Technical Elective (Electrical Power)	3

Manufacturing

ENGR236	Inferential Statistics	3
IE 235	Lean Production	3
ENGR313	Engineering Economics	3
IE 363	Design of Experiment	3
IE 413	Quality Control	3
IE 483	Rapid Prototyping	3

TOTAL **18**

NTU uses a degree checklist to enable students to check their progress and to confer with the Adviser or Registrar's office in case of problems or to ascertain if courses count against program requirements. Before graduation the Registrar's Office checks that all courses and requirements are met. If course substitutions are allowed they are documented to avoid potential problems.

The new 2017 degree checklist is included below:

Table 1.F.1 EE Checklist 2017

Freshman Year		
1 Fall		
EE-101	Electrical Engineering Fundamentals I (*Satisfies CMP-101*)	3
ENGR-103	Introduction to Engineering	3
CS-Elective	Computer Programming Elective	3
ENG-110	Freshman Composition	3
NAV-101	Introduction to Navajo Language	4
		Total: 16
2 Spring		
EE-102	Electrical Engineering Fundamentals II	3
EE-103	Digital Logic Design	3
CHM-120	General Chemistry I	4
ENG-111	Composition and Research	3
HUM-XXX	Humanities Elective	3
		Total: 16
Sophomore Year		
3 Fall		
EE-201	Electrical Engineering Fundamentals III	3
MTH-205	Discrete Mathematics	3
MTH-162	Calculus I	4
	Concentration Course	3
SSCXX	Social Science or Behavioral Sci Elective	3
		Total: 16
4 Spring		
EE-202	Electrical Engineering Fundamentals IV	3
EE-203	Electronics I	3
EE-212	Instrumentation I	2
MTH-163	Calculus II	4
PHY-111/121	Algebra or Calculus-Based Physics I	4
		Total: 16
Junior Year		
5 Fall		
EE-301	Signals & Systems	3
ENGR-301	Introduction to Modeling and Simulation	4
	Concentration Course	3
MTH-310	Differential Equations	4
PHY-112/122	Algebra or Calculus-Based Physics II	4
		Total: 18
6 Spring		
EE-303	Probability & Random Signals	3
EE-313	Summer Internship	3
EE-310	Embedded System Design	3

EE-312	Instrumentation II	2
EE-396	Junior Research Project	3
		Total: 14
Senior Year		
7 Fall		
EE-422	Capstone Design I	3
EE-406	Computer Networks	3
	Concentration Course	3
	Concentration Course	3
		Total: 12
8 Spring		
MTH-410	Linear Algebra	3
	Concentration Course	3
	Concentration Course	3
EE-423	Capstone Design II	3
		Total: 12
		Total: 120

G. Transcripts of Recent Graduates

The program will provide unofficial transcripts of program graduates to date. Transcripts from our two ABET eligible students are included in the application package with instructions to interpret it.

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

Navajo Technical University's mission is to provide university readiness programs, certificates, associate, baccalaureate, and graduate degrees. Students, faculty, and staff will provide value to the Diné community through research, community engagement, service learning, and activities designed to foster cultural and environmental preservation and sustainable economic development. The University is committed to a high quality, student-oriented, hands-on-learning environment based on the Diné cultural principles: Nitsáhákees (Thinking), Nahátá (Planning), Īína (Implementing), Siihasin (Reflection).

Electrical Engineering Mission Statement:
The mission of the Electrical Engineering program at Navajo Technical University is to provide the best possible education, research, services, and resources to prepare students for careers in industry, research or academia and to achieve success in life.

B. Program Educational Objectives

The program objectives can be found in the general catalog and the program website both available at:

http://www.navajotech.edu/academics/degree-programs/bachelor-of-science/electrical-engineering

Our electrical engineering alumni will show that they meet expectations by performing within one or more of these parameters in five to seven years after graduation:

1. Show progress in their career through greater supervisory tasks, advancing to larger managerial responsibility or increasing technical accountability.

2. Acquire professional engineer's license, other certifications of expertise in technical areas or attend graduate school in an appropriate technical discipline.

3. Demonstrate success by continuing employment and/or technical accomplishments as entrepreneurs, civil servants or in commercial or industrial endeavors.

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

As a new program in a new university the program educational objectives were selected to align with key elements of the mission of the university. That is to provide value to the Diné community through research, community engagement, service learning, and activities designed to foster cultural and environmental preservation and sustainable economic development. This includes success in gaining relevant and fulfilling employment and the readiness to pursue graduate education.

The Electrical Engineering program fulfills the first portion of the mission of Navajo Technical University by providing the baccalaureate program B.S.E.E to members of the Navajo Nation. The Program Educational Objectives specifically align with the other portions of the NTU mission statement as follows:

Program Educational Objective #1: All graduates will show progress in their career through greater supervisory tasks, advancing to larger managerial responsibility or increasing technical accountability.

This objective supports and aligns with the following portion of the institutional mission statement **"… designed to foster … and sustainable economic development."**

Program Educational Objective #2: All graduates will acquire professional engineer's license, other certifications of expertise in technical areas or attend graduate school in an appropriate technical discipline.

This objective supports and aligns with the following portions of the institutional mission statement "**Navajo Technical University's mission is to provide … and graduate degrees to members of the Navajo Nation."**

Program Educational Objective #3: All graduates will demonstrate success by continuing employment and/or technical accomplishments as entrepreneurs, civil servants or in commercial or industrial endeavors.

This objective supports and aligns with the following portion of the institutional mission statement "**… designed to foster cultural and environmental preservation and sustainable economic development."**

There are few economic opportunities available to most Navajo communities. Engineering schools have historically served as the engines of economic opportunity and prosperity in many parts of America. The graduates of the NTU engineering programs will have the capacity to contribute to sustainable economic development on Navajo.

D. Program Constituencies

As a Tribal University NTU has a much broader constituency than traditional universities in the United States. These include:

- Graduates of the program (Alumni).

- Employers of the graduates.

Graduates of the NTU EE Program (Alumni)

Graduates of the program will rely on the program to maintain ABET accreditation and build the quality and reputation of the program. Alumni will look to the program to be a destination for friends and family members and an agent in the betterment of life on Navajo.

A NTU alumni association is slowly developing. The EE program will encourage membership and participation of graduates in the Alumni group which will serve to represent this constituency.

Employers of NTU EE Graduates

Employers from across the United States will learn to find NTU as a source of well qualified Native American Electrical Engineers to help address the extreme shortage present in the work force. Employers such as Arizona Public Service (utility) and Emerging Technology Vetures, Inc. (ETV) are interested in our graduates, particularly if ABET accredited.

The NTU Engineering Advisory Board (EAB) currently represents this constituency.

E. Process for Review of the Program Educational Objectives

Program Educational Objectives are not expected to change often. The PEOs will be reviewed every year initially and then every three years thereafter by the Engineering Advisory Board (industrial and alumni advisory board). Formal assessment will be obtained through surveys of alumni every year initially and then about every three years. We are still working on a survey to be used and expect to launch that next year (Spring 2018). The responses will be communicated to the Engineering Advisory Board, and the program faculty. The assessment data will be reviewed and revisions recommended for program enhancement from any or all of the groups. Objective changes will be approved by Engineering Advisory Board and program faculty before being instituted.

The process of Program Review through the use of assessment data is in the early stages at NTU. It was only in the 2014-2015 school year that NTU began discussing Program Review as opposed to individual Course Review. Since evaluation of Program Educational Objectives requires alumni feedback in the one to five year span, it will be a number of years before robust data begins to arrive.

Table 2.E.1 Feedback on Program Educational Objectives

Input Method	Schedule	Constituent
Alumni Survey	Every year initially then every three years	Alumni 2 – 5 years' out
Engineering Advisory Board discussions	Twice annually at EAB meetings	Employers, industrial representatives (possible employers)

Results of the inputs to the PEOs are documented as part of the university assessment process by the Assessment Office. The program's ABET coordinator also maintains assessment records on the program's server. The coordinator, the chairperson, and the chair of the Curriculum Committee have direct access to these files.

The PEOs were originally established in fall 2015. Changes were made based on the advice of our ABET consultant and were approved by the Engineering Advisory Board in May 2017.

The survey and other instruments and the results of input methods defined in Table 2.E.1 will be available to the evaluation team in the resource room.

CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

The Electrical Engineering Student Outcomes are published on the department's web page at

http://www.navajotech.edu/academics/degree-programs/bachelor-of-science/electrical-engineering

The Student Outcomes for the EE program are listed in Table 3.A.1. The EE program follows the ABET a-k. The Electrical Engineering Program is committed to providing an educational experience in which students completing our program will have demonstrated the following student outcomes:

Table 3.A.1. EE Student Outcomes

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

Table 3.A.2 shows performance indicators for each outcome for the Electrical Engineering program. Since engineering faculty members only have a direct influence on the courses taught within our program, the integration of student outcomes is guaranteed in the EE courses alone. Student study in math and basic sciences enhances achievement of outcomes, but engineering faculty members have no consistent ability to influence change in courses taught outside of our program.

Table 3.A.2 Student outcomes and performance indicators

a-k	Student Outcome	Performance Indicators
a	An ability to apply knowledge of mathematics, science, and engineering	• Chooses a mathematical model of a system or process appropriate for required accuracy • Applies mathematical principles to achieve analytical or numerical solution to model equations • Examines approaches to solving an engineering problem in order to choose the more effective approach
b	An ability to design and conduct experiments, as well as to analyze and interpret data	• Observes good lab practice and operates instrumentation with ease • Determines data that are appropriate to collect and selects appropriate equipment, protocols, etc. for measuring the appropriate variables to get required data • Uses appropriate tools to analyze data and verifies and validates experimental results including the use of statistics to account for possible experimental error
c	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	• Produces a clear and unambiguous needs statement in a design project • Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions • Carries solution through to the most economic/desirable solution and justifies the approach
d	An ability to function on multi-disciplinary teams	• Recognizes participant roles in a team setting and fulfills appropriate roles to assure team success • Integrates input from all team members and makes decisions in relation to objective criteria • Improves communication among teammates and asks for feedback and uses suggestions
e	An ability to identify, formulate, and solve engineering problems	• Problem statement shows understanding of the problem • Solution procedure and methods are defined. • Problem solution is appropriate and within reasonable constraints

f	An understanding of professional and ethical responsibility	• Knows code of ethics for the discipline • Able to evaluate the ethical dimensions of a problem in the discipline
g	An ability to communicate effectively	• Writing conforms to appropriate technical style format appropriate to the audience • Appropriate use of graphics • Mechanics and grammar are appropriate • Oral: Body language and clarity of speech enhances communication
h	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	• Evaluates conflicting/competing social values in order to make informed decisions about an engineering solution. • Evaluates and analyzes the economics of an engineering problem solution • Identifies the environmental and social issues involved in an engineering solution and incorporates that sensitivity into the design process
i	A recognition of the need for, and an ability to engage in life-long learning	• Expresses an awareness that education is continuous after graduation • Able to find information relevant to problem solution without guidance
j	A knowledge of contemporary issues	• Identifies the current critical issues confronting the discipline • Evaluates alternative engineering solutions or scenarios taking into consideration current issues
k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	• Selects appropriate techniques and tools for a specific engineering task and compares results with results from alternative tools or techniques • Uses computer-based and other resources effectively in assignments and projects

B. Relationship of Student Outcomes to Program Educational Objectives

The complete mapping of Student Outcomes and the Program Educational Objectives is shown in Table 3.B.1. These relationships clearly indicate how students achieving program outcomes are prepared to attain our educational objectives.

Table 3.B.1: Relationship of Engineering Program Educational Objectives to Student Outcomes

Student Outcomes	Program Educational Objective #1: Show progress in their career through greater supervisory tasks, advancing to larger managerial responsibility or increasing technical accountability.	Program Educational Objective #2: Acquire professional engineer's license, other certifications of expertise in technical areas or attend graduate school in an appropriate technical discipline.	Program Educational Objective #3: Demonstrate success by continuing employment and/or technical accomplishments as entrepreneurs, civil servants or in commercial or industrial endeavors.
a. An ability to apply knowledge of mathematics, science, and engineering		X	
b. An ability to design and conduct experiments, as well as to analyze and interpret data			X
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	X		
d. An ability to function on multi-disciplinary teams	X		
e. An ability to identify, formulate, and solve engineering problems			X

f. An understanding of professional and ethical responsibility	**X**		
g. An ability to communicate effectively	**X**		
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context			**X**
i. A recognition of the need for, and an ability to engage in life-long learning		**X**	
j. A knowledge of contemporary issues	**X**		
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.			**X**

CRITERION 4. CONTINUOUS IMPROVEMENT

Continuous improvement is accomplished through regular assessment, data review, and implementation of changes. Assessment is provided through a number of assessment vehicles, as described in Section A.

A. Student Outcomes

The evaluation of and degree to which the learning outcomes for the Electrical Engineering program are met is accomplished by various assessment tools, direct/indirect and quantitative/qualitative.

Direct assessment methods are those where a conclusion can be reached directly from student submitted work, such as measurement of Student Outcomes a, b, c and e through homework, tests and/or projects where methods used and conclusions reached are easily interpreted and evaluated through a quantitative paradigm.

Indirect assessment methods are those where a conclusion is drawn inferentially from evidence observed, such as Student Outcome d where a Professor supervising student projects would be able to see which students functioned well in multidisciplinary teams or not. These evaluations are most often through rubrics for expected behavior demonstrated at each level of achievement.

Exemplary Performance is indicated by 100% scoring on Figures 4.A.1 through 4.A.11.

Satisfactory Performance is indicated by achieving 80 to 90% scoring on Figures 4.A.1 through 4.A.11.

Learning Performance is indicated by 60 to 70% scoring on Figures 4.A.1 through 4.A.11.

Performance Needing Improvement is indicated by anything below 60% scoring on Figures 4.A.1 through 4.A.11.

Table 4.A.1 is a summary of the Electrical Engineering student outcome assessment tools. In general, the responsible entities for the collection of data, analysis, and evaluation include the faculty, the Engineering Advisory Board, outside evaluators and the Dean of Instruction. Some of the methods are still being implemented in assessing the EE program.

Table 4.A.1. Summary of Electrical Engineering Student Outcome Assessment Tools

Tool Name	Frequency	External or Internal	Documentation and Maintenance of Results
Academic Program Review (APR)	Annually	External	Electronic and hard copy; maintained by Dean of Instruction
Engineering Advisory Board (EAB)	Twice per Year	External	Minutes of meetings maintained by Dean of Instruction
Alumni Survey	Annually	External	Electronic and hard copy; maintained by Assessment Committee Chair
Exit Survey	Twice Per Year	Internal	Electronic and hard copy; maintained by Dean of Instruction
Student Performance	Twice per year	Internal	Electronic copy; maintained by Assessment Committee Chair
Program Assessment	Annually	Internal	Electronic copy; maintained by Assessment Committee Chair
Focus Groups	Annually	External	Electronic and hard copy; maintained by evaluators and Dean of Instruction

Table 4.A.2 is a schedule of when different Student Outcomes are planned to be evaluated. This has also been applied to Table 4.A.3 where it is expanded to which outcomes are expected to be evaluated in which classes. This is true for all classes except Capstone, where we hope to be able to measure all Student Outcomes every time the class is held. In the Junior Research Project, we expect to measure most of the Student Outcomes except the Student Outcome d. All other courses we expect to measure a maximum of four outcomes per class with three outcomes being usual.

Table 4.A.2. Six-Year Program-Level Assessment Plan for Electrical Engineering

Program Outcomes	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
(a) An ability to apply knowledge of mathematics, science, and engineering			x			x
(b) An ability to design and conduct experiments as well as to analyze and interpret data			x			x
(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability		x			x	
(d) An ability to function on multidisciplinary teams		x			x	
(e) An ability to identify, formulate, and solve engineering problems			x			x
(f) An understanding of professional and ethical responsibility	x			x		
(g) An ability to communicate effectively	x			x		
(h) The broader education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context		x			x	
(i) A recognition of the need for, and an ability to engage in life-long learning		x			x	
(j) A knowledge of contemporary issues		x			x	
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	x			x		

Table 4.A.3. Mapping of Student Outcomes to courses.

Courses	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
EE-101:Electrical Engineering Fundamentals I	x				**x**			**x**			x
ENGR-103: Intro to Engineering				x	x	x	x				
EE-102: Electrical Engineering Fundamentals II	x				x						
EE-103: Digital Logic Design	x										x

EE-201: Electrical Engineering Fundamentals III	x		x		x						x
EE-202: Electrical Engineering Fundamentals IV	x		x		x						x
EE-203: Electronics I	x		x		x						x
EE-212: Instrumentation I	x	x									x
EE-301: Signals & Systems	x	x	x								x
ENGR-301: Introduction to Modeling and Simulation	x	x			x						x
EE-303: Probability & Random Signals	x				x						
EE-310: Embedded System Design			x		x					x	x
EE-312: Instrumentation II	x		x		x						x
EE-313: Summer Internship	x				x						x
IE-396: Junior Research Project	x	x	x		x	x	x	x	x	x	x
EE-406: Computer Networks	x									x	x
EE-422: Capstone Design I	x	x	x	x	x	x	x	x	x	x	x
EE-423: Capstone Design II	x	x	x	x	x	x	x	x	x	x	x

Table 4.A.4. Cycle of activity for each student outcome over the 6-year period

Activity for each Student Outcome	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Yr 6**
Review of performance indicators that define the outcome	X			X		
Review the map of educational strategies related to performance indicators		X			X	
Review mapping and identify where data will be collected		X			X	
Develop and/or review assessment methods used to assess performance indicators		X			X	
Collect data			X			X
Evaluate assessment data including processes				X		
Report findings				X		
Take action where necessary				X		

Data is collected every year and there is some activity which is taking place on each outcome each year. The cycle of activity is shown in Table 4.A.4.

Results for each student outcome are reported in tables like the example for student outcome a in Table 4.A.5. All supporting documentation is available in the ABET resource room at the time of the visit. Each table represents the activity for the current ABET accreditation cycle. Each outcome table includes performance indicators, courses and/or co-curricular activities that provide students an opportunity to demonstrate the indicator, where summative data are collected, timetable, method of assessment and the performance target. The first complete assessment cycles for the EE program was generated with the data from the Spring 2017 with the exception of Student Outcome ‘f’ which was evaluated from Introduction to Engineering in Fall 2016 term. The remainder of the first cycles was generated with the data from spring 2017. This Self-Study Report contains completed assessment for all student outcomes and includes graphs showing the results of attainment of the student outcomes as determined in the Engineering Assessment Committee meeting of May 15th and 16th, 2017.

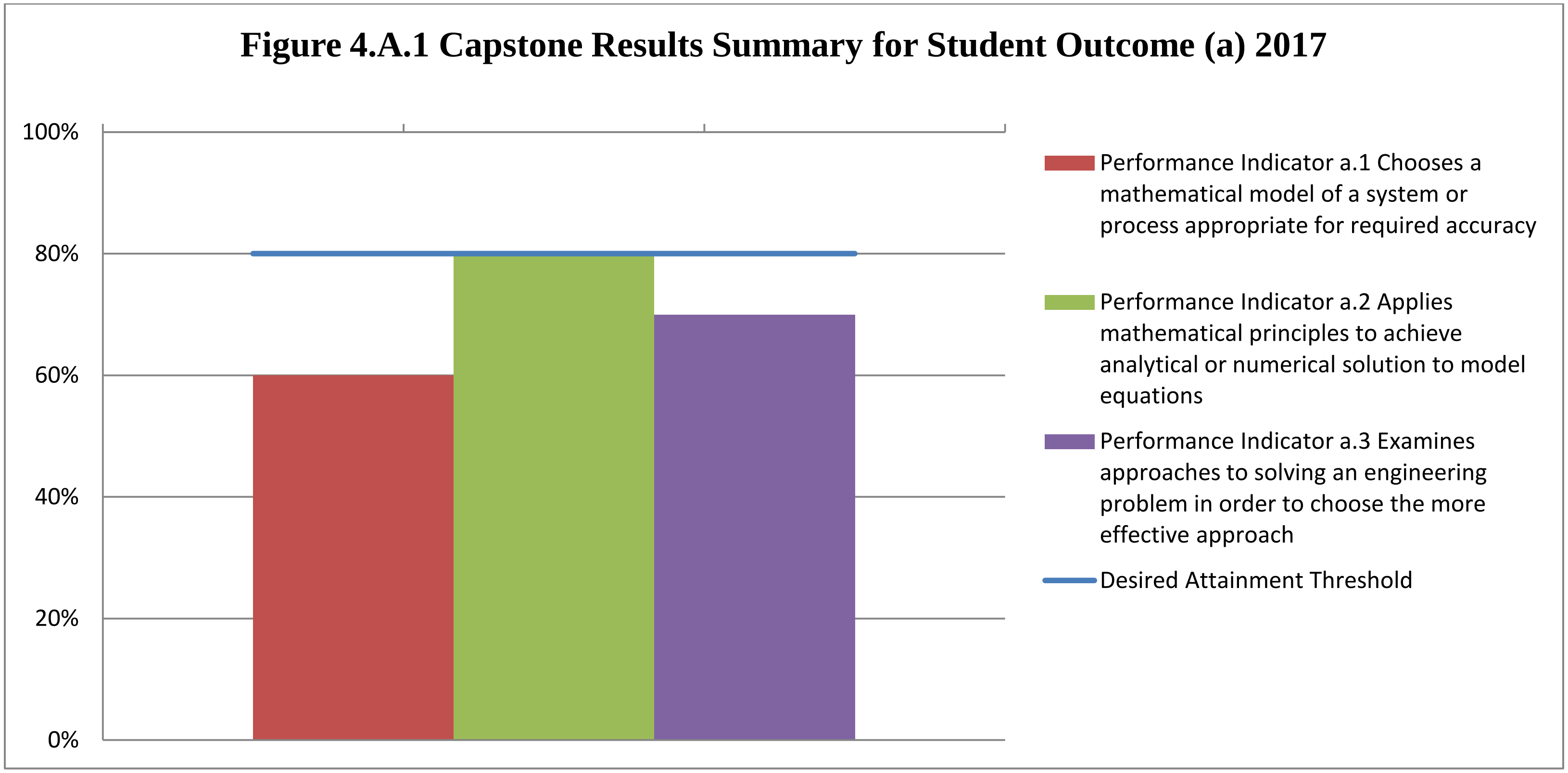
Display materials available at time of visit in the ABET resource room will include:

- Rubrics used by faculty to assess the indicators
- Samples of student work
- Results of evaluations

Tables 4.A.5 - 4.A.16 show classes and methods of assessment data collection for each individual student outcome by performance indicators for those outcomes. Figures 4.A.1 - 4.A.11 show the most recent results of assessment, mostly from the Capstone class of Spring 2017.

Table 4.A.5 Student Outcomes (a) - An ability to apply knowledge of mathematics, science, and engineering

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Chooses a mathematical model of a system or process appropriate for required accuracy	EE101, EE102, EE103, EE201, EE202, EE203, EE212, EE301, ENGR301 EE303, EE312, EE313, EE320, EE396, EE406, EE422, EE423	Quiz, Test and Homework problems, Course Projects, Final Design Project Report (Rubric)	EE 423	3 years	2019/2022 for all listed classes but Capstone where attempt to collect every year is made	80%
Applies mathematical principles to achieve analytical or numerical solution to model equations	EE101, EE102, EE103, EE201, EE202, EE203, EE212, EE301, ENGR301 EE303, EE312, EE313, EE320, EE396, EE406, EE422, EE423	Quiz, Test and Homework problems, Course Projects, Final Design Project Report (Rubric)	EE 423	3 years	2019/2022 for all listed classes but Capstone where attempt to collect every year is made	80%
Examines approaches to solving an engineering problem in order to choose the more effective approach	EE101, EE102, EE103, EE201, EE202, EE203, EE212, EE301, ENGR301 EE303, EE312, EE313, EE320, EE396, EE406, EE422, EE423	Quiz, Test and Homework problems, Course Projects, Final Design Project Report (Rubric)	EE 423	3 years	2019/2022 for all listed classes but Capstone where attempt to collect every year is made	80%



Assessment Results Summary (2017): The results from Capstone show that EE students were in needing improvement level (60%) for indicator a.1, satisfactory level (80%) for a.2, and students achieved learning level (70%) for Indicator a.3.

Evaluation and Actions (2017): Evaluation was performed during the Assessment Workshop on May 15 & 16. According to the old requirements of the capstone, students were not asked to show how to choose math models in the tasks assigned to EE students. Therefore, EE students did not write too much about the math modes in the report. However, math models are required in some other courses in the EE program, which will be assessed in the future. The department will ask faculty members to improve students learning related to Indicator a.1 on how to choose math model in a system, and also Indicator a.3 on how to choose the most effective approach to problem solving. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.A.6 Student Outcomes (b) - An ability to design and conduct experiments as well as to analyze and interpret data

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Observes good lab practice and operates instrumentation with ease	EE212, EE301, ENGR301 EE396, EE422, EE423	Faculty developed examination	EE 423	3 years	2019/2022 for all listed classes but Capstone where attempt to collect every year is made	80%
Determines data that are appropriate to collect and selects appropriate equipment, protocols, etc. for measuring the appropriate variables to get required data	EE212, EE301, ENGR301 EE396, EE422, EE423	Faculty developed examination	EE 423	3 years	2019/2022 for all listed classes but Capstone where attempt to collect every year is made	80%
Uses appropriate tools to analyze data and verifies and validates experimental results including the use of statistics to account for possible experimental error	EE212, EE301, ENGR301 EE396, EE422, EE423	Quiz, Test and Homework problems, Course Projects, Final Design Project Report (Rubric)	EE 423	3 years	2019/2022 for all listed classes but Capstone where attempt to collect every year is made	80%

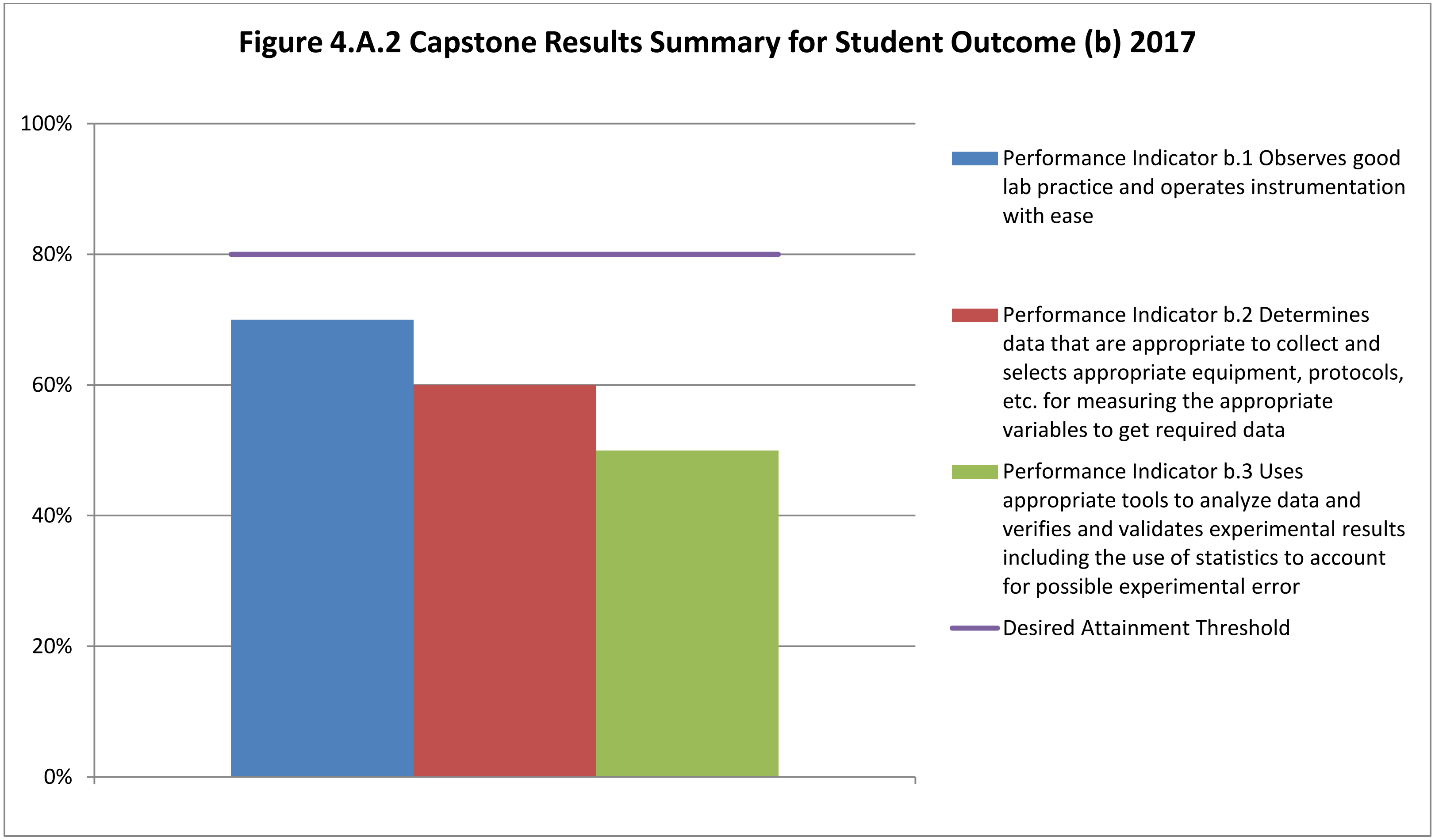


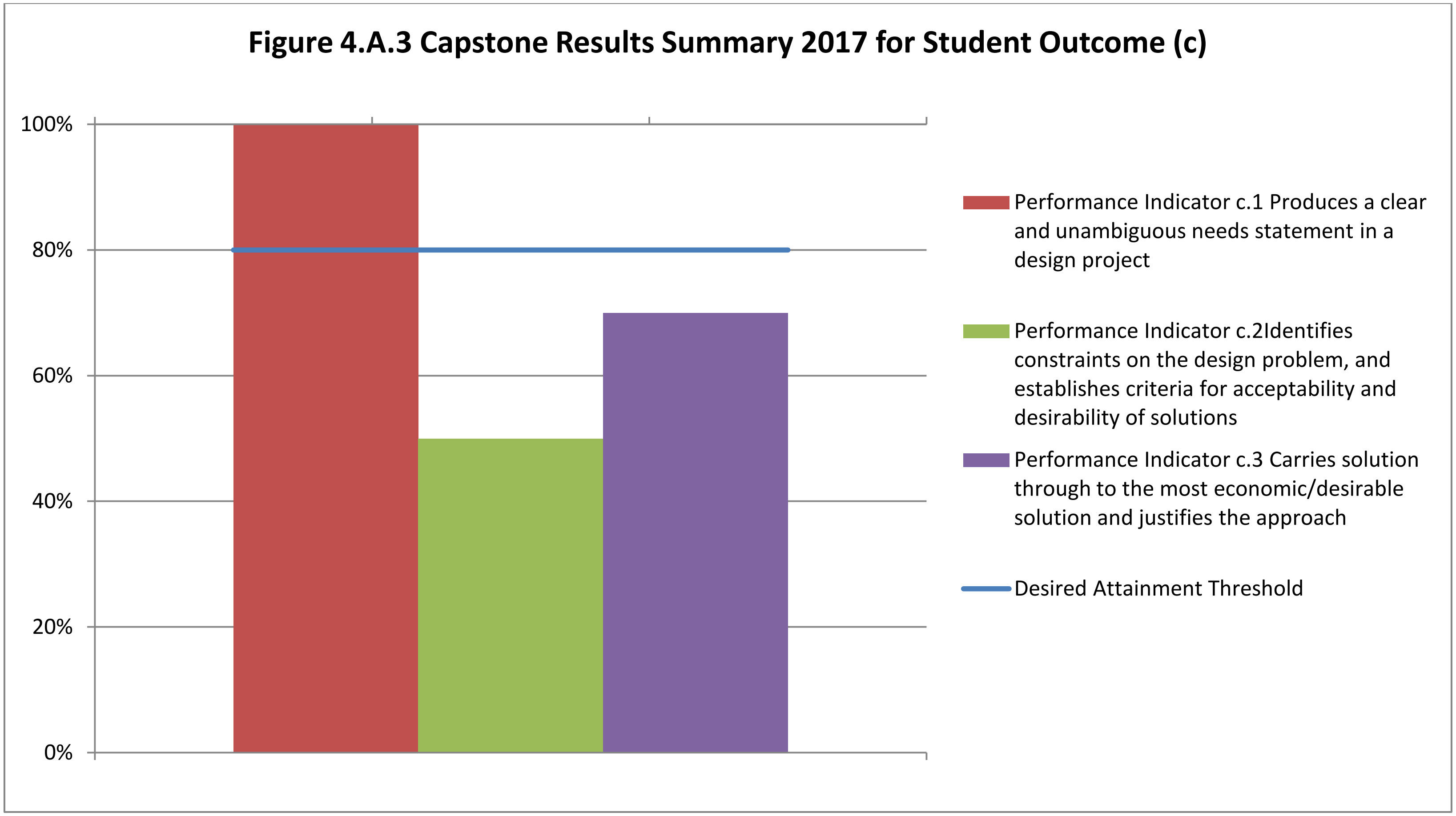
Figure 4.A.2 Capstone Results Summary for Student Outcome (b) 2017

Assessment Results Summary (2017): The Capstone results are not satisfactory for Indicators b.1, b.2 or b.3. Students achieved learning level for Indicators b.1 (60%), and b.3 (70%) and only needs improvement level for b.2 (50%).

Evaluation and Actions (2017): Evaluation was performed during the Assessment Workshop on May 15 & 16. The department will ask faculty to improve student learning related to these Indicators. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.A.7 Student Outcomes (c) - An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Produces a clear and unambiguous needs statement in a design project	ENGR103, EE201, EE202, EE203, EE301, EE310, EE312, EE396, EE422, EE423	Final Design Project (Rubric)	EE 423	3 years	2018/ 2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions	ENGR103, EE201, EE202, EE203, EE301, EE310, EE312, EE396, EE422, EE423	Final Design Project (Rubric)	EE 423	3 years	2018/ 2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Carries solution through to the most economic/desirable solution and justifies the approach	ENGR103, EE201, EE202, EE203, EE301, EE310, EE312, EE396, EE422, EE423	Final Design Project (Rubric)	EE 423	3 years	2018/ 2021 for all listed classes but Capstone where attempt to collect every year is made	80%

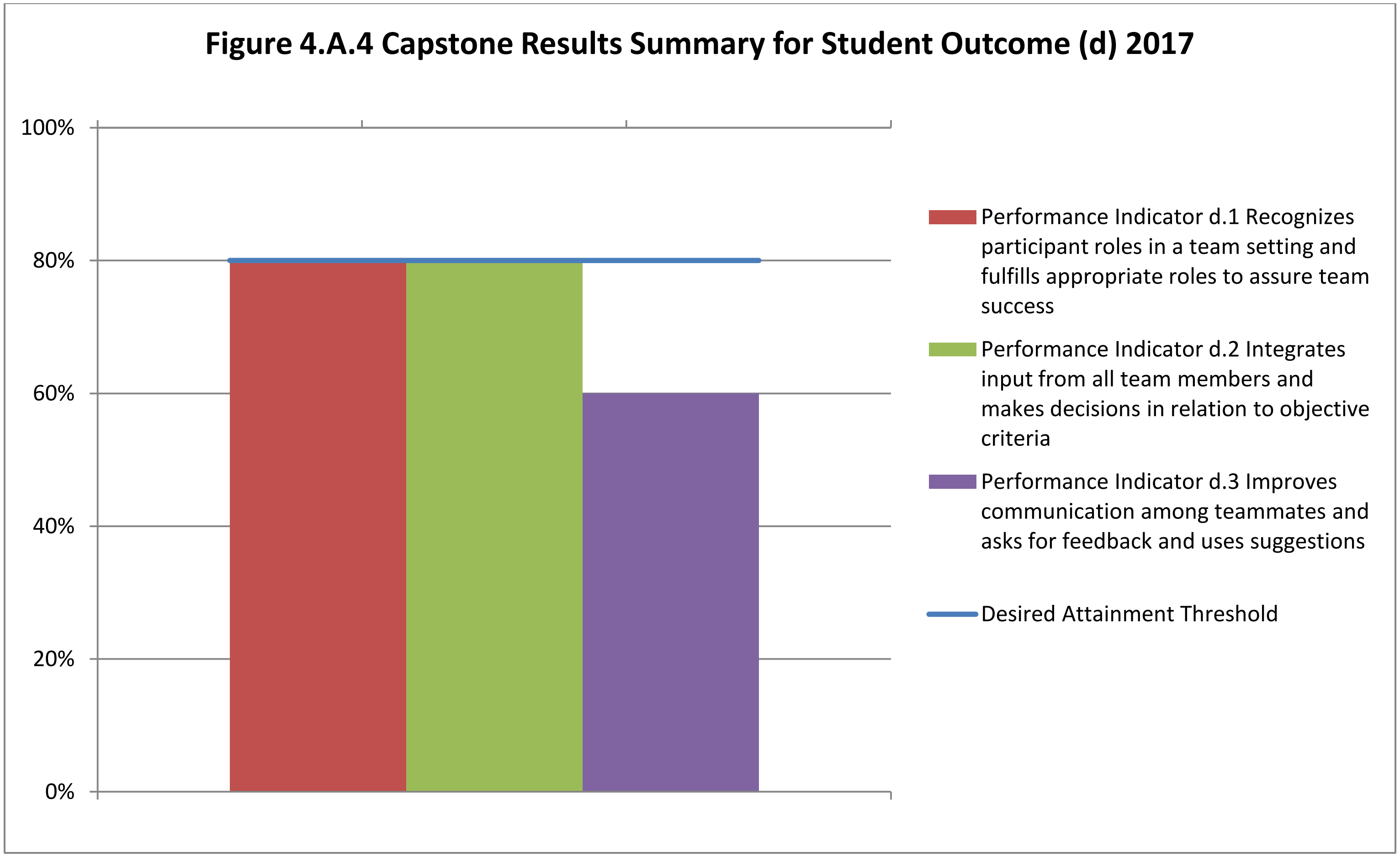


Assessment Results Summary (2017): The results show that students achieved excellent (100%) level for Indicator c.1. The results are not satisfactory at needs improvement for Indicator c.2 (50%) or learning level for c.3 (70%).

Evaluation and Actions (2017): Evaluation was performed during the Assessment Workshop on May 15 & 16. The department will ask faculty to improve student learning related to these Indicators. It was decided to work with Faculty on identifying constraints and justification on economic and desirability of solutions used to improve student understanding of Indicators c.2 and c.3. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.A.8 Student Outcomes (d) - An ability to function on multi-disciplinary teams

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Recognizes participant roles in a team setting and fulfills appropriate roles to assure team success	ENGR103 EE422, EE423	Faculty Observation, and Design Projects (Notebook)	EE 423	3 years	2018/ 2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Integrates input from all team members and makes decisions in relation to objective criteria	ENGR103 EE422, EE423	Faculty Observation, and Design Projects (Notebook)	EE 423	3 years	2018/ 2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Improves communication among teammates and asks for feedback and uses suggestions	ENGR103 EE422, EE423	Faculty Observation, and Design Projects (Notebook)	EE 423	3 years	2018/ 2021 for all listed classes but Capstone where attempt to collect every year is made	80%

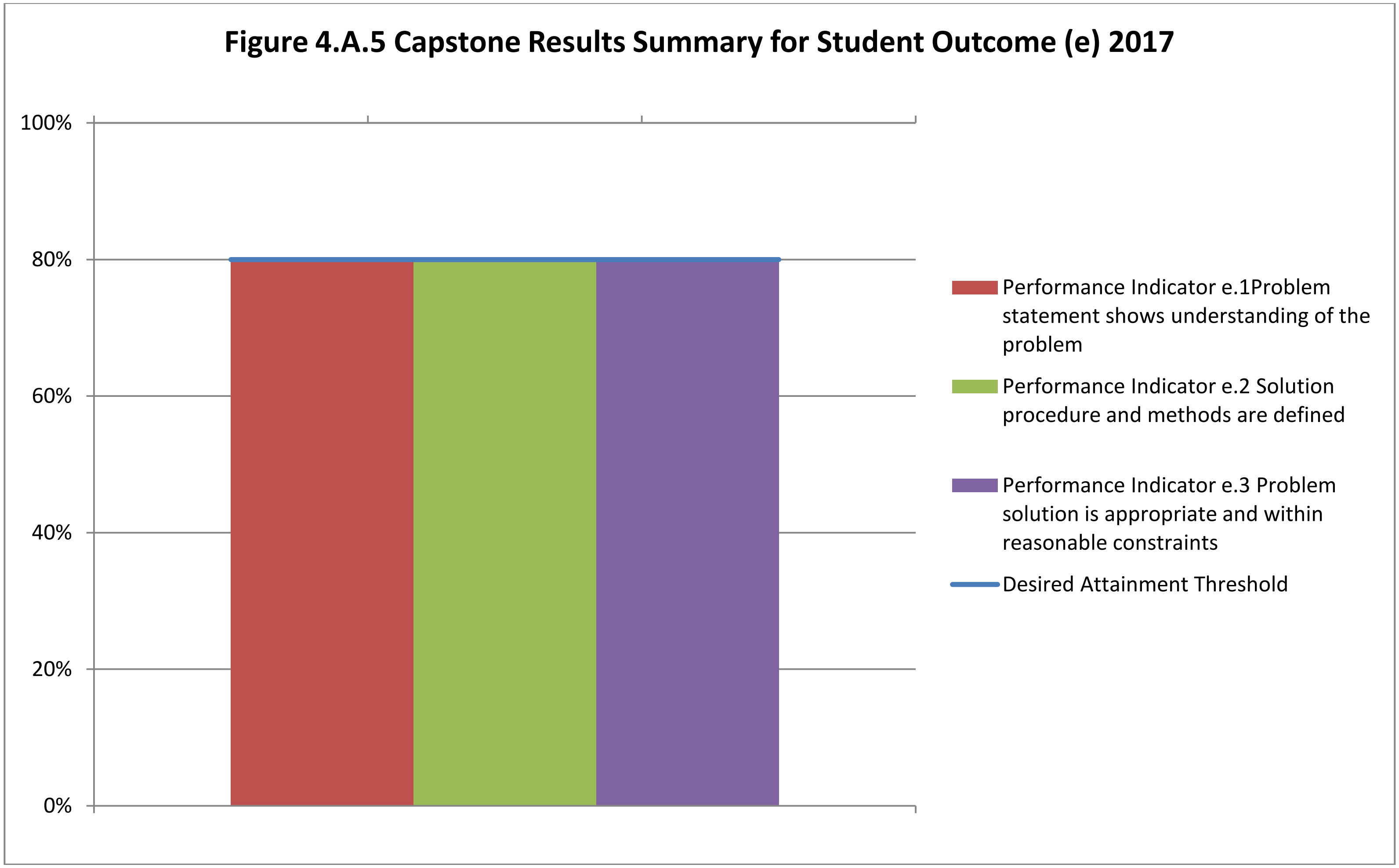


Assessment Results Summary (2017): The results show that students achieved satisfactory level (80%) for Indicator d.1 and d.2. Indicator d.3 (60%) was at learning level.

Evaluation and Actions (2017): Evaluation was performed during the Assessment Workshop on May 15 & 16. It was decided to put more of the burden on the group leader to run team meetings to better evaluate Indicator d.3 in future. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance. Notebook has not been used in the Capstone project this year. It will be required to use for the future Capstone project to show evidence of teamwork.

Table 4.A.9 Student Outcomes (e) - An ability to identify, formulate, and solve engineering problems

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Problem statement shows understanding of the problem	EE101, EE102, EE201, EE202, EE203, ENGR301 EE303, EE310, EE312, EE313, EE396, EE422, EE423	Final Project report analysis using rubric	EE 423	3 years	2019/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Solution procedure and methods are defined	EE101, EE102, EE201, EE202, EE203, ENGR301 EE303, EE310, EE312, EE313, EE396, EE422, EE423	Final Project report analysis using rubric	EE 423	3 years	2019/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Problem solution is appropriate and within reasonable constraints	EE101, EE102, EE201, EE202, EE203, ENGR301 EE303, EE310, EE312, EE313, EE396, EE422, EE423	Final Project report analysis using rubric	EE 423	3 years	2019/2021 for all listed classes but Capstone where attempt to collect every year is made	80%

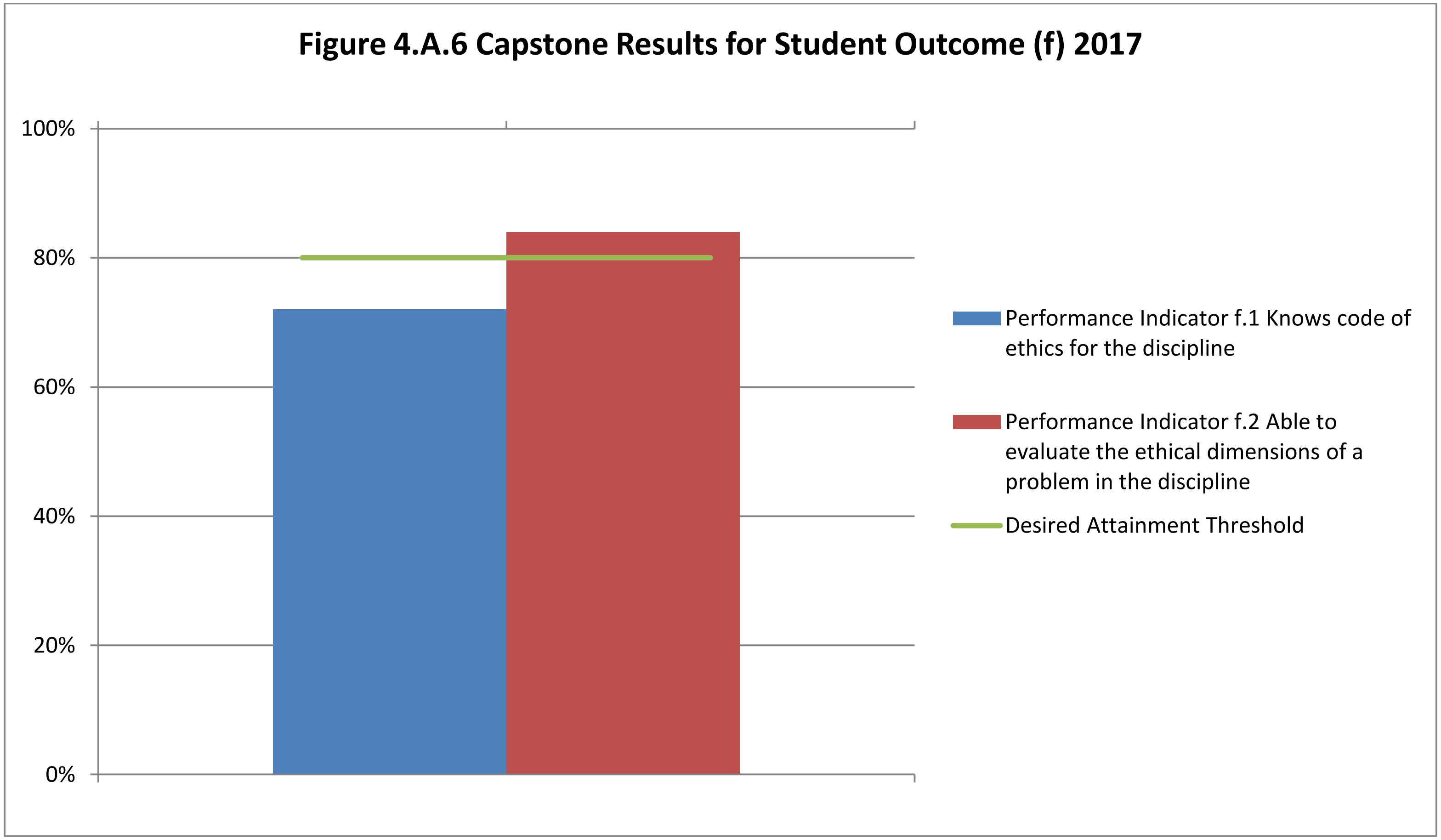


<u>**Assessment Results Summary (2017)**</u>**:** The Capstone results show that students achieved satisfactory level (80%) for Indicator 1, 2, and 3.

<u>**Evaluation and Actions (2017)**</u>**:** Evaluation was performed during the Assessment Workshop on May 15 & 16. It was decided not to make any changes at this time. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.A.10 Student Outcomes (f) - An understanding of professional and ethical responsibility

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Knows code of ethics for the discipline	ENGR103, EE396, EE422, EE423	Questions from Quizzes, Tests and Homework	EE 423	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%
Able to evaluate the ethical dimensions of a problem in the discipline	ENGR103, EE396, EE422, EE423	Questions from Quizzes, Tests and Homework	EE 423	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%

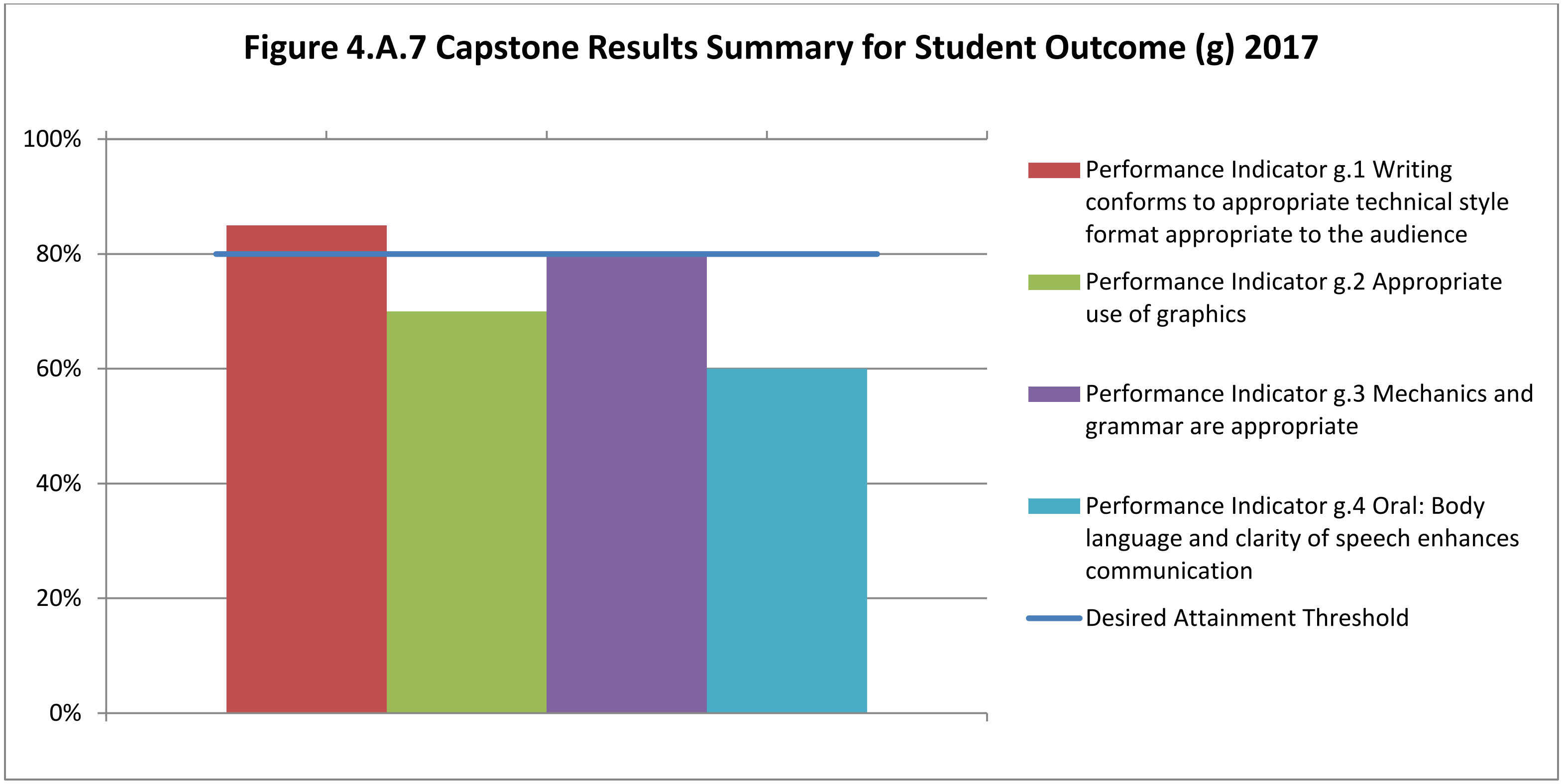


<u>Assessment Results Summary (2016)</u>: Results presented here are from Introduction to Engineering (ENGR-103) showing that students achieved satisfactory level (84%) for Indicator f.2. Indicator f.1 achieved only a learning level (72%). These were scored from a homework assignment for f.1 and a question on the Midterm for f.2.

<u>Evaluation and Actions (2017)</u>: Evaluation was performed during the Assessment Workshop on May 15 & 16. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance. Tests on ethics will be used in Capstone for assessment and evaluation.

Table 4.A.11 Student Outcomes (g) - An ability to communicate effectively

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Writing conforms to appropriate technical style format appropriate to the audience	ENGR103, EE-202, EE212, EE310, EE312 EE396, EE422, EE423	Final Project report analysis using rubric	EE 423	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%
Appropriate use of graphics	ENGR103, EE-202, EE212, EE310, EE312 EE396, EE422, EE423	Final Project report analysis using rubric	EE 423	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%
Mechanics and grammar are appropriate	ENGR103, EE-202, EE212, EE310, EE312 EE396, EE422, EE423	Final Project report analysis using rubric	EE 423	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%
Oral: Body language and clarity of speech enhances communication	ENGR103, EE-202, EE212, EE310, EE312 EE396, EE422, EE423	Final Project Presentation using rubric	EE 423	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%

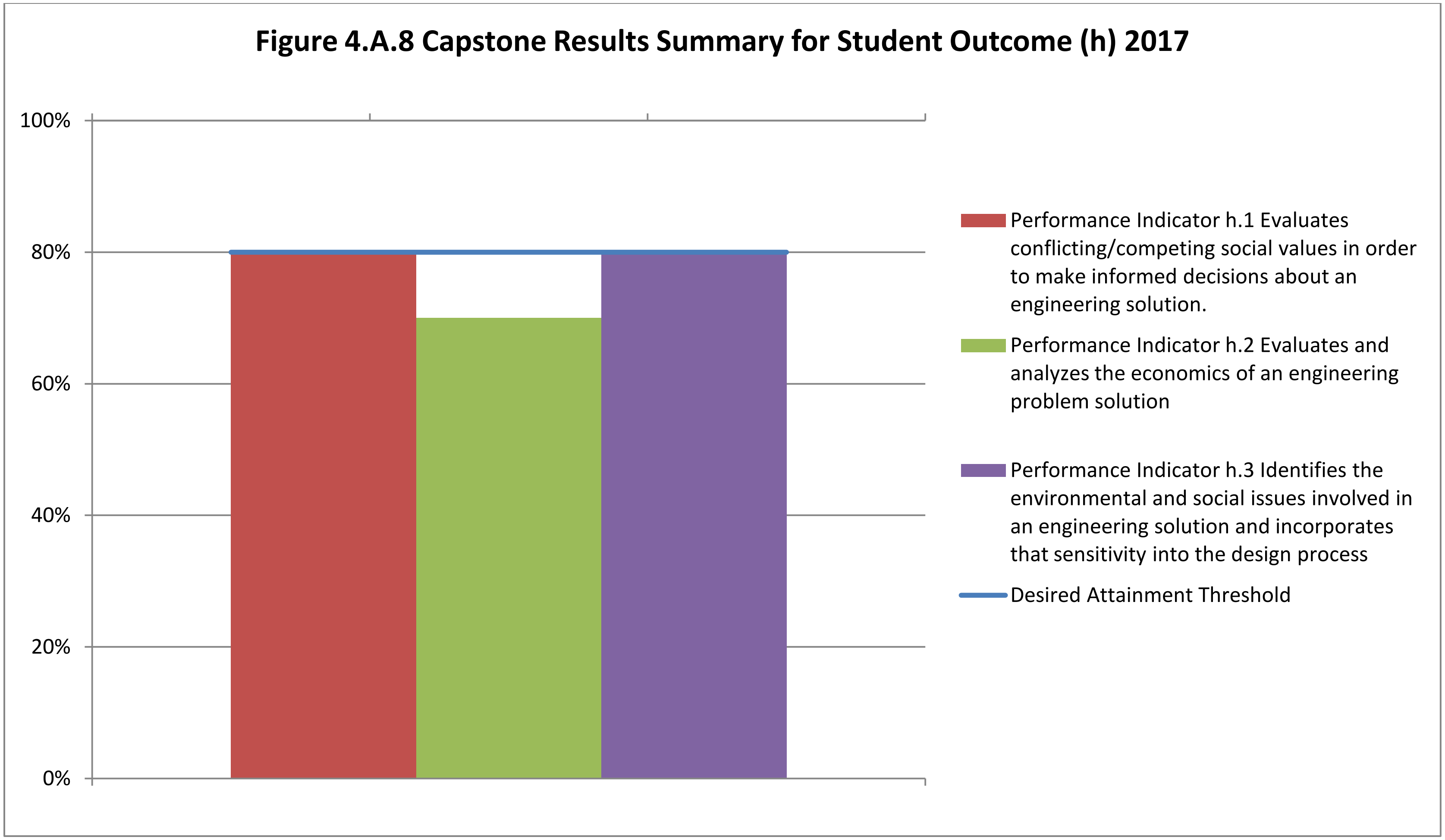


<u>Assessment Results Summary (2017)</u>: The average results from Capstone and EE 202 show that students achieved satisfactory level (85% and 80%) for the Indicators g.1 and g.3. Indicators g.2 (70%) is rated as learning and g.4 (60%) is rated as needs improvement.

<u>Evaluation and Actions (2017)</u>: Evaluation was performed during the Assessment Workshop on May 15 & 16. Indicator 2 showed insufficient ability to communicate through figures, drawings and graphs, which will be addressed in ENGR103, EE-202, EE212, EE310, EE312 and all design courses possible will require CAD type drawings. Information for Indicator 4 was that overall some students did not have good oral presentation skills. This will be addressed in EE-202, EE310. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.A.12 Student Outcomes (h) - The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Evaluates conflicting/competing social values in order to make informed decisions about an engineering solution	EE101, EE396, EE422, EE423	Final Design Projects (Rubric)	EE 423	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Evaluates and analyzes the economics of an engineering problem solution	EE101, EE396, EE422, EE423	Final Design Projects (Rubric)	EE 423	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Identifies the environmental and social issues involved in an engineering solution and incorporates that sensitivity into the design process	EE101, EE396, EE422, EE423	Final Design Projects (Rubric)	EE 423	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%

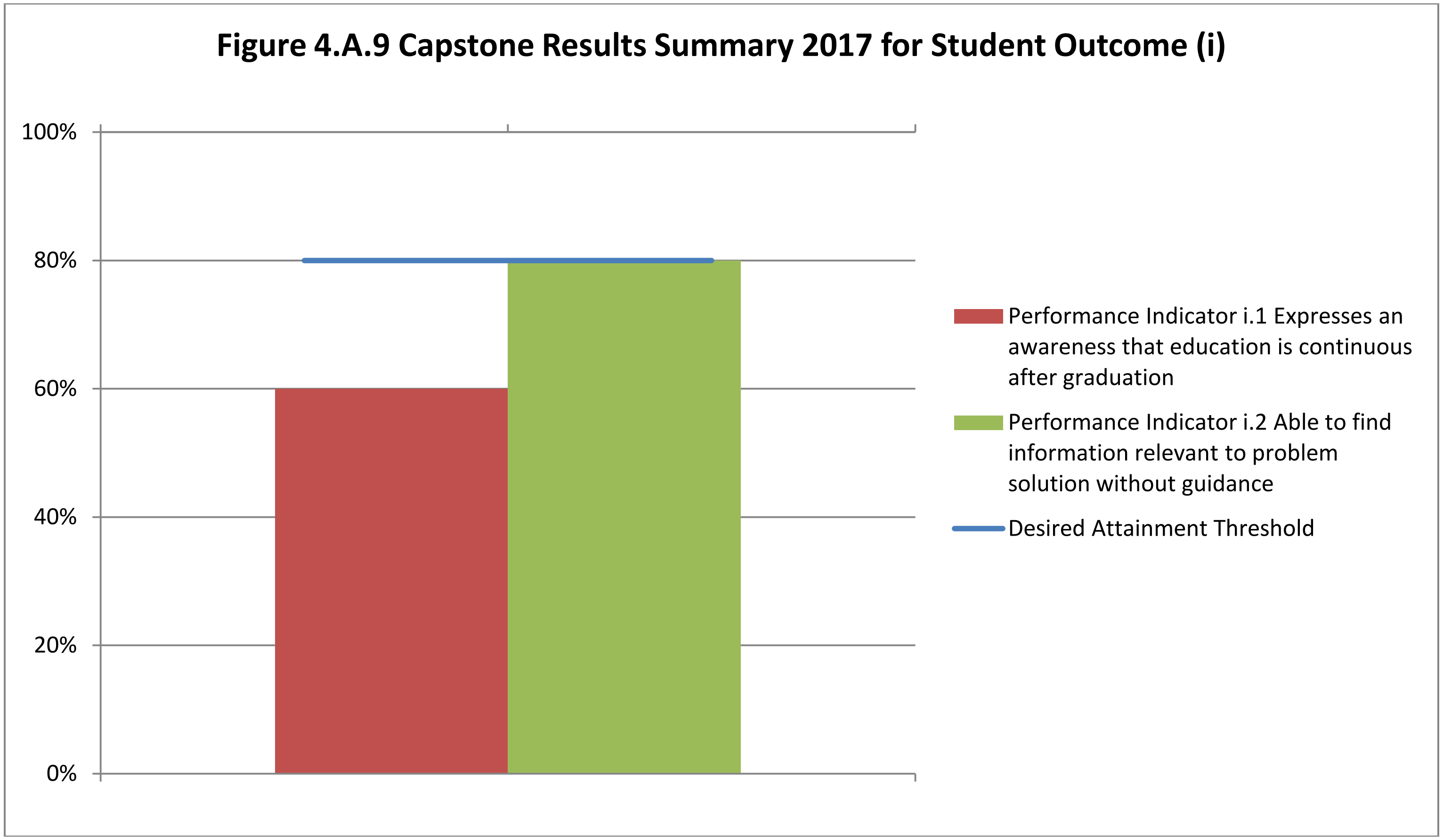


<u>Assessment Results Summary (2017)</u>: The Capstone results show that students achieved satisfactory (80%) levels for Indicators h.1 and h.3. Students achieved learning level (70%) for Indicator h.2.

<u>Evaluation and Actions (2017)</u>: Evaluation was performed during the Assessment Workshop on May 15 & 16. More emphasis on improving student learning related to Indicator h.2. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.A.13 Student Outcomes (i) - A recognition of the need for, and an ability to engage in life-long learning

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Expresses an awareness that education is continuous after graduation	EE396, EE422, EE423	Final Design Projects	EE 423	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Able to find information relevant to problem solution without guidance	EE396, EE422, EE423	Final Design Projects	EE 423	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%

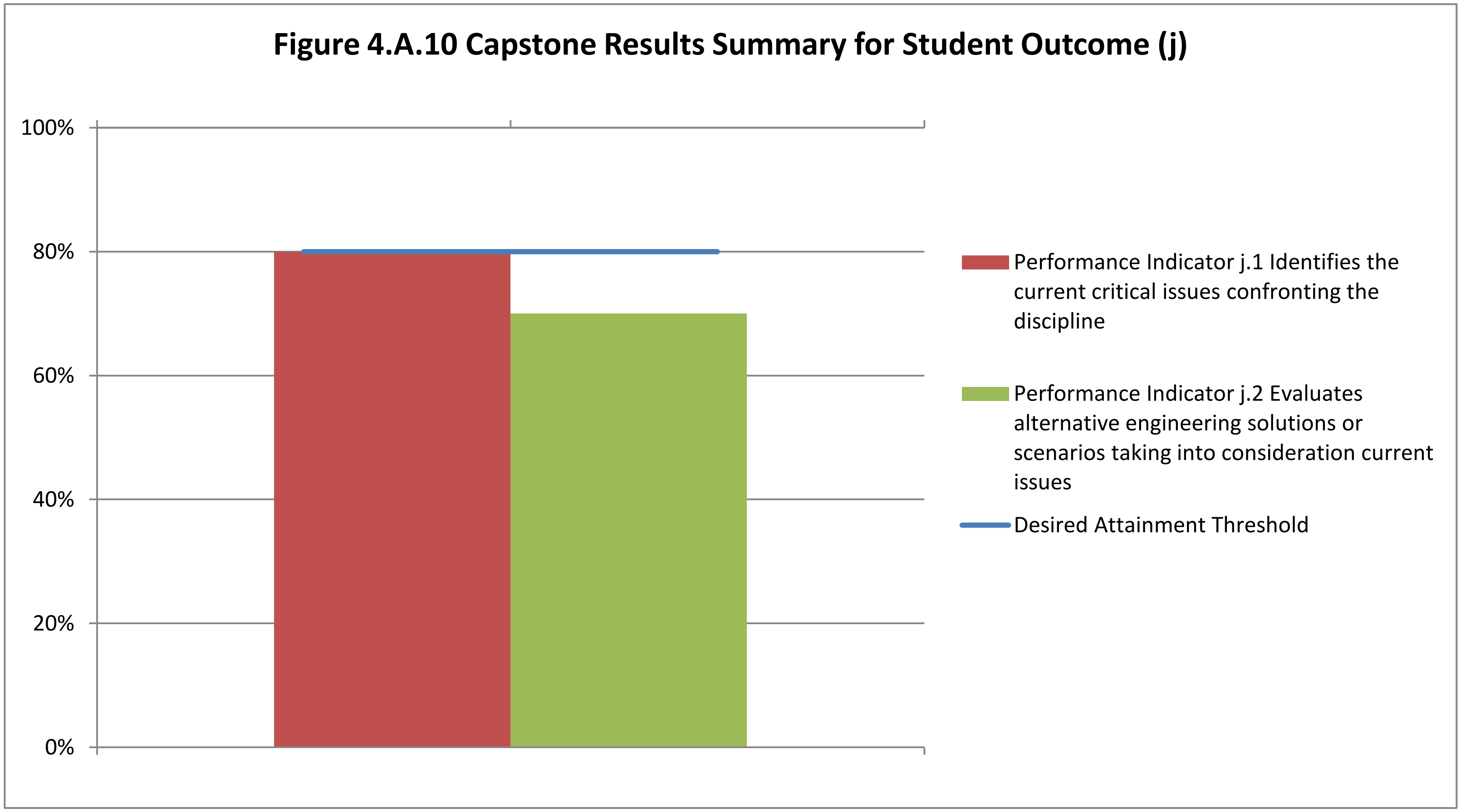


<u>Assessment Results Summary (2017)</u>: The Capstone show that students achieved learning level (60%) for Indicator i.1 and satisfactory level (80%) for Indicator i.2.

<u>Evaluation and Actions (2017)</u>: Evaluation was performed during the Assessment Workshop on May 15 & 16. It was decided to talk to Faculty about emphasizing continuous education in the profession. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.A.14 Student Outcomes (j) - A knowledge of contemporary issues

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Identifies the current critical issues confronting the discipline	EE310, EE313, EE396, EE406, EE422, EE423	Quizzes, Tests, Homework and Final Design Project	EE 423	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Evaluates alternative engineering solutions or scenarios taking into consideration current issues	EE310, EE313, EE396, EE406, EE422, EE423	Quizzes, Tests, Homework and Final Design Project	EE 423	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%

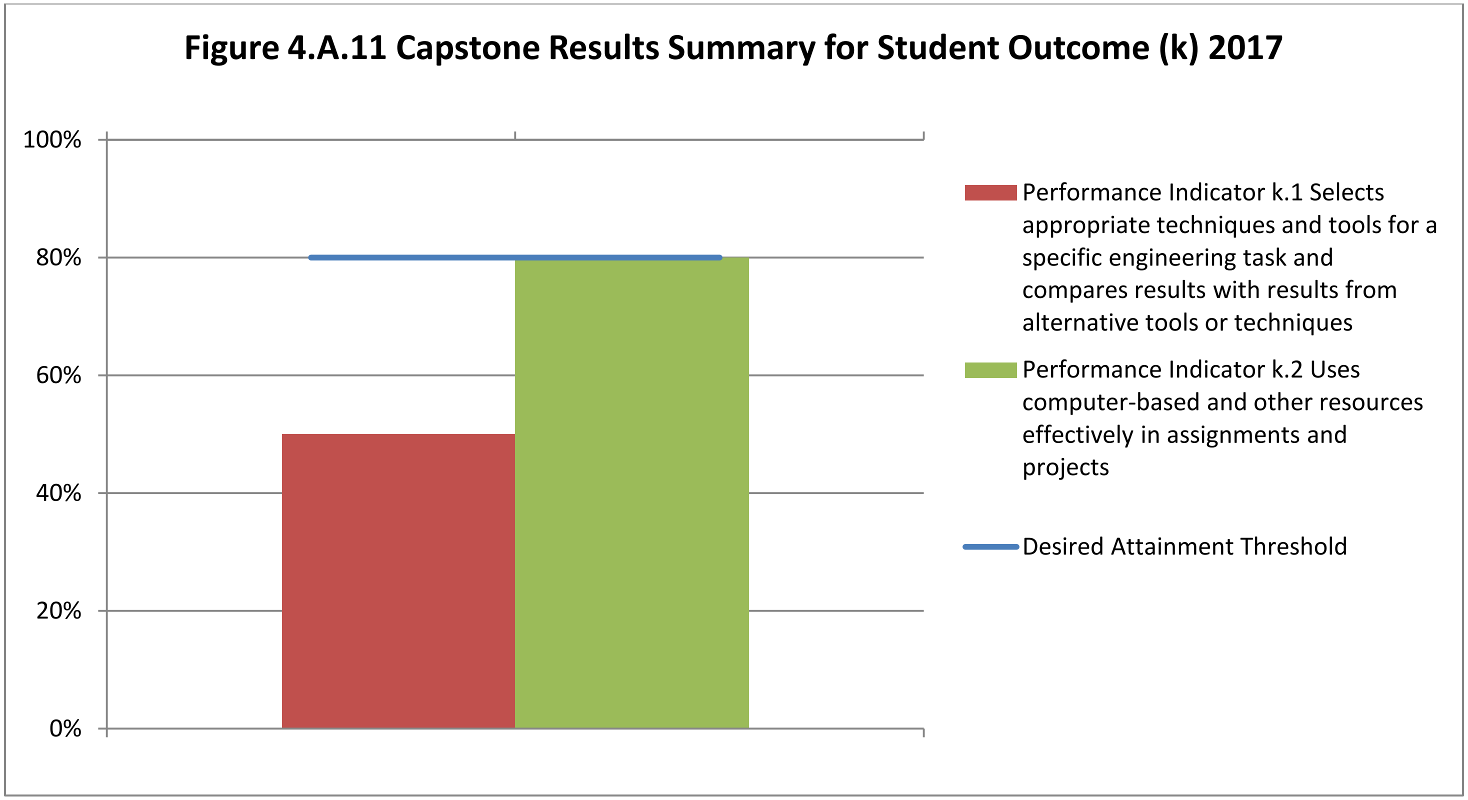


<u>Assessment Results Summary (2017)</u>: The Capstone results show that students achieved satisfactory level (80%) for Indicator j.1 or learning level (60%) for Indicator j.2.

<u>Evaluation and Actions (2017)</u>: Evaluation was performed during the Assessment Workshop on May 15 & 16. It was decided to talk to Faculty about emphasizing continuing education and the need to keep up with current issues in the profession. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.A.15 Student Outcomes (k) - An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Performance Indicators	Educational Strategies	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) / semester of data collection	Target for Performance
Selects appropriate techniques and tools for a specific engineering task and compares results with results from alternative tools or techniques	EE101, EE103, EE201, EE202, EE203, EE212, EE301, ENGR301 EE310, EE312, EE396, EE406, EE422, EE423	Quizzes, Tests, Homework and Final Design Project	EE 423	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%
Uses computer-based and other resources effectively in assignments or projects	EE101, EE103, EE201, EE202, EE203, EE212, EE301, ENGR301 EE310, EE312, EE396, EE406, EE422, EE423	Quizzes, Tests, Homework and Final Design Project	EE 423	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%



<u>Assessment Results Summary (2017)</u>: The Capstone results show that students achieved needs improvement level (50%) for Indicator k.1. Indicator k.2 was at a satisfactory level (80%).

<u>Evaluation and Actions (2017)</u>: Evaluation was performed during the Assessment Workshop on May 15 & 16. Students did not present why the techniques and tools they chose were the best suitable for the tasks. Faculty will emphasize using alterative techniques for comparisons in future. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Program Assessment

The following is the Program Assessment form currently in use at NTU:

Program Assessment

Assessment Planning/Reporting Sheet **Program:**
Course #: **Semester:**
Campus:
Instructor:

Answer questions 1 – 5B for your Assessment Plan/proposal. **Answer all questions for your Assessment Report.** **Please attach your syllabus, pre/post-tests, rubrics and graphs in a separate file identified with your name and the semester/year.**
1. What is your program mission statement?
2. What are your program outcomes?
3. What is/are the program goal(s) you are going to measure?
4. What is/are the method(s) (direct or indirect, or both) you will use to measure your programs goals?
5. What are your pre-assessment outcomes? A. Number of students for pre-assessment: _______ B. What is your expectation/benchmark?
6. What are your post-assessment outcomes? A. Number of students for post-assessment: _______ B. Did your students meet your expectation/benchmark?
7. Based on your post assessment outcomes, what changes will you make in teaching methodology, **program outcomes**, or anything else to improve student learning?
8. How will your proposed changes continue to support your stated program goals?
9. Based on your conclusions from your post assessment outcomes, how are you going to improve your assessment activities?

Benchmark: ______% students will meet or exceed expectation.

Exceeds Expectation Students are able to successfully complete > 80% of the evaluation method (i.e., pre-test, survey, etc.) **<u>Results</u>** Initial: Final:
Meets Expectation Students are able to successfully complete > 80% of the evaluation method (i.e., pre-test, survey, etc.) **<u>Results</u>** Initial: Final:
Does not meet Expectation Students are able to successfully complete > 80% of the evaluation method (i.e., pre-test, survey, etc.) **<u>Results</u>** Initial: Final:

(What percentage of the class do you expect to meet or exceed your expectation for the course?)

Final Result: ____% Met or exceeded expectations
____% Did not meet expectations

B. Continuous Improvement

Our continuous improvement process has four components which derive from the Diné Philosophy of Education as illustrated in Figure 4.B.1.

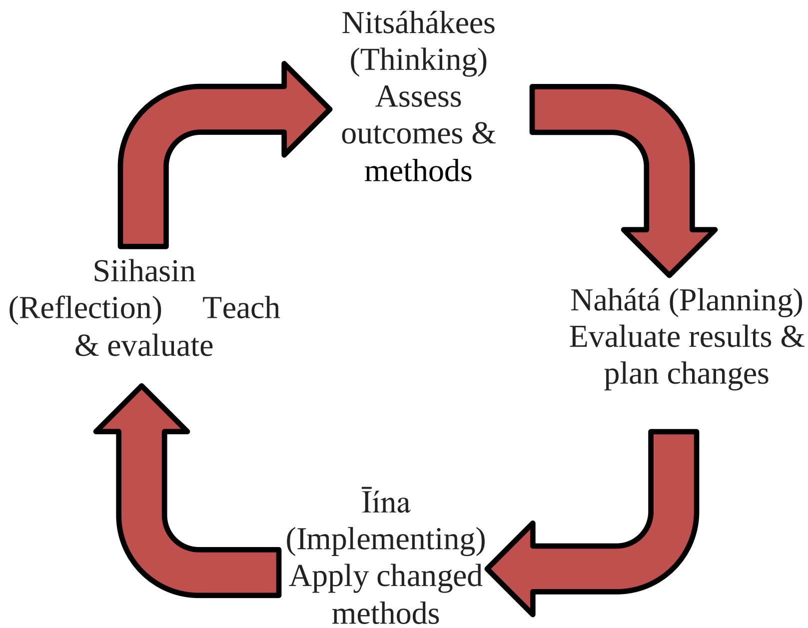


Figure 4.B.1 The Continuous Improvement Process of the NTU EE program

Nitsáhákees (Thinking)

Our assessment cycle process has been shaped by the Diné Philosophy of Education. The first component is Nitsáhákees (Thinking), where we assess the outcomes and methods. Assessment is a process by which the engineering faculty and others investigate the data collected in the evaluation process and review the efficiency of elements of the program. In the Fall of 2017 we will be presenting the Faculty with the new rubric using Performance Indicators for assessment. The evaluation component of the NTU EE continuous improvement process includes the following input:

a. Answers to questions on Homework, Quizzes, Midterms and Finals
b. Student Projects
c. Faculty opinion of attainment of ABET Outcomes
d. Senior Exit Interviews
e. Alumni Survey
f. Engineering Advisory Board Meeting

This data collection is subject to the following actions and characteristics:

● All 11 outcomes (a-k) are assessed by at least two courses.

● There are rubrics for the performance indicators, two or more for each outcome (a-k). If two courses test the same outcome, the same rubric is used.

● A schedule for testing all outcomes is given in Tables 4.A.1 - 4.A.3.

● Rubrics for assessment have been updated based on advice from Dr. Susan Schall and knowledge gained at the ABET Symposium of this April 2017. The new rubrics are based on performance indicators developed from the a. through k. student outcomes. These rubrics were changed from the previous set of rubrics, which were course based, one for each core course as we have learned more about the assessment process. The new rubrics are outcome (a-k) based and focus on program assessment.

● Outcomes are matched to courses with a schedule for the evaluation of each course is given in Tables 4.A.2 - 4.A.3.

Nahátá (Planning)

The second component is Nahátá (Planning) where we evaluate results from assessment and plan what changes will bring better outcomes. As a result of program assessment, suggestions or recommendations for improvement are completed. Other input may include outside evaluators, the Assessment Committee and the Dean of Instruction.

We have implemented having Engineering Faculty Assessment meetings to evaluate and assess more specifically for our engineering programs. Our first meeting of this type was in May 2017 and led to robust discussion of how we assess the Capstone course. In the Spring of 2017 a combined IE-424/EE-423 Capstone class had been held and we discussed changes to the course and the elements that lead up to it. Some of the changes we are implementing from that are:

1) More use of CAD software in design projects in lower level courses.
2) Use of better rubrics with performance indicators for evaluating student outcomes from all courses.
3) Making the Electrical Engineering curriculum have two Capstone Classes, in the first the EE students will work with an IE student taking Project Management for the PM portions of the course and in the second IE students will join the course to complete the Capstone project.
4) More emphasis on design standards and constraints in all classes.

Īína (Implementing)

The third step is Īína (Implementing) after the engineering faculty assessment meeting, professors are expected to take the changes discussed and to apply them.

There have been many changes of curriculum to bring the program into better alignment with ABET guidelines. Suggestions and changes that have happened in the 2014-2017 for the current ABET review period include:

1) Splitting Engineering Statistics into two courses. Basic Statistics and Probability and Inferential Statistics will be offered to give students more time and practice in learning essential statistical skills. Mr. Harry Whiting asked for this change because of the many concepts that were poorly covered in Engineering Statistics as one course.
2) Elimination of College Algebra and Trigonometry from the curriculum: ABET requirements assume that students have taken these courses or their equivalent. If students join the program without having these courses, they will have to take them to be able to advance to Calculus. College Algebra and Trigonometry will no longer be counted toward the Criterion 5 requirement toward one year of Math/Science.
3) Replacing MTH-105 Mathematics for Engineering Applications with CS-1xx Computer Programming Elective Computer Programming or "Coding" is widely considered the single most important topic in the 21st century. There already exists in the U.S. a "digital-divide" where youth that do not have exposure to coding will have greatly reduced opportunities and options in their future. Our ABET assessment for Spring 2017 revealed a weakness amongst the EE students in coding. The program has elected to significantly increase the coding incorporated into the program.
4) Adding EE 303 Probability & Random Signals as a probability course in electrical engineering application is required by ABET.
5) Replacing EE-302 Electromagnetic Fields & Waves as a course required for graduation with a new course ENGR-301 Introduction to Modeling & Simulation. EE-302 is not required by ABET. ENGR-301 has been developed over a 4 year period by engineers at NASA Houston and TCU faculty at SKC and SIPI. This course prepares students of any discipline to create and program mathematical and scientific models for every aspect of the modern world. Other terms for this material is "Computational Engineering and Science".
6) Replace the required course EE-304 Energy Systems & Power Electronics with EE-313 Summer Internship. EE-304 is not required by ABET. Most EE students pursue summer internships and they are strongly encouraged and supported at NTU. Students will be allowed to substitute a 300 or 400 level engineering elective for Internship if they are not able or do not desire to pursue an internship.
7) Reduce the curriculum from 123 credit hours to 120 credit hours by eliminating EE-320. Instrumentation & Process Control as a course required for graduation. The U.S. Department of Education has requested colleges and universities to reduce the credit hours required for a baccalaureate degree to 120 semester credits or less. One motivation is to shorten the time spent in college beyond four years and to reduce the student loan debt most students are left with. EE-320 is not required by ABET. EE-320 will be retained as an elective course.
8) Replacing a Concentration Course in the Junior year Spring semester with a required course EE-396 Junior Research Project for 3 semester credits since the assessment of the Capstone course revealed that the students need structured pre-requisite experience and knowledge with engineering projects. Requiring EE-396 in the Junior year Spring semester will give this preparation and effectively create a 3-semester capstone sequence.
9) Replace IE-380 Project Management with a new course EE-422 Capstone Design I. Assessment of EE-423 Capstone Design revealed several significant concerns in 3 ABET required student learning outcomes, the ABET a-k Student Outcomes, and the desire of the program for the students to build, test, and demonstrate a working project by the time

they finish Capstone. The 2017 capstone students were able to produce crude prototypes but could have manufactured and tested a working device if another semester were available to them. EE-422 will be offered each fall semester scheduled at the same slots with the Electrical Engineering students in IE-380 so that we can continue our successful multidisciplinary approach to Capstone. Project Management is not a requirement of ABET for EE programs.

The changes listed above will be evaluated through the assessment cycle to determine their suitability for developing students and delivering necessary content. Assessment should allow us to assess the effectiveness of these changes.

Siihasin (Reflection)

The fourth component is Siihasin (Reflection) during this part of the cycle professors are expected to be teaching in the new methods and seeing how student learning and outcomes are being shaped.

C. Additional Information

Copies of any of the assessment instruments or materials referenced in 4.A. and 4.B will 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 will also be included.

CRITERION 5. CURRICULUM

A. Program Curriculum

The curriculum for the Electrical Engineering program at Navajo Technical University has been designed by the faculty to provide the best possible preparation for engineering practice through a balance of theory and application, including training in contemporary industry tools, scholarly skills, and opportunities in entrepreneurism and leadership.

The curriculum aligns with the program educational objectives through its direct support of the student outcomes. Student outcomes map directly into program educational objectives.

The Navajo Tech Electrical Engineering curriculum builds from basic to advanced courses, has a logical prerequisite tree, and balances semester loads among various technical and general education courses. All students take a common engineering core that satisfies the ABET EAC Criteria for Electrical Engineering. Students can elect to pursue courses in one of three options, Computer Engineering & Digital Systems, Electrical Power and Energy Systems, or Manufacturing.

The EE Curriculum has courses divided into the following categories:

Math/Science

Math and Science courses for a total of 30 credit hours, which include General Chemistry with Lab, Physics with Lab and Math and Statistics classes. Math/Science curriculum is absolutely necessary to engineering education in any discipline. Our curriculum in this area includes Calculus, Differential Equations, Linear Algebra, General Chemistry, and Physics since that is the area of math that is often the most needed in Electrical Engineering.

Course	Title	Credits
MTH 162	Calculus I	4
MTH 163	Calculus II	4
MTH 205	Discrete Math	3
MTH 310	Differential Equations	4
MTH 410	Linear Algebra	3
CHM 120	General Chemistry & Lab	4
PHY 111/121	Algebra or Calculus-based Physics I	4
PHY 112/122	Algebra or Calculus-based Physics II	4
TOTAL		**30**

Engineering Design

Engineering Design courses for a total of 53 credit hours, which include engineering sciences and engineering design appropriate to the student's field of study. Design knowledge is an integral part of achieving success as defined by the PEOs. Probability & Random Signals, a probability and statistic course with EE application, is also a required course in EE curriculum.

Course	Title	Credits
EE 101	Electrical Engineering Fundamentals I	*3*
ENGR 103	Introduction to Engineering	*3*
EE 102	Electrical Engineering Fundamentals II	*3*
EE 103	Digital Logic Design	*3*
EE 201	Electrical Engineering Fundamentals III	*3*
EE 202	Electrical Engineering Fundamentals IV	*3*
EE 203	Electronics I	*3*
EE 212	Instrumentation I	*2*
EE 301	Signals and Systems	*3*
ENGR-301	Introduction to Modeling and Simulation	*4*
EE 303	Probability & Random Signals	*3*
EE 310	Embedded System Design	*3*
EE 312	Instrumentation II	*2*
EE 313	Summer Internship	*3*
EE 396	Junior Research Project	*3*
EE 406	Computer Networks	*3*
EE 422	Capstone Design I	*3*
EE 423	Capstone Design II	*3*
TOTAL		**53**

Almost all courses in the EE program require the student to solve an open-ended problem and are teamed with upper-classmen in design and making projects. Table 5.A.1 summarizes classes where design experience projects are taught in EE curriculum.

Table 5.A.1 Outline of Design Experiences in the EE Curriculum

EE Design Courses	**Design Content**
EE 101 Electrical Engineering Fundamentals I	• Design and implement a solution to a student-defined problem in the context of engineering design
ENGR 103 Introduction to Engineering	• Design Process & use of Design Notebook • Final Semester Design Project
EE 102 Electrical Engineering Fundamentals II	• Design Op-Amp circuits to perform operations such as integration, differentiation and filtering on electronic signals
EE 103 Digital Logic Design	• Analyze and design combinational systems using standard gates and minimization methods (such as Karnaugh maps) • Analyze and design sequential systems composed of standard sequential modules, such as counters and

	registers
EE 201 Electrical Engineering Fundamentals III	• Design an electronic system beginning with the formal specification, and including implementation and test
EE 202 Electrical Engineering Fundamentals IV	• Design electronic systems and use them in real world applications
EE 203 Electronics I	• Analyze and design basic amplifier configurations • Analyze and design various Opamp configurations • Design a system to meet desired needs within realistic constraints and implement it
EE 212 Instrumentation I	• Design experiments to obtain required data
EE 301 Signals and Systems	• Design system parameters based on requirements
ENGR-301 Introduction to Modeling and Simulation	• Design and implement a model and simulation to a student-defined problem in the context of engineering design • Utilize tools to implement an engineering design
EE 310 Embedded System Design	• Design embedded computer system hardware • Design, implement, and debug multi-threaded application software that operates under real-time constraints on embedded computer systems • implement the design in hardware and software, and measure performance against the design constraints
EE 312 Instrumentation II	• Design computer-assist systems to perform data acquisition
EE 396 Junior Research Project	• Students must engage in a semester long design project incorporating the following minimum factors: design of system/product, creating prototype, use of standards
EE 422/EE423 Capstone Design I / II	• Students must engage in two-semester long design project incorporating the following minimum factors: Scheduling time, creating budget, design of system/product, creating prototype (waived in some cases), economic analysis, use of standards

General Education/Humanities

General Education/Humanities courses for a total of 16 credit hours, which include a requirement for English, History, Humanities and Navajo Language classes. In 1920's America the Progressive education movement was at its peak. One of the ideas introduced was the 'well rounded person'. These courses are intended to make students aware of subjects not necessarily within a strict engineering context, but to give a wider view of the world and the students place in it.

ENG – 110 Freshman Composition	3
ENG – 111 Composition and Research	3
NAV - 101 or 201 Navajo Language	4
HUM – XXX Humanities Elective	3

SC/BS – XXX Social Sci. or Behavioral Sci. Elective	3
TOTAL	**16**

Computer Science Course

A computer science elective is required in EE curriculum.

CS - Elective Computer Programming Elective	3
TOTAL	**3**

Skills Courses

The EE program is designed to provide a broad Electrical Engineering foundation with the option for students to select a concentration to focus their degree based on their career plans. The concentrations consist of 18 semester hours of engineering electives selected from a list of technical electives published in the catalog. There are presently three concentrations: Computer Engineering/Digital Systems, Electric Power and Energy Systems, and Manufacturing. A student can also elect to not declare a concentration in which case the student, with the approval of the advisor, selects 18 hours of technical electives from the list published in the catalog.

Computer Engineering and Digital Systems Electives

ITS 250	Data Structures	3
EE 230	Introduction to VHDL and FPGA	3
EE 330	Computer Organization & Assembly Language Program	3
EE 430	Computer Architecture and Design	3
EE 440	Operating Systems I	3
XXX	Technical Elective (Computer Engineering)	3

Electrical Power & Energy Systems Electives

EE 370	Electrical Machinery	3
EE 460	Electrical Power Plants	3
EE 470	Electric Power Devices	3
EE 471	Power System Analysis	3
EE 472	Power Electronics & Power Management	3
XXX	Technical Elective (Electrical Power)	3

Manufacturing

ENGR236	Inferential Statistics	3
IE 235	Lean Production	3
ENGR313	Engineering Economics	3
IE 363	Design of Experiment	3

IE 413	Quality Control	3
IE 483	Rapid Prototyping	3

Program Checklist

Navajo Tech uses program checklists for advising and checking requirements for graduation. The 2017 EE Checklist is shown in Table 5.A.2.

Table 5.A.2. 2017 EE Program Checklist.

Freshman Year		
1 Fall		
EE-101	Electrical Engineering Fundamentals I (*Satisfies CMP-101*)	3
ENGR-103	Introduction to Engineering	3
CS-Elective	Computer Programming Elective	3
ENG-110	Freshman Composition	3
NAV-101	Introduction to Navajo Language	4
		Total: 16
2 Spring		
EE-102	Electrical Engineering Fundamentals II	3
EE-103	Digital Logic Design	3
CHM-120	General Chemistry I	4
ENG-111	Composition and Research	3
HUM-XXX	Humanities Elective	3
		Total: 16
Sophomore Year		
3 Fall		
EE-201	Electrical Engineering Fundamentals III	3
MTH-205	Discrete Mathematics	3
MTH-162	Calculus I	4
	Concentration Course	3
SSCXX	Social Science or Behavioral Sci Elective	3
		Total: 16
4 Spring		
EE-202	Electrical Engineering Fundamentals IV	3
EE-203	Electronics I	3
EE-212	Instrumentation I	2
MTH-163	Calculus II	4
PHY-111/121	Algebra or Calculus-Based Physics I	4
		Total: 16
Junior Year		
5 Fall		
EE-301	Signals & Systems	3
ENGR-301	Introduction to Modeling and Simulation	4
	Concentration Course	3
MTH-310	Differential Equations	4

PHY-112/122	Algebra or Calculus-Based Physics II	4
		Total: 18
6 Spring		
EE-303	Probability & Random Signals	3
EE-313	Summer Internship	3
EE-310	Embedded System Design	3
EE-312	Instrumentation II	2
EE-396	Junior Research Project	3
		Total: 14
Senior Year		
7 Fall		
EE-422	Capstone Design I	3
EE-406	Computer Networks	3
	Concentration Course	3
	Concentration Course	3
		Total: 12
8 Spring		
MTH-410	Linear Algebra	3
	Concentration Course	3
	Concentration Course	3
EE-423	Capstone Design II	3
		Total: 12
		Total: 120

EE Program Curriculum Tables including Concentrations

Table 5.A.3 (a) lists the required engineering and math/science courses that constitute the EE core curriculum. All the listed courses are required for every EE student. The totals at the bottom of the table demonstrate that the 30 semester credit hours of college level math & science and the 53 semester credit hours of engineering topics satisfies the Criterion 5 minimums of 25% and 48 hours respectively.

Table 5.A.3 (b) is the curriculum where the student elects to not declare a concentration. Instead the student selects 21 credit hours of technical electives from the approved list published in the catalog.

Table 5.A.3 (c) is the curriculum for the Concentration in Computer Engineering & Digital Systems.

Table 5.A.3 (d) is the curriculum for the Concentration in Electrical Power & Energy Systems.

Table 5.A.3 (e) is the curriculum for the Concentration in Manufacturing.

Table 5.A.3 (a) - Electrical Engineering-BSEE Degree Program – Core EE & Math/Science Requirements

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)
1st Year/ 1st Semester:			
EE - 101 Electrical Engineering Fundamentals I	R		*3*
ENG – 110 Freshman Composition	R		
NAV - 101 or 201 Navajo Language	R		
ENGR – 103 Introduction to Engineering	R		*3*
1st Year/ 2nd Semester:			
ENG – 111 Composition and Research	R		
EE – 102 Electrical Engineering Fundamentals II	R		*3*
EE – 103 Digital Logic Design	R		*3*(√)
CHM-120 - General Chemistry I	R	4	
2nd Year/1st Semester:			
MTH – 162 Calculus I	R	4	
MTH – 205 Discrete Mathematics	R	3	
EE – 201 Electrical Engineering Fundamentals III	R		*3*
2nd Year/ 2nd Semester:			
EE – 202 Electrical Engineering Fundamentals IV	R		*3*
MTH – 163: Calculus II	R	4	
PHY – 111/121 Algebra or Calculus-Based Physics I	R	4	
EE – 203 Electronics I	R		*3*(√)
EE – 212 Instrumentation I	R		*2*
3rd Year/ 1st Semester:			
EE – 301 Signals and Systems	R		*3*
ENGR-301 - Introduction to Modeling and Simulation	R		*4*(√)
MTH – 310 Differential Equations	R	4	
PHY – 112/122 Algebra or Calculus-Based Physics II	R	4	
3rd Year/ 2nd Semester:			
EE – 303 Probability & Random Signals	R		*3*
EE - 313 - Summer Internship	R		*3*
EE – 310 Embedded System Design	R		*3*(√)

EE – 312 Instrumentation II	R		*2*(√)
EE – 396 Junior Research Project	R		*3*(√)
4th Year/1st Semester:			
EE - 422 - Capstone Design I	R		*3*(√)
EE – 406 Computer Networks	R		*3*
4th Year/ 2nd Semester:			
EE – 423 Capstone Design II	R		*3*(√)
MTH-410 Linear Algebra	R	3	
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		Hours	Hours
EE & Math/Science Core Requirements	83	30	*53*
PERCENT OF TOTAL		27.05%	41%
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours
	Minimum Percentage	25%	37.5 %

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.

Table 5.A.3 (b) - Electrical Engineering-BSEE Degree Program – EE Core + 18 Hours of Electrical Engineering Technical Electives+ 3 Computer Science Electives

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)*			
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	CS-Elective
1st Year/ 1st Semester:					
EE - 101 Electrical Engineering Fundamentals I	R		*3*		
ENG – 110 Freshman Composition	R			*3*	
CS-Elective - Computer Programming Elective	E				*3*
NAV - 101 or 201 Navajo Language	R			*4*	
ENGR – 103 Introduction to Engineering	R		*3*		
1st Year/ 2nd Semester:					
ENG – 111 Composition and Research	R			*3*	
HUM – XXX Humanities Elective	E			*3*	
EE – 102 Electrical Engineering Fundamentals II	R		*3*		
EE – 103 Digital Logic Design	R		*3*(√)		
CHM-120 - General Chemistry I	R	4			
2nd Year/1st Semester:					
MTH – 162 Calculus I	R	4			
EE - Concentration Course	E		*3*		
MTH – 205 Discrete Mathematics	R	3			
EE – 201 Electrical Engineering Fundamentals III	R		*3*		
SC/BS – XXX Social Sci. or Behavioral Sci. Elective	E			*3*	
2nd Year/ 2nd Semester:					
EE – 202 Electrical Engineering Fundamentals IV	R		*3*		
MTH – 163: Calculus II	R	4			
PHY – 111/121 Algebra or Calculus-Based Physics I	R	4			
EE – 203 Electronics I	R		*3*(√)		
EE – 212 Instrumentation I	R		*2*		
3rd Year/ 1st Semester:					
EE – 301 Signals and Systems	R		*3*		
ENGR-301 - Introduction to Modeling and Simulation	R		*4*(√)		
EE – Concentration Course	E		*3*		
MTH – 310 Differential Equations	R	4			
PHY – 112/122 Algebra or Calculus-Based Physics II	R	4			
3rd Year/ 2nd Semester:					

EE – 303 Probability & Random Signals	R		3		
EE - 313 - Summer Internship	R		3		
EE – 310 Embedded System Design	R		3(√)		
EE – 312 Instrumentation II	R		2(√)		
EE – 396 Junior Research Project	R		3(√)		
4th Year/1st Semester:					
EE - 422 - Capstone Design I	R		3(√)		
EE – 406 Computer Networks	R		3		
EE – Concentration Course	E		3		
EE – Concentration Course	E		3		
4th Year/ 2nd Semester:					
EE – 423 Capstone Design II	R		3(√)		
MTH-410 Linear Algebra	R	3			
EE – Concentration Course	E		3		
EE – Concentration Course	E		3		
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		Hours	Hours	Hours	Hours
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM	120	30	71	16	3
PERCENT OF TOTAL		25%	59.20%	13.44%	2.5%
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours		
	Minimum Percentage	25%	37.5%		

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.

Table 5.A.3 (c) - Electrical Engineering-BSEE Degree Program – Computer Engineering & Digital Systems Concentration

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)*			
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	CS-Elective
1st Year/ 1st Semester:					
EE - 101 Electrical Engineering Fundamentals I	R		*3*		
ENG – 110 Freshman Composition	R			*3*	
CS-Elective - Computer Programming Elective	E				*3*
NAV - 101 or 201 Navajo Language	R			*4*	
ENGR – 103 Introduction to Engineering	R		*3*		
1st Year/ 2nd Semester:					
ENG – 111 Composition and Research	R			*3*	
HUM – XXX Humanities Elective	E			*3*	
EE – 102 Electrical Engineering Fundamentals II	R		*3*		
EE – 103 Digital Logic Design	R		*3*(√)		
CHM-120 - General Chemistry I	R	4			
2nd Year/1st Semester:					
MTH – 162 Calculus I	R	4			
ITS-250 Data Structures	E		*3*		
MTH – 205 Discrete Mathematics	R	3			
EE – 201 Electrical Engineering Fundamentals III	R		*3*		
SC/BS – XXX Social Sci. or Behavioral Sci. Elective	E			*3*	
2nd Year/ 2nd Semester:					
EE – 202 Electrical Engineering Fundamentals IV	R		*3*		
MTH – 163: Calculus II	R	4			
PHY – 111/121 Algebra or Calculus-Based Physics I	R	4			
EE – 203 Electronics I	R		*3*(√)		
EE – 212 Instrumentation I	R		*2*		
3rd Year/ 1st Semester:					
EE – 301 Signals and Systems	R		*3*		
ENGR-301 - Introduction to Modeling and Simulation	R		*4*(√)		
EE-230 Introduction to VHDL and FPGA	E		*3*		
MTH – 310 Differential Equations	R	4			
PHY – 112/122 Algebra or Calculus-Based Physics II	R	4			
3rd Year/ 2nd Semester:					
EE – 303 Probability & Random Signals	R		*3*		

EE - 313 - Summer Internship (Computer Engineering)	R		*3*		
EE – 310 Embedded System Design	R		*3*(√)		
EE – 312 Instrumentation II	R		*2*(√)		
EE – 396 Junior Research Project	R		*3*(√)		
4th Year/1st Semester:					
EE - 422 - Capstone Design I	R		*3*(√)		
EE – 406 Computer Networks	R		*3*		
EE330 – Computer Organization & Assembly Language Program	E		*3*		
EE440 – Operating Systems I	E		*3*		
4th Year/ 2nd Semester:					
EE – 423 Capstone Design II	R		*3*(√)		
MTH-410 Linear Algebra	R	3			
EE430 – Computer Architecture and Design	E		*3*		
EE – Concentration Course (Computer Engineering)	E		*3*		
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		Hours	Hours	Hours	Hours
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM	120	30	*71*	*16*	*3*
PERCENT OF TOTAL		25%	59.20%	13.44%	2.5%
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours		
	Minimum Percentage	25%	37.5 %		

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.

Table 5.A.3 (d) - Electrical Engineering-BSEE Degree Program – Electrical Power & Energy Systems Concentration

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)*			
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	CS-Elective
1st Year/ 1st Semester:					
EE - 101 Electrical Engineering Fundamentals I	R		*3*		
ENG – 110 Freshman Composition	R			*3*	
CS-Elective - Computer Programming Elective	E				*3*
NAV - 101 or 201 Navajo Language	R			*4*	
ENGR – 103 Introduction to Engineering	R		*3*		
1st Year/ 2nd Semester:					
ENG – 111 Composition and Research	R			*3*	
HUM – XXX Humanities Elective	E			*3*	
EE – 102 Electrical Engineering Fundamentals II	R		*3*		
EE – 103 Digital Logic Design	R		*3*(√)		
CHM-120 - General Chemistry I	R	4			
2nd Year/1st Semester:					
MTH – 162 Calculus I	R	4			
EE - Concentration Course (Electrical Power)	E		*3*		
MTH – 205 Discrete Mathematics	R	3			
EE – 201 Electrical Engineering Fundamentals III	R		*3*		
SC/BS – XXX Social Sci. or Behavioral Sci. Elective	E			*3*	
2nd Year/ 2nd Semester:					
EE – 202 Electrical Engineering Fundamentals IV	R		*3*		
MTH – 163: Calculus II	R	4			
PHY – 111/121 Algebra or Calculus-Based Physics I	R	4			
EE – 203 Electronics I	R		*3*(√)		
EE – 212 Instrumentation I	R		*2*		
3rd Year/ 1st Semester:					
EE – 301 Signals and Systems	R		*3*		
ENGR-301 - Introduction to Modeling and Simulation	R		*4*(√)		
EE-370 Electrical Machinery	E		*3*		
MTH – 310 Differential Equations	R	4			
PHY – 112/122 Algebra or Calculus-Based Physics II	R	4			
3rd Year/ 2nd Semester:					
EE – 303 Probability & Random Signals	R		*3*		

EE - 313 - Summer Internship (Electrical Power)	R		*3*		
EE – 310 Embedded System Design	R		*3*(√)		
EE – 312 Instrumentation II	R		*2*(√)		
EE – 396 Junior Research Project	R		*3*(√)		
4th Year/1st Semester:					
EE - 422 - Capstone Design I	R		*3*(√)		
EE – 406 Computer Networks	R		*3*		
EE - 460 – Electrical Power Plants	E		*3*		
EE - 470 Electric Power Devices	E		*3*		
4th Year/ 2nd Semester:					
EE – 423 Capstone Design II	R		*3*(√)		
MTH-410 Linear Algebra	R	3			
EE –471 Power System Analysis	E		*3*		
EE – 472 Power Electronics & Power Management	E		*3*		
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		Hours	Hours	Hours	Hours
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM	120	30	*71*	*16*	*3*
PERCENT OF TOTAL		25%	59.20%	13.44%	2.5%
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours		
	Minimum Percentage	25%	37.5%		

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.

Table 5.A.3 (e) - Electrical Engineering-BSEE Degree Program – Manufacturing Concentration

Course (Department, Number, Title) List all courses in the program by term starting with the first term of the first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[1]	*Subject Area (Credit Hours)*			
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	CS-Elective
1st Year/ 1st Semester:					
EE - 101 Electrical Engineering Fundamentals I	R		*3*		
ENG – 110 Freshman Composition	R			*3*	
CS-Elective - Computer Programming Elective	E				*3*
NAV - 101 or 201 Navajo Language	R			*4*	
ENGR – 103 Introduction to Engineering	R		*3*		
1st Year/ 2nd Semester:					
ENG – 111 Composition and Research	R			*3*	
HUM – XXX Humanities Elective	E			*3*	
EE – 102 Electrical Engineering Fundamentals II	R		*3*		
EE – 103 Digital Logic Design	R		*3*(√)		
CHM-120 - General Chemistry I	R	4			
2nd Year/1st Semester:					
MTH-162 Calculus I	R	4			
ENGR-236 Inferential Statistics	E		*3*		
MTH – 205 Discrete Mathematics	R	3			
EE – 201 Electrical Engineering Fundamentals III	R		*3*		
SC/BS – XXX Social Sci. or Behavioral Sci. Elective	E			*3*	
2nd Year/ 2nd Semester:					
EE – 202 Electrical Engineering Fundamentals IV	R		*3*		
MTH – 163: Calculus II	R	4			
PHY – 111/121 Algebra or Calculus-Based Physics I	R	4			
EE – 203 Electronics I	R		*3*(√)		
EE – 212 Instrumentation I	R		*2*		
3rd Year/ 1st Semester:					
EE – 301 Signals and Systems	R		*3*		
ENGR-301 - Introduction to Modeling and Simulation	R		*4*(√)		
IE-235 Lean Production	E		*3*		
MTH – 310 Differential Equations	R	4			
PHY – 112/122 Algebra or Calculus-Based Physics II	R	4			
3rd Year/ 2nd Semester:					
EE – 303 Probability & Random Signals	R		*3*		
EE - 313 - Summer Internship (Manufacturing)	R		*3*		

EE – 310 Embedded System Design	R		*3*(√)		
EE – 312 Instrumentation II	R		*2*(√)		
EE – 396 Junior Research Project	R		*3*(√)		
4th Year/1st Semester:					
EE - 422 - Capstone Design I	R		*3*(√)		
EE – 406 Computer Networks	R		*3*		
ENGR-313 Engineering Economics	E		*3*		
IE-363 Design of Experiment	E		*3*		
4th Year/ 2nd Semester:					
EE – 423 Capstone Design II	R		*3*(√)		
MTH-410 Linear Algebra	R	3			
IE-413 Quality Control	E		*3*		
IE-483 Rapid Prototyping	E		*3*		
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		Hours	Hours	Hours	Hours
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM	120	30	*71*	*16*	*3*
PERCENT OF TOTAL		25%	59.20%	13.44%	2.5%
Total must satisfy either credit hours or percentage — Minimum Semester Credit Hours		32 Hours	48 Hours		
Total must satisfy either credit hours or percentage — Minimum Percentage		25%	37.5 %		

1. **Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group.

Curriculum and Program Educational Objectives

As a professional person it is expected that graduation is not the end of education or achievement. Our Program Educational Objectives are focused on achievement on the part of the Electrical Engineering graduate after they obtain a BSEE degree. It is considered that the current curriculum gives the graduate skills and knowledge that will support this.

NTU Program Educational Objectives for Electrical Engineering

Our engineering alumni will show that they meet expectations by performing within one or more of these parameters in five to seven years after graduation:

1) Show progress in their career through greater supervisory tasks, advancing to larger managerial responsibility or increasing technical accountability.

2) Acquire professional engineer's license, other certifications of expertise in technical areas or attend graduate school in an appropriate technical discipline.

3) Demonstrate success by continuing employment and/or technical accomplishments as entrepreneurs, civil servants or in commercial or industrial endeavors.

PEO #1 is aligned with our curriculum because the sum of the courses should give students an ability to lead design tasks including analyze design requirements, design systems to meet the requirements, and examine the results. This understanding leads naturally to greater supervisory tasks, and increasing technical accountability.

PEO #2 is aligned with our curriculum because the course work is designed to give the student an advanced education in many aspects of electrical engineering design. No program can cover every subject applicable to Electrical Engineering in a 120 credit hour program, but we have covered an engineering education that allows students to go on to obtain certifications, a professional engineers license or to go to graduate school to continue their education or sharpen their skills. For example, all math courses and EE303 Probability & Random Signals give math bases when students go to graduate school. EE301 Signals and Systems and other signal and communication system elective courses prepare students in the signal processing and communication areas. EE310 Embedded System Design and other computer architecture elective courses prepare students in the embedded system area. EE406 Computer Networks is a basic course for students to get certifications in Computer Networking area.

PEO #3 is aligned with our curriculum because we strive to provide the best education for students, allowing them to go into any field and succeed. The skill set the students acquire during their education here contains elements of commercial and business thinking (e.g., projects in different design courses require students to evaluate the product costs including Capstone projects, ENGR-313 Engineering Economics), technical design and accomplishment (e.g., circuits design courses such as EE201, EE202, and EE203, embedded system design EE310, etc.) Of course there is crossover in many of these courses where principles from more than one area of endeavor is taught.

Curriculum and Student Outcomes

The a – k Student Outcomes are a roadmap to becoming a successful engineer. In this section specific examples of how the curriculum supports attainment of the student outcomes is discussed.

Student Outcome a. An ability to apply knowledge of mathematics, science, and engineering:

This outcome underlies all curriculum taught within the Electrical Engineering curriculum from the earliest classes like Introduction to Engineering to Capstone. Knowledge of math, science and engineering and how they are applied is a foundational element.

Student Outcome b. An ability to design and conduct experiments, as well as to analyze and interpret data:

A lot of emphasis on this principle is incorporated in courses EE212 Instruments I, EE301 Signals and Systems, ENGR301 Introduction of Modeling and Simulation. Other courses reinforce this learning throughout the curriculum.

Student Outcome c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability:

In our Electrical Engineering program students are taught to examine the design of all elements as part of a system. Different courses have different design requirements, such as design of a single circuit, design of software functions, and design of a system including hardware and software, which must function together for the greater good. Design courses include circuits design courses EE201, EE202, and EE203, embedded system design course EE310, LabVIEW design course EE312, FPGA design courses EE103, EE-230, and Modeling and Simulation ENGR301, etc.

Student Outcome d. An ability to function on multi-disciplinary teams:

In modern engineering practice, more than ever before engineers function as part of a diverse team of specialists all working toward the same goal. Classes such as Introduction to Engineering and Capstone are natural educational opportunities for students to interact with others of different skills and abilities where all can make valid contributions to the final project.

Student Outcome e. An ability to identify, formulate, and solve engineering problems:

This is part of the student curriculum from the first semester they start. Whether it is Introduction to Engineering class where students identify and solve very simple engineering problems to something as complicated as System Simulation where students must unravel many layers of complicated interrelationships to be able to create and validate models of complex systems the Electrical engineering program works very hard to make sure students have this knowledge.

Student Outcome f. An understanding of professional and ethical responsibility:

Ethic Codes of Conduct and correct ethical behavior have been taught explicitly during Introduction to Engineering (required course) and Project Management (elective course) classes. Ethical problems and conundrums are discussed as they arise in other courses.

Student Outcome g. An ability to communicate effectively:

Students must be able to communicate well in school and even more so when they enter the world of professional practice. Our students must communicate well since most of the Electrical Engineering curriculum requires end of semester class projects requiring a presentation and report.

Student Outcome h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context:

General Education courses intended to give students a wider view of the world are an integral part of the curriculum. Additionally professors are expected to bring up issues that illustrate the impact of engineering solutions past and present on not only the engineering aspects, but also the wider impacts of those solutions.

Student Outcome i. A recognition of the need for, and an ability to engage in life-long learning:

Professors lead by example in this area relating their journey and learning experiences to illustrate the importance of life-long learning. This is emphasized in Introduction to Engineering and Capstone and Professors stories about their work to gain higher degrees, get certifications or licenses drive home a subtle point to the students. Additionally participation in Student Conferences and other activities help to accustom students to the concept of continuing learning activity. Life-long learning is assessed in exams and exit surveys.

Student Outcome j. A knowledge of contemporary issues:

Engineers do not work in a vacuum cut off from the wider world. The best engineer is one who knows what is happening in the world and the place of themselves and their work within it. Throughout the curriculum Professors relate the engineering education they are delivering to issues that are contemporary today and to situations that have occurred in the past.

Student Outcome k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice:

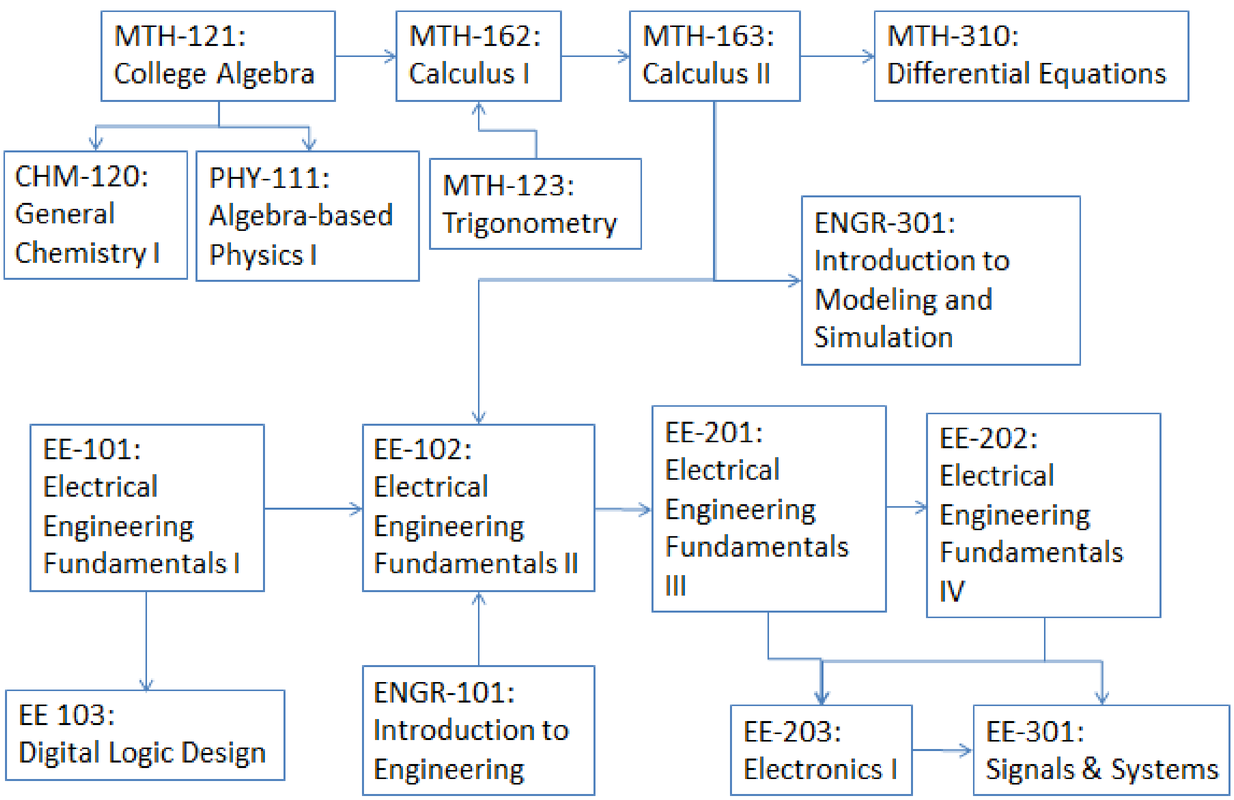
Being able to understand and use the latest techniques, tools and methods is crucial to being able to function as an engineer. In Electrical Engineering, we incorporate tools such as Matlab, LabVIEW, C/C++ development, Modeling and Simulation, embedded system development, and FPGA development as well as spending time making sure students can use the Microsoft Office suite. Techniques taught in classes emphasize the selection of the best techniques for the purpose given. Many classes within the program (18 credit hours) are there to increase the students' skills and knowledge to make them better more broadly educated engineers.

Curriculum and Prerequisites

Courses are intended to be taken in an order that ensures that the student is learning progressively more complex material that is building on the more basic material learned in earlier courses. While putting off some courses is not a problem, in other cases the student may be unable to understand a course at all if the prerequisite has not been taken. Even if they successfully pass the class they may not have a depth of understanding needed.

One of the areas of potential improvement for the Electrical Engineering program is to create more prerequisites through the program to help channel students better. This is a possible method to move toward a cohort system, which will benefit the students by allowing them consistently to take classes with students they know and students can work together for greater understanding of course material.

Figure 5.A.1 is a flowchart illustrating the prerequisite structure of the Electrical Engineering program's required courses.



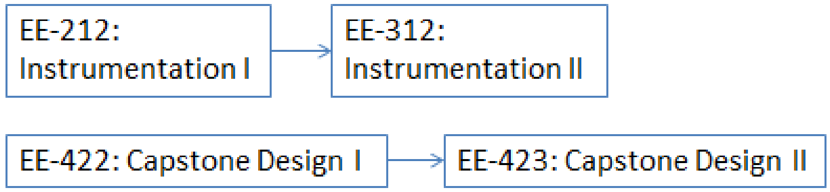


Figure 5.A.1 Diagram of Prerequisites for Electrical Engineering Curriculum

Major Design Experience

While we have design incorporated into many courses in the Electrical Engineering program, Capstone is expected to be a very important course in that the students take an idea and do research and engineering work to manifest an idea or product. The last Capstone class was a combined IE-424/EE-423 course with four Industrial engineering students and two electrical Engineering students. We have worked to combine these classes so that students learn to work on a multidisciplinary team.

Capstone is expected to give the students a taste of the experience of a working engineer. Capstone projects must incorporate knowledge and skills acquired in many classes. Almost all engineering classes require a project based on the knowledge and skills of that course, but the Capstone is expected to go beyond that to synthesis of knowledge cutting across their broader education. Constraints for this project are initially set by the students, but checked and corrected by the Professors supervising the class. Design standards are incorporated in the project and in the most recent class we had Dr. Vohnout lecturing on design standards for creating elements within the project to be made with 3D printers and Dr. Romine lecturing on Electrical Engineering standards and control for the project (Amphibious Submarine Drone).

After the Spring 2017 Capstone class changes were made by Electrical Engineering to have two semesters of Capstone. It was also decided at the May 15-16 Engineering Assessment Meeting that future Capstone classes will be given a checklist of requirements to make sure that the class better incorporates use of design standards and all necessary elements of Project Management. Industrial Engineering Students will work with the first half of EE Capstone to ensure that adequate time and effort is spent on putting in place a plan that will be workable for the Capstone process. IE students will join the combined Capstone class to help complete the project in the Spring semester.

Materials for ABET PEVs

Materials that will be available to the PEVs in the Material Room will be:

1) Binders separated by individual courses containing Syllabi, representative samples of student work in the form of homework, quizzes, midterms, finals and project work.

2) Individual Student Portfolios for individual classes

3) Transcripts for all graduates of the Electrical Engineering program

4) PowerPoint presentations and Reports from student internships

5) Textbooks used in the courses, both those formerly used and the present editions

6) Folders with Assessment Reports

7) Minutes of Engineering Assessment Meetings

8) Minutes of Engineering Advisory Board meetings

9) Bylaws of the Engineering Advisory Board

10) Checklists for all versions of curriculum for the EE program as it has evolved from 2012 to now

11) Copies of Senior Exit Interview Survey with results and Engineering Alumni Survey

B. Course Syllabi

Appendix A includes a syllabus for each required course in the EE curriculum.

CRITERION 6. FACULTY

A. Faculty Qualifications

Faculty qualifications and numbers is an area that the program understands needs enhancement. Dr. Romine has 25+ years of experience in academia and industry. He has served as coordinator and chairman of ABET accredited programs. Navajo Tech has developed a number of strategies to increase the qualifications of the EE faculty. Including sharing faculty from other disciplines and programs and recruiting faculty to telecommute or rotate between on-campus and off-campus.

The current members come from a wide variety of backgrounds and bring experience from education, research, and industry. Several faculty members are currently consultants with industry. Most faculty hold earned Ph.D. degrees. Three of the faculty members have significant industrial experience, and are active with sponsored research programs. All faculty members are members of at least one professional society related to engineering. Mr. Harry Whiting is a registered professional engineer.

See Table 6.A.1 and the faculty resumes in Appendix B for more information on faculty qualifications.

B. Faculty Workload

Navajo Tech's history as a technical college has resulted in emphasis on teaching rather than research. The traditional teaching load at NTU is five courses or 14 to 16 credit hours per semester. This workload is a deterrent to hiring and retaining qualified faculty. The workload can be reduced by recruiting a larger pool of part-time faculty that either telecommute or rotate. The most recent workload for faculty who teach major courses in Industrial Engineering is given in Table 6.B.1

C. Faculty Size

Small faculty numbers are a common characteristic of most all TCUs. The absence of federal or state funding for college education beyond Career Technical Education results in most programs with one or two faculty max. Currently there are two full time faculties for the Electrical Engineering program, Dr. Peter Romine and Dr. Bei Xie. There is also an e-faculty, Julian Boateng, who teaches EE courses remotely. Together with the leveraging of faculty from other programs, the number of faculties has been sufficient to offer all EE courses this year (2016-2017). Dr. Romine has been the EE advisor since he first started with NTU. Dr. Romine's advice as to classes, career advice and personal counseling have been used by students of the EE program. Mr. Harry S. Whiting, an Industrial Engineering faculty, teaches ENGR-103, which is a required course for EE program.

D. Professional Development

Professional development resources as plentiful for STEM faculty at NTU due to generous funding from the National Science Foundation.

All Engineering faculty members are expected to maintain currency in their discipline through scholarly and professional development activities. Engineering faculty participate in a wide range of professional societies including IEEE, ASEE, SACNAS, AISES, AIHEC and others.

Both Dr. Romine and Dr. Xie attended ABET symposium in April 2017 in Baltimore. Dr. Romine also attended the 'Wolves Den' Inventors and Entrepreneurs Workshop with students at New Mexico Technical University in April 2017.

E. Authority and Responsibility of Faculty

Faculty are expected to have a lot of input regarding course creation and modification; we offer Special Topics courses so that Professors can teach topics outside the regular curriculum to enhance the opportunities for students and allow Faculty to teach courses in their specialty areas that may not be part of the regular curriculum. NTU are continuously improving their skills and knowledge about assessment and all professors are expected to participate in class and program evaluation and to use that data to modify courses to better serve the students and their learning. Since faculty often teach the same classes every year they are expected to recognize problems in understanding by the students and together with assessment data to be able to make necessary adjustments and make modifications that will assist students in better learning the subject matter.

The Dean of Instruction, Casmir Agbaraji, PhD, was the first instructor (all teachers at what was Navajo Technical College at that time were ranked 'Instructor') was Industrial Engineering. He is robustly involved in curriculum and other issues of all engineering programs here at NTU. Student complaints are usually handled by the Dean.

The Provost position is currently open and applicants are being sought. The Graduate Dean, Wesley Thomas, is covering this position in addition to other duties. Traditionally the Provost has been the arbiter for disputes between Faculty and Staff members as well as some disputes between Faculty and Students.

The Dean of Student Services position is vacant at the moment with the last Dean having left at the end of the Spring 2017 semester. In the past this Dean has not been involved in the engineering programs.

The President of the University has not been involved in decisions affecting the engineering programs aside from their initial authorization.

Table 6.A.1. Faculty Qualifications

Electrical Engineering Program

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience			Professional Registration/ Certification	Level of Activity[4] H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/summer work in industry
Dr. Peter L. Romine, PhD	PhD-ECE-1992	ASC	NTT	FT	10	25	2.5	None	L	M	L
Bei Xie, PhD	PhD-ECe-2012	AST	NTT	FT	3	0.25	0.25	None	L	M	L
Julian Boateng		I	NTT	PT							
Harry Whiting II, PE	MSIE-IE-2002	AST	NTT	FT	10	4	4	PE-Texas 96441	L	L	L
Edwin Zack Crues	PhD-AE-1989	A	NTT	PT	20+	5	0.5	None	M	M	M
Daniel Z. Frank	PhD-ME Student	I	NTT	PT	0	2	0.5	None	M	M	M
Chester Henry	BSEE	A	NTT	PT	10+	5	5	None	M	M	M

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. At the institution
4. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.

Table 6.B.1. Faculty Workload Summary

Electrical Engineering Program

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the Program[5]
			Teaching	Research or Scholarship	Other[4]	
Dr. Peter Romine, PhD	FT	**Fall 2014**: ECE-123/3; ECE-223/3; ECE-324/4 **Spring 2015**: ECE-112/2; ECE-113/3; ECE-214/4; ECE-224/4; ECE-234/4 **Summer 2015**: EE-301/3; EE-395/3 **Fall 2015**: EE-101/3; EE-102/3; EE-103/3; EE-203/3; EE-301/3; EE-302/3; EE-304/3; EE-320/3; EE-395/3 **Spring 2016**: EE-103/3; EE-202/3; EE-212/2; EE-295/3; EE-301/3; EE-303/3; EE-310/3; EE-312/3; EE-423/3 **Summer 2016**: EE-312/3 **Fall 2016**: EE-101/3; EE-102/3; EE-103/3; EE-201/3; EE-203/3; EE-212/3; EE-230/3; MTH-205/3 **Spring 2017**: EE102/3,E310/3,EE330/3,EE423/3	90%	5%	5%	100%
Bei Xie, PhD	FT	**Spring 2017:** EE-103/3, EE303/3, EE312/2, EE406/3 **Summer** 2017: EE430/3	90%	5%	5%	100%
Julian Boateng	PT	**Spring 2017**: EE-202/3	100%			100%
Edwin Zack Crues, PhD	PT	**Spring 2016:** EE-201/3	/	/	/	/
Daniel Z. Frank	PT	**Fall 2016**: EE-495/3				
Chester Henry	PT	**Spring 2016**: EE-102/3	/	/	/	/
Harry S. Whiting II, PE	FT	**Fall 2012:** ENGR-234/3; ENGR-313/3 **Spring 2013:** ENGR-234/3 **Fall 2013:** ENGR-234/3; ENGR-313/3	90%	5%	5%	100%

		Spring 2014: ENGR-234/3 **Fall 2014:** ENGR-103/3; ENGR-313/3 **Spring 2015:** ENGR-234/3 **Fall 2015:** ENGR-234/3; ENGR-313/3; ENGR-103/3; IE-380/3 **Spring 2016:** ENGR-234/3 **Fall 2016:** ENGR-103/3; ENGR 234/3, IE-380/3				

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.
6. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
7. For the academic year for which the Self-Study Report is being prepared.
8. Program activity distribution should be in percent of effort in the program and should total 100%.
9. Indicate sabbatical leave, etc., under "Other."
10. Out of the total time employed at the institution.

CRITERION 7. FACILITIES

A. Offices, Classrooms and Laboratories

1. **Offices**:
   NTU offices or office spaces minimally equipped with a computer, monitor, and desktop printers. Other IT related equipment may be installed at the request of the instructor and approval from both their department head and IT directors.

   Science and Technology Building Room 323 (colloquially Tech 323) is the office for the full time Electrical Engineering professor, along with Dr. Harry Whiting of the Industrial Engineering program and Dr. Gholam Ehteshami, Chemical Engineering. The office is equipped with computers for each occupant with Microsoft Office and other programs as needed for individual research interest or classes and a scanner/printer. Office hours are posted for all Professors in the form of a schedule showing classes with locations and office hours. Professors are available by email; students will receive a reply in most cases within 24 hours. Immediate / emergency reasons would require a phone call, Professors make their office telephone number available and in case of emergency they sometimes list personal cell phone numbers on the syllabus.

   Other Faculty offices for those teaching in the Electrical Engineering program on a part-time basis are located in IT building as well as the Fablab (Fabrication Lab). All faculty have a computer with at least the Microsoft Office suite installed.

   Tutorial Services and STEAM Lab:
   There are Interns available for tutoring in STEAM lab. The intern serves as an embedded tutors for one Math course each week. Their hours are posted each semester and students are encouraged to use their services and those of the STEAM (Science, Technology, Engineering, Arts, and Mathematics) Lab.

   Tutoring is available to all students in the STEAM Lab. The lab offers tutoring services and general use of computers. In lieu of structured tutoring, the facilities may be used simply as a quiet place to work on homework assignments. Hours of operation vary from semester to semester, but include some afternoons and evenings, with extended hours during midterms and finals. Tutorial Services is also a source of employment for students who are qualified for the work-study program. The STEAM/Tutoring lab is located in the Student Union Building.

2. **Classrooms**:
   NTU classrooms are minimally equipped with student accessible computers, monitors, and presentation systems. Most Electrical Engineering courses are taught and located in the EE mod. There are two classrooms available in EE mod. Computers with software, EE instruments, and projectors are available in those classrooms. New furniture is available in EE mod. Some classes are in Science and Technology Building Rooms 322 and 325, and also the Center for Digital Technology, AKA Fabrication Lab ("FabLab").

3. **Laboratory facilities**:
   NTU laboratories are minimally equipped with staff and student accessible computers, monitors, and lab printers. IT related equipment are directly related to the machines being operated during lab session. Other IT related equipment may be installed at the request of the instructor and approval from both their department head and IT directors.

   Students have access to computers in EE mod, Tech 322 and Tech 325 when classes are not in progress or if the instructor allows them to work while a class is in session. EE mod has 9 computers and Instruments including Function generator, Oscilloscope, Digit multi-meter, Power supply, Soldering/Desoldering station, Resistance decade box, and Capacitance decade box. There are also FPGA boards, myDAQ devices, Arduino UNO microprocessors. The software includes LabVIEW, Quartus II Web Edition, Wireshark, and Arduino IDE. Computers in Tech 322 and Tech 325 have 3D modeling software (AutoCAD, Inventor, Solidworks, and Creo Simulate) and we have added ARENA and Minitab, using them in the spring semester of 2017 for System Simulation and Design of Experiments classes. The "FabLab" houses laser scanners, 3D printing machines, tensile strength machine, and other equipment that can be utilized by students. Some classes such as Rapid Prototyping, Laser Scanning and Digital Inspection are held completely or partially in the "Fablab" since that is where the equipment is housed.

B. Computing Resources

All computing resources NTU purchases and installs must first get approval from the IT department. The approval structure ensures equipment compatibility, usability, and maintainability. Workstation, desktops, and laptops are purchased through the big box vendor CDWG and the manufacture NTU has standardized on are Lenovo business built systems. There are special circumstances where purpose-built workstations and desktops can be presented to IT for approval. The bill of materials approval and the physical build process is the sole responsibility of the IT department.

The IT department accommodates most modern-day computer operating systems for campus workstations, desktops, and laptops. Microsoft Windows 7 Professional is the current installation NTU IT is supporting. The IT department is scheduled to start Windows 10 Professional upgrades in Fall 2017. Other typical applications the IT department installs during an installation are Microsoft Office Professional, Adobe Acrobat Reader, VLC player, Malwarebytes, SuperAntiSpyware, Ccleaner, Revo-Uninstaller, Chrome, Firefox, and Sophos Endpoint Protection. These applications are part of the basic package installed on all computer technologies.

General student areas such as the Library, STEM Lab, Elearning lab, classroom, and labs, may receive additional applications for the particular discipline being pursued. In these situations, the IT department works hand in hand with the lead instructors or department heads to accommodate local and network licensing. Other modern days operating systems supported are Ubuntu Linux, Centos, Fedora, and Mac OS.

Servers are built from the chassis up to accommodate the application of the system. NTU does operate several Lenovo, IBMs, and Dell systems. However, the new server systems being installed are Supermicro Chassis with specified processors, system ram, and storage devises. Dependent upon the application of the server, NTU's IT office accommodates Windows Server 2008 R2 and above, Ubuntu Server, Centos server, and recently VMware VSphere for virtual server systems. Servers are configured with the requirements of the academic department and the help of the lead individuals requesting the system.

NTU's current Local Area Network (LAN) backbone has the capability of 10 Gigabit per second (Gbps). New and major classrooms have the capacity to be upgraded to 20 Gbps in the future. This allows the ability to provide local high performance computing and storage access. All computing technologies are connected at line card speeds to enterprise Brocade/Ruckus campus switches.
NTU's Wide Area Network (WAN) includes 1 Gbps Ethernet service through Frontier communication's fiber optics, 100 Megabit per second (Mbps) over NTUA licensed microwave/fiber optics, 177 Mbps and 155 Mbps over NTU build licensed microwave systems dropped at ABQ-G operated by the University of New Mexico. There are future plans to add layer 2 wave services to Denver and Phoenix. These services will have the capacity of 1 to 10 Gbps.

NTU's local Wi-Fi access is being upgrade in phases. First phase completed the install, testing and commission of the central wireless access controller and Wi-Fi radio installs in both the new student union building and library. Phase 2 is to extend the managed coverage to the Science and Technology building, IT building, FabLab, and engineering classrooms. Phase 3 is to extend and upgrade the managed coverage to the residential facilitates.

EE mod

There are nine (9) computers for students to use.

- Software:
    - Microsoft Office, JAVA, Mozilla Firefox, LabVIEW, Quartus II Web Edition, Wireshark: packet analyzer software, Arduino IDE
- Anti-Virus Software:
    - CCleaner, Malwarebytes Anti-Maleware, and SUPERAntiSpyware

STEAM Lab

Located in the Student Union Building and houses tutorial services that are open to all NTU students. Hours of operation vary from semester to semester, but include mornings, afternoons, and evenings, with extended hours during midterms and finals. Specific hours are posted on the entrance door and on posting boards throughout the campus. There are currently thirteen (13) computers for use. Printing and scanning is available free of charge for students.

- Software:
    - Adobe Reader XI, Apple Software, Basic Circuits Challenge 5.1, Mozilla Firefox, Window Media Player, Bluefish, Dia, JAVA, Microsoft Office, Python 2.7, Sketchup Publisher, Notepad, LayOut 2015, and StyleBuilder 2015
- Anti-Virus Software:
    - CCleaner, Malwarebytes Anti-Maleware, and SUPERAntiSpyware

Fabrication Lab ("FabLab")
Hours of Operation: 8:00 AM to 5:00 PM
Table space for studying and putting projects together, 6 computers have double monitors, 2 computers have one monitor

- Software:
    - Geomagic, Microsoft Office, JAVA, Maya, AutoCAD, PT Creo, and Autodesk Inventor
- Anti-Virus Software:
    - SUPERAntiSpyware, and CCleaner

E-Learning (MOODLE)

NTU's goal is to expand access to higher education opportunities for individual and community members of the Navajo Nation and others through electronically offered classes. Distance learning and online teaching technology will be used to provide relevant and timely coursework, information, and training to enhance the learning experience by removing the barriers of both time and place. Once the distance education program is fully implemented, students can enroll at NTU from off-campus computer labs or at home. The E-Learning office is located in Modular Building 8. Hours of operation are Monday 8:00 AM to 8:00 PM, Tuesday through Thursday from 8:00 AM to 7:00 PM, and Friday 8:00 AM to 5:00 PM. Monday through Friday, the E-learning lab will be closed from 12:00 PM to 1:00 PM and closed on the weekends.
Computers:

- Microsoft Office

The Information Technology (IT) building houses our classes for Information Technology classes while providing technology services throughout the campus. The building is open from Monday through Friday at 8:00 A.M. to 5:00 P.M., while closed on the weekends.
Hours of Operation: Monday through Friday at 8:00 A.M. to 5:00 P.M.

The Science and Technology Building houses our Science, Business, and Engineering courses. Engineering courses are typically located in the Engineering room (322) or the Computer Aided Drafting "CAD" room (325). The building is open from Monday through Friday at 8:00 A.M. to 5:00 P.M., while closed on the weekends.

- Engineering room (325)
  The engineering room has nineteen (19) computer stations and study stations with printing capabilities. There are 3 other additional tables that can be used for studying, laptop use, tutoring, and projects.
    - Software

        - Microsoft Office, Mozilla Firefox, Google Earth, Arduino, QGIS Desktop, MATLAB, Adobe Reader X, Oracle VM VirtualBox, Microsoft Silverlight, Notepad +++, PyScripter, JAVA, QGIS-Pisa, JING, TI-83 Plus Flash Debugger, ARENA, Minitab 17 and some computers have Goggle Chrome
    - Antivirus Software:
        - CCleaner, Malwarebytes Anti-Malware, Kaspersky Anti-Virus 6.0, and SUPERAntiSpyware
- CAD room (322)
  The Computer Aided Drafting room has 16 double monitor computers and 1 single monitor computer stations with printing capabilities.
    - Software:
        - Adobe Acrobat Distiller X, Adobe Acrobat X Pro, Google Chrome, Mozilla Firefox, Windows Media Player, AutoCAD 2014, Geomagic, Google Earth, JAVA, Microsoft Office, Microsoft Silverlight, Microsoft Visual Studio 2005, PTC Creo, and Solid Works 2015
    - Antivirus Software:
        - AVG PC TuneUp, CCleaner, Kaspersky Anti-Virus 6.0, and SUPERAntiSpyware

C. Guidance

Students are trained on how to use the equipment in the Fabrication Lab (“FabLab”) prior to use. Trained personnel are present at all times to assist students that have questions or in need of help. Gregory Dodge, FabLab Technician, is available to assist students and faculty with equipment or computer software used in conjunction with the equipment.

Harold Halliday and Harry Whiting are working on implementing more formal training procedures.

D. Maintenance and Upgrading of Facilities

NTU does not have an overarching policy on maintaining and upgrading equipment. The professors and staff of engineering however are constantly thinking of how we can expand on the equipment for research and student use. Dr. Vohnout has been particularly active in maintaining and improving laboratory equipment and facilities for classes.

NTU aims to establish, support and maintain the capital and technical infrastructure of its campus, while managing resources responsibly, efficiently and with accountability, operating and maintaining our buildings, grounds and utilities in a clean, safe and responsible manner. In the Five Year Plan for Engineering a component of maintaining and upgrading laboratory facilities is being incorporated.

IT does have a policy for maintaining and upgrading computers and software, but that information has not been shared. The computers in Tech 325 are scheduled to be replaced in the summer of 2017 with new equipment.

E. Library Services

The Library is available to students and recently there has been an added addition of an online shared library with other college and universities around the country. Hours of operation are Monday through Thursday at 8:00 A.M. to 9:00 P.M., Friday at 8:00 A.M. to 5:00 P.M., Saturday at 10:00 A.M. to 7:00 P.M., but closed from 2:00 P.M. to 3:00 P.M., and Sunday 12:00 P.M. to 9:00 P.M. but closed from 4:00 P.M. to 5:00 P.M. There are tables for study and laptop use. Library users have access to 28 research computers in the library with printing capabilities. Students will need a library card to have access to the computers. Guests are given a code that they could use. The computer usage is programmed for fifteen (15) minutes; additional minutes can be added if students/guests are not finished.

- Software
    - Adobe Reader X, Mozilla Firefox, PhotoPad Image Editor, PhotoStage Slideshow Producer, VideoPad Sound Editor, JAVA, Microsoft Office, Basic Circuits Challenge, Power Supply Challenge, Premise 4, DC Circuits Challenge, and NCH Software Suite
- Antivirus Software:
    - CCleaner, Malwarebytes Anti-Malware, SUPERAntiSpyware, and Kapersky Anti-Virus 6.0

The library collections contain over 7,000+ print and non-print volumes, arranged according to the Library of Congress Classification System. The library subscribes to over forty research databases including: Academic Search Premier, ArticlesFirst, CINALH, Credo Reference, ERIC, Literature Resource Center, Newsbank, Computers & Applied Sciences, FirstSearch, Environmental Complete, Wilson Science Full-text, Wilson General Science and WorldCat. The library research databases can be accessed off-campus via NTU Library website with user id and password. Students may borrow books or obtain copies of articles via the library's InterLibrary Loan (ILL) service when the requested items are not owned by the library (note: the process may take up to two weeks or less to receive materials from other libraries in our network). More information on resources is available for students and faculty at the library or by telephone.

F. Overall Comments on Facilities

Navajo Technical University is expanding facilities through grants and partnerships. In conjunction with the Navajo Nation Economic Development Agency we will be building a dedicated Metrology Laboratory starting in 2017 and will be building a Manufacturing Center to encourage innovation among students, faculty and others from the Navajo Nation. In the Fall of 2017 new laboratories for Biology and Chemistry will be opened that will allow the present facilities (lab/Lecture rooms) to be used more by Physics and Chemical Engineering. The Electrical Engineering program has taken over the old Bookstore since Fall 2016 so that we now have two rooms serve as classrooms and lab. With other classrooms in Tech building, the classrooms are enough for EE program.

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

The leadership of the program has to this point relied on one or two individuals, such as Dr. Romine and Dr. Ehteshami. This is obviously inadequate for future needs, so part of the five year plan is to eventually expand the size of the EE program faculty and to create continuity and greater ability to pursue research.

B. Program Budget and Financial Support

Navajo Technical University is funded based on enrollment through the Bureau of Indian Education. NTU also receives additional tuition and fee funding with every increase in enrollment. Navajo Nation funding does not fluctuate, but is pegged at 3.5 million dollars a year. Other discretionary funding from federal and state grants and private foundation grants are variable. Additionally the University is in the process of hiring a Director for Institutional Advancement for fundraising. Part of the five year plan is to establish an endowment fund which will be able to continue all engineering programs regardless of future grant or school funding.

Presently a number of interns are supported by an educational grant from NSF, who act as embedded tutors in certain math classes, graders and support research efforts.

C. Staffing

Harold 'Scott' Halliday, our Director of the Center for Digital Technology (Fablab) acts as Project Coordinator for some IE classes, such as Introduction to Engineering and Capstone. Gregory Dodge acts as a Lab Assistant to Scott and helps students with hands on aspects of working in the Fablab.

Training is provided every semester during 'Orientation Week', where returning and new faculty are given training on assessment, Diné Philosophy of Education, NTU Policies and Procedures, Budgeting and other topics relating to teaching in general and at NTU in particular. Committee meetings are often held at this time to familiarize those just starting or to pick up the threads for those already at NTU. New Professors are also given on the job training in procedures and methods and advice on how to teach in the NTU environment.

D. Faculty Hiring and Retention

1. When new faculty member is going to be hired a request is sent to the Human Resources (HR) Department with a memo about why new faculty are needed complete with a draft job description.
2. The job description is approved by the Dean of Instruction and the HR Director.
3. An ad is placed in Higher Ed Jobs with the job description and posted on the NTU website.
4. Accumulated applications are reviewed by the HR department.

5. Candidates who meet requirements are interviewed by a committee with one representative of HR, and at least three members of the faculty and/or the administration (usually the Dean of Instruction).
6. After interviews are completed, the committee discusses the candidates and ranks them in order of desirability for hire.
7. A memo is written and sent to the Dean of Instruction recommending the hiring of the best candidate with a listing of the other candidates in rank order in case the initial selection is unavailable.
8. Human Resources do a background investigation of the candidate(s).
9. Human Resources contact successful candidate(s) with details of employment, contract, etc.

Retention

Every effort is made to retain faculty at NTU. There is faculty housing which helps to reduce the amount of commuting that is done by the faculty as a collective whole. Our cafeteria offers three meals a day for most of the year. Professional development is well funded for faculty members attending professional events and for further education.

E. Support of Faculty Professional Development

Navajo Technical University (NTU) is an institutional member of Online Learning consortium (OLC). As an instructional member, all faculty have access to discounted pricing on conferences, free webinars, peer networking, and early access to research available through the consortium, including discounts for online faculty development workshops. Best of all, OLC is a globally recognized Quality Scorecard – an exclusive process for measuring and quantifying elements of quality within online higher education programs which is free only to institutional members.

In addition, NTU has also purchased Quality Matters (QM). QM is a faculty-centered, peer review process that is designed to certify the quality of online courses and online components. QM has received national recognition for its peer-based approach to quality assurance and continuous improvement in online education.

Both OLC and QM are great resources for the Engineering programs for professional development, course reviews, ensuring quality course design and delivery, help with program reviews, and the ability to network with other faculty teaching in the same subject matter. Overall, NTU is working on providing support to the faculty to help establish a state-of-the-art Engineering program.

PROGRAM CRITERIA

Electrical Engineering program mainly prepares graduates to be able to solve engineering problems, design systems according to real world requirements, and work in multi-disciplinary teams. The detail program criteria have been shown in session CRITERION 5. CURRICULUM.

EE 303 Probability & Random Signals 3hrs, is a required core EE course, which satisfies one of the curriculum requirements "The curriculum must include *probability and statistics, including applications appropriate to the program name.*"

The following math and sciences courses satisfy the math and science requirements by ABET. Mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); Electrical programs must contain linear algebra, complex variables, and discrete mathematics.

Course	Title	Credits
MTH 162	Calculus I	4
MTH 163	Calculus II	4
MTH 205	Discrete Math	3
MTH 310	Differential Equations	4
MTH 410	Linear Algebra	3
CHM 120	General Chemistry & Lab	4
PHY 111/121	Algebra or Calculus-based Physics I	4
PHY 112/122	Algebra or Calculus-based Physics II	4
TOTAL		**30**

The following engineering core courses satisfy the engineering course requirements by ABET. Engineering topics (including computing science) are necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.

Course Title	Credits
EE 101 Electrical Engineering Fundamentals I	*3*
ENGR 103 Introduction to Engineering	*3*
EE 102 Electrical Engineering Fundamentals II	*3*
EE 103 Digital Logic Design	*3*
EE 201 Electrical Engineering Fundamentals III	*3*
EE 202 Electrical Engineering Fundamentals IV	*3*
EE 203 Electronics I	*3*
EE 212 Instrumentation I	*2*
EE 301 Signals and Systems	*3*
ENGR 301 Introduction to Modeling and Simulation	*4*
EE 303 Probability & Random Signals	*3*
EE 310 Embedded System Design	*3*

EE 312 Instrumentation II	*2*
EE 313 Summer Internship	*3*
EE 396 Junior Research Project	*3*
EE 406 Computer Networks	*3*
EE 422 Capstone Design I	*3*
EE 423 Capstone Design II	*3*
TOTAL	**53**

APPENDICES

Appendix A – Course Syllabi
Appendix B – Faculty Vitae
Appendix C – Equipment
Appendix D – Institutional Summary
Appendix E – NTU Engineering 5- year Strategic Plan

APPENDIX A – COURSE SYLLABI

All Navajo Technical University syllabi have these listed:

Mission Statement
Navajo Technical University's mission is to provide college readiness programs, certificates, associate, baccalaureate, and graduate degrees. Students, faculty, and staff will provide value to the Diné community through research, community engagement, service learning, and activities designed to foster cultural and environmental preservation and sustainable economic development. The University is committed to a high quality, student-oriented, hands-on-learning environment based on the Diné cultural principles: *Nitsáhákees (Thinking), Nahátá (Planning), Īína (Implementing), and Siihasin (Reflection).*

Grading Plan
(Points varies with each instructor)
A = 100 – 90%
B = 89 – 80%
C = 79 – 70%
D = 69 – 60%
F < 60%

Cell phone use
Please turn cell phones off or place them on silence or vibrate mode BEFORE coming to class. Also, answer cell phones OUTSIDE OF CLASS (not in the classroom). Exercising cell phone use courtesy is appreciated by both the instructor and classmates.

Attendance Policy
Students are expected to regularly attend all classes for which they are registered. A percentage of the student's grade will be based on class attendance and participation. Absence from class, regardless of the reason, does not relieve the student of his/her responsibility to complete all course work by the required deadlines. Furthermore, it is the student's responsibility to obtain notes, handouts, and any other information covered when absent from class and to arrange to make up any in-class assignments or tests if permitted by the instructor. Incomplete or missing assignments will necessarily affect the student's grades. Instructors will report excessive and/or unexplained absences to the Counseling Department for investigation and potential intervention. Instructors may drop students from the class after three (3) absences unless prior arrangements are made with the instructor to make up work and the instructor deems any excuse acceptable.

Academic Integrity
Integrity (honesty) is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own. Students who engage in academic dishonesty diminish their education and bring discredit to the college community. Avoid situations likely to compromise academic integrity such as: cheating, facilitating academic dishonesty, and plagiarism; modifying academic work to obtain additional credit is in the

same class unless approved in advance by the instructor, failure to observe rules of academic integrity established by the instructor.

Diné Philosophy of Education

The Diné Philosophy of Education (DPE) is incorporated into every class for students to become aware of and to understand the significance of the four Diné philosophical elements, including its affiliation with the four directions, four sacred mountains, the four set of thought processes and so forth: Nitsáhákees (Thinking), Nahátá (Planning), Īína (Implementing), and Siihasin (Reflection) which are essential and relevant to self-identity, respect and wisdom to achieve career goals successfully.

Students with Disabilities

The Navajo Technical University and the General Science program are committed to serving all enrolled students in a non-discriminatory and accommodating manner. Any student who feels he/she may need an accommodation based on the impact of disability, or needs special accommodations should inform the instructor privately of such so that accommodations arrangements can be made. Students who need an accommodation should also contact the Special Needs Counselor, Malcolm McKerry, whose phone number is 505-786-4138.

ABET Course Syllabi for

1. **Course number and name:** EE-101: Electrical Engineering Fundamentals I
2. **Credits and contact hours:** 3 Credits and (Mon/Wed) 3:30 PM – 4:50 PM
3. **Instructor's Name:** Dr. Peter Romine, PhD
4. **Textbook:** Alexander, C. & Sadiku, M. (2013). Fundamentals of Electric Circuits (5th ed.). New York, NY, USA: McGraw-Hill. ISBN: 978-0-07-338057-5
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    Introduction to fundamentals of electrical engineering theory and practice. This course covers the foundations of engineering problem solving and other skills necessary for success. Students will be taught engineering practice through hands-on approaches. Students will learn basic electrical elements (resistors, capacitors, and inductors), power sources, Ohm's law and Kirchhoff's law.
    b. **Pre-requisites or co-requisites**
    There are no required pre-requisites or co-requisites for EE-101: Electrical Engineering Fundamentals I.
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
    EE-101 Electrical Engineering Fundamentals I is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
    a. **Specific outcomes of instruction:**
    1. Students will reliably demonstrate the ability to convert units used in electrical engineering and solve problem involving unit conversion.
    2. Students will demonstrate the ability to evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) based on their physical parameters and dimensions.
    3. Students will reliably demonstrate skills in solving problems concerning voltage, potential, current and Ohm's law.
    4. Students will reliably demonstrate the ability to solve basic DC circuits using Kirchhoff's current and voltage laws.
    5. Students will demonstrate the ability to solving problems concerning electric power in basic DC circuits.
    b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Apply** basic engineering methodology to solve problems (ABET Outcomes: A, k)	Midterm & Final
2. **Design and implement** a solution to a student-defined problem in the context of engineering design (ABET Outcomes: a, e, k)	Projects
3. **Explain** the history of electrical and computer engineering, and other engineering majors, as it relates to the societal impacts of innovations and design choices	Projects

(ABET Outcomes: f, H, J)	
4. **Identify** at least one company that hires engineers in the student's specific sub-discipline of interest (ABET Outcomes: f, h, j)	Homework
5. **Identify** tools and techniques that will assist them to succeed better in their engineering education (ABET Outcomes: a, K)	Projects

Grading Plan:
90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- History of electrical engineering
- Areas of specialization
- Problem solving (engineering method)
- Study, homework, and research skills
- Continuous learning and creative thought (learning to be a more effective student)
- Nature and purpose of design (platform for learning)
- Teamwork skills and professional practice
- Nature of engineering ethics (engineer's obligation and ethical decision-making)
- Current, voltage, power, Kirchhoff's current and voltage laws, voltage and current division.
- Introduction to electrical engineering software tools including PSPICE, MATLAB, IDEs, etc.
- Basic hands-on electronics with diode, transistor, and OP-AMP applications.
- Basic digital logic and number systems
- Basic embedded systems programming (C language)

ABET Course Syllabi for

1. **Course number and name:** MTH-162: Calculus I
2. **Credits and contact hours:** 4 Credits and (Tues/Thurs) 2:30 PM – 4:10 PM
3. **Instructor's Name:** Roberto Nacorda
4. **Textbook:** Calculus, 10th ed., Ron Larson & Bruce Edwards
   ISBN-13: 978-1-285-05916-7
   ISBN-10: 1-285-05916-6
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   This course is designed to develop the analytical ability of students through (1) modeling functions of calculation of its limit, (2) defining and solving derivatives of functions, (3) solving equations of tangent and normal lines, (4) implicit differentiation, (5) chain rule, (6) related rates and optimizations, (7) fundamental theorem of Calculus, (8) volume of solids of revolution. At times, the learning process relating to the Navajo Culture in the areas of *Nitsáhákees, Nahátá, Īína, and Siihasin* will be covered as well as other cultures (multi-cultural studies).
   b. **Pre-requisites or co-requisites**
   A grade of C or better in MTH-123: Trigonometry or an equivalent course or satisfactory placement score.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   MTH-163: Calculus I is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
   At the end of the semester the students will:
   - Apply their knowledge about differentiation and integration
   - Define/describe calculus concepts
   - Solve problems involving differentiation and integration

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

COURSE OUTCOMES	COURSE MEASUREMENTS
Students will apply techniques and strategies in solving calculus problems.	Formative assessment, Summative assessment, and Applications.
Students will solve real-world application problems that measures their knowledge in calculus.	
Students will use differentiation and integration to demonstrate skills in sovling real-world problems.	
Students will solve problems involving differentiation and integration.	

Grading Plan:	
Quiz	25%
Homework/Classwork	15%
Midterms/Finals	50%
Attendance/Participation	10%

Assessment Pieces:

The students will be assessed in a variety of ways:

- Quizzes
- Midterms/ Finals
- Regular formative assessments (classwork and homework)
- Informal assessments like recitation or teacher observation.

7. **Brief list of topics to be covered.**
    - Review of Algebra & Trigonometry
    - Limits
    - Differentiation (derivatives)
    - Applications of Differentiation
    - Integration
    - Applications of Integration

ABET Course Syllabi for

1. **Course number and name:** EE-102 Electrical Engineering Fundamentals II
2. **Credits and contact hours:** 3 Credits and (Tues/Thurs) 3:30 PM – 4:50 PM
3. **Instructor's Name:** Dr. Peter Romine, Ph.D.
4. **Textbook:** Alexander, C. & Sadiku, M. (2013). Fundamentals of Electric Circuits (5th ed.). New York, NY, USA: McGraw-Hill. ISBN: 978-0-07-338057-5
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   In depth study of electrical theory, analysis and design of electric circuits. This course builds upon the basics presented in EE-101 Electrical Engineering Fundamentals. Resistive networks will be discussed in-depth and solved using node and loop analysis. Operational Amplifiers and applications will be introduced. First and second order circuits will be touched on.
   b. **Pre-requisites or co-requisites:**
   EE-101 Electrical Engineering Fundamentals I, MTH-163 Calculus II, or ENGR-101 Introduction to Engineering

   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   EE 102 Electrical Engineering Fundamentals II is a *required* course in the Electrical Engineering Program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**

1. Learn how to develop and employ circuit models for elementary electronic components, e.g., resistors, sources, inductors, capacitors, diodes and transistors
2. Become adept at using various methods of circuit analysis, including simplified methods such as series-parallel reductions, voltage and current dividers, and the node method; Appreciate the consequences of linearity, in particular the principle of superposition and Thevenin-Norton equivalent circuits
3. Learn how operational amplifiers are modeled and analyzed, and to design Op-Amp circuits to perform operations such as integration, differentiation and filtering on electronic signals

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **State and utilize** the current-voltage relationships of resistors, capacitors, inductors, and independent and dependent current and voltage sources in solving dc circuits and calculating power and energy (ABET outcomes: A, e)	Midterm & Final
2. **State** Ohm's and Kirchoff's laws, and **apply** these to voltage and current division, series/parallel and Wye-	Projects

Delta transformations, mesh analysis, and nodal analysis for resistive circuits (ABET outcomes: A, e)	
3. **State** Superposition, Thevenin's and Norton's theorems, and **apply** these for the analysis of dc circuits (ABET outcomes: A, e)	Projects
4. **Analyze** circuits made up of ideal opamps and resistors (ABET outcomes: A, e)	Projects
5. **Analyze** first-order and second-order circuits, which contain resistors, capacitors, or inductors (ABET outcomes: A, e)	Homework

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Basic circuit concepts and laws
- Methods of analysis (e.g., nodal, mesh)
- Circuit theorems
- Analyze simple electronic circuits containing diodes and transistors.
- Operational amplifiers
- Capacitors and inductors
- First-Order circuits
- Second-Order circuits

ABET Course Syllabi for

1. **Course number and name:** EE 103: Digital Logic Design
2. **Credits and contact hours:** 3 Credits and (Mon/Wed) 9:30 AM – 10:50 PM
3. **Instructor's Name:** Dr. Bei Xie
4. **Textbook:** William Kleitz, *Digital Electronics: A Practical Approach with VHDL, 9th Edition*
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   A first course in digital logic design. Data types and representations, Boolean algebra, state machines, simplification of switching expressions, and introductory computer arithmetic. Design will include traditional schematic design methods and an introduction to hardware description languages such as VHDL and Verilog.
   b. **Pre-requisites or co-requisites**
   Pre-requisite is EE-101: Electrical Engineering Fundamentals I
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   EE 103: Digital Logic Design is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
   1. An ability to define different number systems, binary addition and subtraction, 2's complement representation and operations with this representation.
   2. An ability to understand the different switching algebra theorems and apply them for logic functions.
   3. An ability to define the Karnaugh map for a few variables and perform an algorithmic reduction of logic functions.
   4. An ability to define the following combinational circuits: buses, encoders/decoders, (de)multiplexers, exclusive-ORs, comparators, arithmetic-logic units; and to be able to build simple applications.
   5. An ability to understand the bistable element and the different latches and flip-flops.
   6. An ability to derive the state-machine analysis or synthesis and to perform simple projects with a few flip-flops.
   7. An ability to understand sequential circuits, like counters and shift registers, and to perform simple projects with them.
   8. An ability to use modern engineering tools to implement combinational digital systems.

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Map** the high-level description of a digital system into a binary description of it (ABET Outcomes: A)	Midterm & Final

2. **Analyze and design** combinational systems using standard gates and minimization methods (such as Karnaugh maps) (ABET Outcomes: A)	Midterm & Final
3. **Analyze and design** sequential systems composed of standard sequential modules, such as counters and registers (ABET Outcomes: A,C)	Final
4. **Perform** basic arithmetic operations with signed integers represented in binary (ABET Outcomes: A)	Midterm & Final
5. **Perform** combinational digital systems using modern engineering tools (ABET Outcomes: K)	In class work

Grading Plan:
90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Concepts and definitions used in digital logic design: notation, number systems, difference between analog and digital system, specification and implementation, analysis and design, design cycle, CAD tools, combinational systems, high-level specs, data representation and coding, binary specs, switching functions (truth tables), gates
- Boolean (switching) algebra and switching expressions
- Gate networks: definition, description. Sets of gates. NAND-NAND and NOR-NOR networks.
- Analysis of gate networks (combinational system). Characteristics of gate networks
- Design of combinational systems. 2-level networks. Minimal two-level nets, Karnaugh maps
- Standard combinational modules: decoders, encoders, priority encoders, multiplexers, demultiplexers, and combinational shifters. Multiplexers as universal modules
- Specification of sequential systems, state description of sequential systems, Mealy and Moore machines, state diagram, time behavior, and binary specification
- Sequential networks, canonical nets, gated latch and D flip-flop, other flip-flops: SR, JK, and T
- Analysis/Design of sequential networks
- Standard sequential modules: registers, shift registers, and counters
- Design of sequential systems using counters or special state assignments
- Controllers and state minimization of sequential systems
- Arithmetic combinational modules. Adders for positive integers: full-adder and carry lookahead adder. Representation of signed integers and operations: addition and subtraction. ALU and comparator modules
- Programmable devices: programmable sequential arrays (PSA), ROM, and circuits with ROMs. Networks of programmable modules and FPGAs

ABET Course Syllabi for

1. **Course number and name:** EE-201: Electrical Engineering Fundamentals III
2. **Credits and contact hours:** 3 Credits and (Tues/Thurs) 11:00 AM – 12:20 PM
3. **Instructor's Name:** Dr. Peter Romine, PhD
4. **Textbook:** Alexander, C. & Sadiku, M. (2013). Fundamentals of Electric Circuits (5th ed.). New York, NY, USA: McGraw-Hill. ISBN: 978-0-07-338057-5
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   Sinusoidal steady-state analysis and phasors. This course builds upon the basics presented in EE-102 Electrical Engineering Fundamentals II. Application of circuit analysis techniques to solve single-phase and three-phase circuits including power, mutual inductance, transformers and passive filters.
   Pre-requisites or co-requisites
   Prerequisite is EE-102: Electrical Engineering Fundamentals II
   b. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   EE 201 is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      1. Students will demonstrate appropriate use of test equipment; identify various sources of electricity in AC circuits.
      2. Analyze AC circuits using appropriate mathematical formulas.
      3. Troubleshoot various AC circuits using schematic diagrams; and apply and interpret basic principles of magnetism.

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Apply** circuit analysis techniques to single-phase AC circuits using phasors to calculate real power, reactive power and apparent power (ABET outcomes: A, e, K)	Midterm & Final
2. **Apply** circuit analysis techniques to three-phase circuits to calculate line- and phase-voltages and currents, and real, reactive and apparent power (ABET outcomes: A, e, K)	Projects
3. **Apply** the principles of frequency dependence of inductive and capacitive components for the analysis of passive filters (ABET outcomes: A, C, K)	Projects
4. **Develop** a system beginning with the formal specification, and including implementation and test (ABET outcomes: A, B, E)	Projects

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Sinusoids and phasors
- Sinusoidal Steady State Analysis
- AC power analysis (single-phase)
- Three-phase AC circuits
- Magnetically coupled circuits and transformers
- Passive filters
- Frequency Response

ABET Course Syllabi for

1. **Course number and name:** EE-202: Electrical Engineering Fundamentals IV
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 8:00 AM – 9:20 AM
3. **Instructor's Name:** Dr. Peter Romine
4. **Textbook:** Alexander, C. & Sadiku, M. (2013). Fundamentals of Electric Circuits (5th ed.). New York, NY, USA: McGraw-Hill. ISBN: 978-0-07-338057-5
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    Laplace transforms, Fourier series, Bode plots, and their application to circuit analysis. This course is a continuation of EE-201 Electrical Engineering Fundamentals III.
    b. **Pre-requisites or co-requisites:**
    Prerequisite: EE-201 Electrical Engineering Fundamentals III
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
    EE-202 is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
    a. **Specific outcomes of instruction:**

    b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Apply** the Laplace Transform to functions and operations, and **determine** the inverse Laplace Transform (ABET Outcomes: A, k)	Midterm & Final
2. **Apply** the Laplace Transform in circuit analysis [in frequency and time domain], and **utilize** transfer functions. (ABET Outcomes: A, c, k)	Projects
3. **Apply** Bode analysis (ABET Outcomes: A, c, e, k)	Projects
4. **Utilize** the trigonometric form of the Fourier Series (ABET Outcomes: A, k)	Projects

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Review of Laplace transforms
- Application of Laplace transform to circuit analysis
- The transfer function
- Time convolution
- Introduction to Fourier series
- Fourier Transform
- Two-Port Networks
- Bode plots

ABET Course Syllabi for

1. **Course number and name:** EE-203: Electronics I
2. **Credits and contact hours:** 3 Credits and (Mon/Wed) 12:30PM - 1:50PM
3. **Instructor's Name:**
4. **Textbook:** *Microelectronic Circuits*, A. Sedra and K. C. Smith, Oxford University Press, Sixth Edition, 2010.
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course will cover fundamental device characteristics including diodes, MOSFETs and bipolar transistors; small- and large-signal characteristics and design of linear circuits. Linear integrated circuitry including Operational amplifiers (Op-Amp) applications and theory will be covered extensively.
   b. **Pre-requisites or co-requisites**
      Prerequisite: EE-201 Electrical Engineering Fundamentals III, Co-requisite: EE-202 Electrical Engineering Fundamentals IV
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      EE 203 is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**

1. Gain an intuitive understanding of the role of power flow and energy storage in electronic circuits
2. Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis
3. Be introduced to the concept of state in a dynamical physical system and learn how to analyze simple first and second order linear circuits containing memory elements
4. Be introduced to the concept of singularity functions and learn how to analyze simple circuits
   containing step and impulse sources;
5. Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis;
6. Learn how the primitives of Boolean algebra are used to describe the processing of binary signals and to use electronic components such as MOSFET's as building blocks in electronically implementing binary functions;
7. Learn how the concept of noise margin is used to provide noise immunity in digital circuits;

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Describe** the operation of diodes, BJTs and	Midterm & Final

MOSFETs (ABET Outcomes: A, e)	
2. **Explain** the concepts of large- and small-signal analyses (ABET Outcomes: A, e)	Projects
3. **Analyze and design** basic amplifier configurations (ABET Outcomes: A, C, e)	Projects
4. **Analyze and design** various Opamp configurations (ABET Outcomes: A, C, e)	Projects
5. **Use** basic commands in the circuit simulator SPICE for analysis of electronic circuits (ABET Outcomes: A, b, c, e, K)	Projects
6. Design a system to meet desired needs within realistic constraints and implement it (ABET Outcomes: A, B,C, E, K)	Projects

Grading Plan:
90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Introduction to electronics
- Diodes: small-signal model, applications
- BJTs: biasing, small-signal model
- BJT single-stage amplifiers: analysis and design
- BJT current mirrors
- MOSFETs: biasing, small-signal model
- MOSFET single-stage amplifiers: analysis and design
- MOSFET current mirrors
- Operational amplifiers
- Laboratory projects involve design and implementation of a regulated dual power supply.
- Students integrate the rectifier, filter, regulator and current limiting circuitry using diodes, bipolar junction transistors, field effect transistors, SPICE software, and basic OP-AMP circuits.

ABET Course Syllabi for

1. **Course number and name:** MTH-163: Calculus II
2. **Credits and contact hours:** 4 Credits and (Tuesday/Thursday) 2:00 PM – 3:40 PM
3. **Instructor's Name:** Sasha Han
4. **Textbook:** <u>*Calculus*</u>, 10th ed., Ron Larson & Bruce Edwards
   ISBN-13: 978-1-285-05916-7
   ISBN-10: 1-285-05916-6
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course covers topics such as applications of integration, area between curves, volumes, techniques of integration, integration by parts, trigonometric substitution, partial fractions, further applications of integration, arc length, area of a surface of revolutions, parametric equations and polar coordinates, infinite sequences and series, comparison tests, ratio tests, root tests, and power series. The course involves four hours of lecture per week.
   b. **Pre-requisites or co-requisites**
      Pre-requisites: A grade of C or better in MTH 162: Calculus I or an equivalent course or satisfactory placement scores.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      MTH-163: Calculus II is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      At the end of the semester the students will:
      - Apply computation rules
      - Define/describe advanced math concepts
      - Solve problems involving rules and properties of calculus
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

COURSE OUTCOMES	COURSE MEASUREMENTS
Students wil apply techniques and strategies in solving advanced mathematics computation	Formative assessment, Summative assessment, Applications
Students will solve real-world application problems that measures advanced mathematics skills	
Students will use algebraic formulas to demonstrate skills in solving real-world problems	
Students will solve problems involving missing dimensions(s) of geometric figures	

Grading Plan:	
Quiz	25%
Homeworks/Classwork	15%
Midterms/Finals	50%
Attendance	10%

Assessment Pieces:
The student will be assessed in a variety of ways:

- Pre-Test/Post Test
- Midterms/Finals
- Regular formative assessments like classwork and homework
- Informal assessments like recitation or teacher observation

7. Brief list of topics to be covered.

- Review of Calculus I – Integration by Substitution
- Derivatives and integrations of logarithmic and exponential functions
- Integration by Parts
- Integration by Partial Fractions
- Trigonometric Integrals
- Integration by Trigonometric Substitution
- Numerical Integration Approximations using Simpson's Rule (optional)
- Applications of Integration –Arc Length
- Applications of Integration – Surface Are of Revolution
- Infinite Sequence, Absolute Value Theorem, monotonic Sequence Theorem, Monotonicity, Boundedness, Convergence of Sequence
- Series, Convergence of series, Geometric, Harmonic, Alternating Harmonic, pHarmonic, Taylor Series Expansion, McLaurin Series Expansion

ABET Course Syllabi for

1. **Course number and name:** EE-212: Instrumentation I
2. **Credits and contact hours:** 3 Credits and (Tues/Thurs) 9:30 AM – 10:50 AM
3. **Instructor's Name:** Dr. Peter Romine, PhD
4. **Textbook:** Online lab manual and handouts from instructor.
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    This class introduces students to fundamental laboratory practices and the use of test equipment to measure basic electrical components, DC/AC circuits using ohmmeters, voltmeters, ammeters and oscilloscopes. Units, systems of units and standards will be covered extensively.
    b. **Pre-requisites or co-requisites**
    None
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
    EE-212 is a *required* course
6. **Specific goals for the course:**
    a. **Specific outcomes of instruction:**
        1. Select appropriate components and assemble functioning circuits. Take measurements and properly interpret collected data.
        2. Write proper experiment-based technical reports
        3. Conduct experimental investigation on real-life electronic and electrical systems.

    b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
Have a strong understanding error propagation, graph analysis, sampling theory (ABET outcomes: a)	Complete Homework assignments, quizzes, exams, and projects.
Have a strong understanding of physical electrical device limitations and characteristics. (ABET outcomes: b)	
Use modern tools to conduct experiments. (ABET outcomes: k)	

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

1. Unit standard
2. Measurement methods and theory
3. Error propagation
4. Physical electrical device limitations and characteristics
5. Graph analysis
6. Sampling theory
7. Electrical measuring devices

ABET Course Syllabi for

1. **Course number and name:** EE-301: Signals & Systems
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 8:00 AM – 9:20 AM
3. **Instructor's Name:** Dr. Peter Romine, PhD
4. **Textbook:**

1. Simon Haykin and Barry Van Veen, Signals and Systems, Second Edition, Wiley, 2003, ISBN 0471-16474-7 (required)
2. S. Haykin and B. VanVeen, *Signals and Systems, 2005 Just Ask Edition*, Wiley, 2005 (required)
3. *Fundamentals of Signals and Systems Using the Web and Matlab*, Third Edition, E. Kamen and B. Heck, Prentice-Hall, Inc, 2007 (required)
4. *Introduction to Matlab 7 for Engineers*, W. Palm III, McGraw Hill, 2005 (recommended)
5. A.V. Oppenheim and A.S. Willsky, *Signals and Systems*, Second Edition, Prentice Hall, 1997 (optional)
6. C.L. Phillips and J.M. Parr, Signal, System, and Transforms, Second Edition, Prentice Hall, 1991, ISBN 0-20-109589-0 (reference)
7. D.K. Lindner, Introduction to Signals and Systems, First Edition, McGraw Hill, 1999, (Fourier transform reference)

5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      Analytical techniques for continuous-time and discrete-time signal, system, and circuit analysis.
   b. **Pre-requisites or co-requisites**
      Prerequisite: EE-202 EE Fundamentals IV, EE-203 Electronics I
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      EE-301 is a *required* course for the Electrical Engineering program
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**

1. Compute and interpret means, correlations/covariances of random variables
2. Compute and interpret auto- and cross-correlation/covariance functions of random processes
3. Discrete-time (DT) processing of continuous-time (CT) signals
4. DT control of CT systems via sampled-data control
5. CT communication of DT signals via pulse-amplitude modulation (PAM), pulse shaping and filtering to combat channel distortions (frequency-dependent group delay and amplitude response, noise).

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Derive** linear models of simple electrical circuits (effective use of differential equations) (ABET: Outcomes A, k)	Midterm & Final
2. **Analyze** linear time invariant system responses in time domain using the convolution. (ABET Outcomes: A, K)	Projects

3. **Analyze** continuous time signals and systems in the frequency domain using the Fourier Transform. **Determine** the Frequency Spectrum of periodic and aperiodic signals using the Fourier Series and Fourier Transform, respectively (ABET Outcomes: A, K)	Projects
4. **Apply** the basic properties of CT and DT signals and systems; **express** physical signals as mathematical functions, including use of standard signals; **use** computers and MATLAB to simulate and analyze signals and systems; **determine** if a system is linear, time-invariant, causal, and memoryless (ABET Outcomes: A, B, K)	Projects
1. **Analyze** continuous-time and discrete-time signals and systems in the frequency domain using mixed signal classes. Use MATLAB and laboratory experiments to **simulate and analyze** signals and systems of these cases (ABET outcomes: A, B, K)	
2. **Explore** sampling concepts that link continuous-time and discrete-time signals and systems. Use MATLAB and laboratory experiments to **simulate and analyze** signals and systems for this situation (ABET outcomes: A, B, K)	
3. **Apply** time-domain and frequency-domain analysis tools to communication system applications (ABET outcomes: A, c, K) 4. **Analyze** continuous-time signals and system responses using the concepts of transfer function representation by use of Laplace and inverse Laplace transforms. Use MATLAB and laboratory experiments to **simulate and analyze** signals and systems using these transforms (ABET outcomes: A, B, K)	
5. **Analyze** discrete-time signals and system responses using the concepts of transfer function representation by use of Z and inverse-Z transforms. Use MATLAB and laboratory experiments to **simulate and analyze** signals and systems using these transforms (ABET outcomes: A, B, K)	

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Matlab skills (using help and basic commands, program using vectors & matrices)

- Basic concepts of continuous- and discrete-time signals and systems.
- Time-domain analysis of linear time-invariant (LTI) continuous-time (CT) and discrete-time (DT) systems.
- Frequency-domain analysis of CT/DT signals and LTI systems.
- Mixed Fourier representations and sampling theorem
- Communications system applications
- Laplace and Inverse Laplace transforms
- Z and Inverse-Z transforms
- MATLAB for signal processing and communications applications

ABET Course Syllabi for

7. **Course number and name:** ENGR-301: Introduction to Modeling and Simulation Credits and contact **hours:** 4 Credits and (Tue/Wed/Thu) 8:00 AM – 9:20 AM
8. **Instructor's Name:** Dr. Peter Romine/Dr. Bei Xie, PhD
9. **Texts:** Materials will be distributed
10. **Specific Course Information:**
    - d. **Brief description of the content of the course (catalog description)**
      Introduction to modeling and simulation. The course will cover modeling and simulation for applications in electrical engineering, including motivation of modeling and simulation, related computer programming, numerical methods for modeling, types of modeling, modeling architecture and design, and simulation. This course will be largely based on in class projects in which the students will design models and implement simulations
    - e. **Pre-requisites or co-requisites**
      MTH-163.
    - f. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      EE-3xx Introduction to Modeling and Simulation is a *required* course in the Electrical Engineering program.
11. **Specific goals for the course:**
    - b. **Specific outcomes of instruction:**
      1. Students will reliably demonstrate the ability to choose proper models for applications in electrical engineering.
      2. Students will demonstrate the ability to apply numerical methods to assist the modeling design.
      3. Students will reliably demonstrate skills in solving problems concerning modeling and simulation.
      4. Students will reliably demonstrate the ability to choose proper simulation tools to implement the designed models.
      5. Students will demonstrate the ability to use simulation tools and computer language to implement the designed models.
    - c. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Apply** basic engineering methodology to solve problems (ABET Outcomes: A, k)	Midterm & Final
2. **Design and implement** a model and simulation to a student-defined problem in the context of engineering design (ABET Outcomes: a, C, e, k)	Projects
3. **Explain** the motivation of modeling and simulation, as it relates to the societal impacts of innovations and design choices (ABET Outcomes: H, J)	Projects
4. **Utilize** tools to implement an engineering design (ABET Outcomes: a, C, e, K)	Projects

5. **Identify** numerical methods to assist the modeling design (ABET Outcomes: a)	Projects
6. **Identify** tools and techniques that will assist them to succeed better in their engineering education (ABET Outcomes: a, K)	Projects

Grading Plan:
90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Introduction of modeling and simulation
- Computer software and languages for modeling and simulation
- Life cycle systems engineering
- Types of modeling
- Modeling techniques
- Numerical methods
- Time based/physics based simulation
- Variations on continuous time simulation
- Simulation interfaces

ABET Course Syllabi for

1. **Course number and name:** MTH-410: Linear Algebra
2. **Credits and contact hours:** 3 Credits
3. **Instructor's Name:** Possibly Dr. Paez Paez or Dr. Ehteshami
4. **Textbook:**
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    This course covers a study of matrices, vectors on a plane, determinants, linear transformations, eigenvalues, and eigenvectors. The class will use technology device such as graphic calculator to aid in computations. Furthermore, they will be trained to be independent learners through both independent practices as well as cooperative learning.
    b. **Pre-requisites or co-requisites**
    There are no pre-requisites or co-requisites for MTH-410: Linear Algebra.
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
    MTH-410: Linear Algebra is a *required* course in the Electrical Engineering program
6. **Specific goals for the course:**
    a. **Specific outcomes of instruction:**
    At the end of this course the successful student will be familiar with the ideas of matrices and their applications in solving problems involving systems of linear equations and linear programming problems. Also he/she will be capable of representing geometric transformations by means of matrices and to express the volume of certain figures and equation of line using determinants.
    b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**
7. **Brief list of topics to be covered.**

ABET Course Syllabi for

1. **Course number and name:** EE-310: Embedded System Design
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 8:00 AM – 9:20 AM
3. **Instructor's Name:** Dr. Peter Romine, PhD
4. **Textbook:** Set of PDF files comprising data sheet information, PowerPC specifications, and Xilinx IP descriptions.
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   Implementation of embedded computer systems focusing on the development of hardware and software for an embedded microcontroller system. Topics include:
   (i) internal microcontroller architecture, (ii), interfacing peripheral devices, (iii) mixed analog and digital systems, (iv) hardware and software implementation of several systems using a microcontroller and peripherals.
   b. **Pre-requisites or co-requisites**
   There are no pre-requisites or co-requisites for EE-310
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   EE-310 is a *required* course in the Electrical Engineering program
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      1. Design embedded computer system hardware
      2. Design, implement, and debug multi-threaded application software that operates under real-time constraints on embedded computer systems
      3. Use and describe the implementation of a real-time operating system on an embedded computer system
      4. Formulate an embedded computer system design problem including multiple constraints, create a design that satisfies the constraints, implement the design in hardware and software, and measure performance against the design constraints
      5. Create computer software and hardware implementations that operate according to well-known standards
      6. Organize and write design documents and project reports
      7. Organize and make technical presentations that describe a design.
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Build** hardware that interfaces an embedded microcontroller to various peripheral devices such as DC motors, displays, analog, and digital circuitry (ABET outcomes: a, c, e, j, k)	Midterm & Final
2. **Program** this system using its interrupt,	Projects

timer/counter, analog to digital converter, and serial communication facilities (ABET outcomes: a, c, k)	
3. **Interface** analog circuitry with the microcontroller (ABET outcomes: a, c, k)	Projects
4. **Effectively utilize** microcontroller software development tools such as a compiler, make files, or compile scripts (ABET outcomes: a, c, e, k)	Projects

Grading Plan:
90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Introduction to microcontroller-based system design
- Microcontroller architecture
- GNU/Linux C programming environment
- Hardware/software debug issues
- Creating and interfacing analog peripherals
- Timers/counters
- Interrupts
- Analog to Digital Converter
- I2C
- EEPROM
- SPI
- UART
- Embedded system software development.
- Lab Projects: 5-7 lab projects requiring hardware/software design, implementation, and documentation

ABET Course Syllabi for

1. **Course number and name:** MTH-310: Differential Equations
2. **Credits and contact hours:** 4 Credits and (Tuesday/Thursday) 8:00 AM – 9:40 AM
3. **Instructor's Name:** Gholam Reza Ehteshami, Ph.D.
4. **Textbook:** *Differential Equations with Boundary – Value Problems*, 8th ed. (or higher), Dennis G. Zill and Warren S. Wright.
   ISBN-13: 978-1-111-82706-9
   ISBN-10: 1-111-82706-0
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      The theory of partial differential equations will be developed. Also, special emphasis will be placed on techniques of solutions and boundary problems.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: MTH-163: Calculus II
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      MTH-310: Differential Equations is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - To recognize various types of differential equations.
      - To solve differential equations by special techniques.
      - Applying differential equations to solve engineering problems.
      - To use Laplace Transform to solve differential equations.
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

COURSE OUTCOMES	COURSE REQUIREMENTS
Describe measurable skills or knowledge that students should be able to demonstrate as evidence that they have mastered course content.	Complete reading assignments, homework assignments, exams, projects, and quizzes.
Solve differential equations of various orders using appropriate methods.	
Analyze real-word problems in fields such as Biology, Chemistry, Economics, Engineering, and Physics. Including problems related to population dynamics, mixtures, growth and decay.	
Identify and classify homogenous and nonhomogenous equations/systems, autonomous equations/systems, and linear and non linear equations/systems.	
Solve first order differential equations using standard methods, such as separation of variables, integratingt factors, exact equations, and substitution methods.	

Grading Plan:	
Homework	20%
Mid-term	20%
Final Exam	25%
Project	10%
Quizzes	20%
Class Participation	5%

7. **Brief list of topics to be covered.**
    - First order and higher order ordinary differential equations
    - Linear differential equations with constant coefficients
    - Differential operators
    - Non-homogenous differential equations and their solutions
    - Special techniques for solving ordinary differential equations
    - Laplace transforms

ABET Course Syllabi for

1. **Course number and name:** EE-312: Instrumentation II
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 12:30 PM – 1:50 PM
3. **Instructor's Name:** Dr. Bei Xie, Ph.D.
4. **Textbook:** R. W. Larsen, *Labview for Engineers*, and handouts from instructor.
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   This laboratory course covers computer-based instrumentation systems such as Labview for applications in electrical engineering. Students will learn how to design computer-based instrumentation systems and will conduct engineering experiments to demonstrate their skills.
   b. **Pre-requisites or co-requisites**
   Pre-requisite: EE-212 Instrumentation I
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   EE-312 is a *required* course
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
   1. Find information on and select the proper instrumentation for making measurements of physical quantities (e.g., pressure and temperature) commonly encountered by mechanical and mechatronic engineers
   2. Plan and carry out measurements of physical quantities commonly encountered by mechanical and mechatronic engineers using common laboratory instruments
   3. Use personal computers as instrument controllers and develop simple computer programs to assist in or automate the collection and analysis of experimental data
   4. Prepare technical papers/reports
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
Implement an instrumentation system according to a design. (ABET outcomes: a, k)	Complete Homework assignments, quizzes, exams, and projects.
Operate the system to collect the desired data. (ABET outcomes: a, e, k)	
Analyze the data collected to determine the performance of the system. (ABET outcomes: a)	
Design systems according to perform required functions (ABET outcomes: a, c, e, k)	

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D

0-59 = F

7. Brief list of topics to be covered.

1. Computer-based instrumentation fundamentals
2. Computer-based instrumentation hardware and software
3. How to design hardware and software
4. Conduct experiments to demonstrate understanding

ABET Course Syllabi for

1. **Course number and name:** EE-396: Junior Research Project
2. **Credits:** 3 Credits
3. **Instructor's Name:** Dr. Peter Romine, Ph.D.
4. **Textbook:** Design for Electrical and Computer Engineers, Ralph M. Ford and Chris S. Coulston (required)
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    An individual design project to expose students to problem situations and issues in engineering design.
    b. **Pre-requisites or co-requisites**
    Must have junior standing status
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
    EE-396 Junior Research Project is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
    a. **Specific outcomes of instruction:**
        1. Identify project/research problems; understand information and grasp meaning; translate knowledge into new context; use information, methods, concepts, and theories of fundamental topics in computer science in new situations;
        2. Apply computer science principles and practices to a real-world problem; demonstrate in-depth knowledge in the area of the project they have undertaken; solve problems using required knowledge and skills; implement and test solutions/algorithms;
        3. Identify potential solutions/algorithms for the project problem; see patterns and modularize the problem, recognize hidden meanings and identify components, show proficiency in software engineering principles;
        4. Create new ideas using the old ones; generalize from given facts in the project they undertake, relate knowledge from several areas in systematic scientific approach, predict and draw conclusions relevant to the project they undertake;
        5. Show evidence of working productively as an individual and in a team on a project that produces a significant software product;
        6. Show evidence of competency in oral and written communications skills through oral presentations, technical reports and/or published research papers in conferences and/or journals;
        7. Use modern techniques, skills and tools necessary for computer science practices relevant to the project they undertake; use techniques in recent research papers to solve problems.

    b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Write** a concise project description stemming from an identified objective (ABET Outcomes: E, G, a, c, f)	Midterm & Final
2. **Collect** and review technical information on a project from relevant external resources (ABET Outcomes: I, J, e)	Reports
3. **Identify** and describe the constraints on projects imposed by resources and in terms of broader impact (ABET Outcomes: C, E, H, a, f)	Reports
4. **Identify** project milestones (ABET Outcomes: G)	Reports
5. **Acquire** tooling and hardware (components) for a breadboard / prototype (ABET Outcomes: K, j)	Reports
6. **Actively revise** and adjust solutions based on new information (ABET Outcomes: B, C, E, I, K, m)	Reports
7. **Record** technical results, and measure progress (ABET Outcomes: G, a)	Reports
8. **Complete** (from design to at least the prototype) an ECE project (ABET Outcomes: A, B, C, E, G, i)	Reports
9. **Generate** Operational and Technical Documentation for an ECE project (ABET Outcomes: G, a, b, c, d)	Reports
10. **Present** project information succinctly to a technically aware audience (ABET Outcomes: A, G, f)	Reports
11. **Analyze** ethical dilemmas in terms of the impact of engineering solutions in global, economic, environmental, social context (ABET Outcomes: F, H, J)	Reports

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Project management fundamentals
- Workplace behavior and ethics
- Project information communication

Total quality improvement, cycles

ABET Course Syllabi for

1. **Course number and name:** EE-406: Computer Networks
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 3:30 PM – 4:45 PM
3. **Instructor's Name:** Dr. Bei Xie, PhD
4. **Textbook:** Andrew S. Tanenbaum, *Computer Networks,* Fifth Edition, Prentice Hall.
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   Internetworking, unicast and multicast routing, congestion control, network quality of service, mobile networking, router architectures, network-aware applications, content dissemination systems, network security, and performance issues.
   b. **Pre-requisites or co-requisites**
   There are no pre-requisites or co-requisites
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   EE-406 is a *required* course
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction: Students will**
      1. **explain** the terminologies of computer networks, such as host, links, protocol stack, access network, throughput, etc.;
      2. **define** network protocol layers;
      3. **describe** essential principles of each network protocol layers, such as circuit/packet switching, reliable data transfer, flow/congestion control, routing, multiple access, etc;
      4. **list** popular network standards , such as 802.11 WiFi, Ethernet, TCP, IP, etc;
      5. **calculate** packet delay, throughput, and channel efficiency according to different network protocols;
      6. **use** IP addressing and apply routing algorithms to find shortest paths for network-layer packet delivery
      7. **use** networking tools to observe and analyze behaviors of networking protocols.

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
Explain the terminologies of computer networks (ABET outcomes: a, j)	Midterm & Final
Describe essential principles of each network protocol layers (ABET outcomes: a, j)	Midterm & Final
List popular network standards (ABET outcomes: a, j)	Midterm & Final
Calculate packet delay, throughput, and channel efficiency according to different network protocols (ABET outcomes: a)	Homework, Midterm, and Final
Apply routing algorithms to find shortest paths for	Homework and Final

network-layer packet delivery. (ABET outcomes: a)	
Use networking tools to observe and analyze behaviors of networking protocols (ABET outcomes: k)	Projects

Grading Plan:
90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. **Brief list of topics to be covered.**
   1. Fundamentals of computer networking
   2. Network hardware
   3. Reference models
   4. Network standardization
   5. Physical layer protocols (CDMA, FDMA, OFDM, etc)
   6. Data link layer protocols (flow control, error detection and correction, Medium Access Control, etc)
   7. Network layer - efficient routing algorithms
   8. TCP/IP protocol stack

ABET Course Syllabi for

8. **Course number and name:** EE-422/423: Capstone Design I/II
9. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 9:30 AM – 10:20 AM
10. **Instructor's Name:** Dr. Peter Romine, Ph.D.
11. **Textbook:** Design for Electrical and Computer Engineers, Ralph M. Ford and Chris S. Coulston (required)
12. **Specific Course Information:**
    - d. **Brief description of the content of the course (catalog description)**
      An extended team design project to expose students to problem situations and issues in engineering design similar to those encountered in industry. (Writing Intensive Course)
    - e. **Pre-requisites or co-requisites**
      Must have senior standing status and EE-422 is a pre-requisite for EE-423
    - f. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      EE-422/423 Capstone Design is a *required* course in the Electrical Engineering program.
13. **Specific goals for the course:**
    - c. **Specific outcomes of instruction:**
      8. Identify project/research problems; understand information and grasp meaning; translate knowledge into new context; use information, methods, concepts, and theories of fundamental topics in computer science in new situations;
      9. Apply computer science principles and practices to a real-world problem; demonstrate in-depth knowledge in the area of the project they have undertaken; solve problems using required knowledge and skills; implement and test solutions/algorithms;
      10. Identify potential solutions/algorithms for the project problem; see patterns and modularize the problem, recognize hidden meanings and identify components, show proficiency in software engineering principles;
      11. Create new ideas using the old ones; generalize from given facts in the project they undertake, relate knowledge from several areas in systematic scientific approach, predict and draw conclusions relevant to the project they undertake;
      12. Show evidence of working productively as an individual and in a team on a project that produces a significant software product;
      13. Show evidence of competency in oral and written communications skills through oral presentations, technical reports and/or published research papers in conferences and/or journals;
      14. Use modern techniques, skills and tools necessary for computer science practices relevant to the project they undertake; use techniques in recent research papers to solve problems.
    - d. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. **Write** a concise project description stemming from an identified objective (ABET Outcomes: E, G, a, c, f)	Midterm & Final
2. **Collect** and review technical information on a project from relevant external resources (ABET Outcomes: I, J, e)	Reports
3. **Identify** and describe the constraints on projects imposed by resources and in terms of broader impact (ABET Outcomes: C, E, H, a, d, f, m)	Reports
4. **Identify** project milestones (ABET Outcomes: G, d)	Reports
5. **Acquire** tooling and hardware (components) for a breadboard / prototype (ABET Outcomes: K, j)	Reports
6. **Actively revise** and adjust solutions based on new information (ABET Outcomes: B, C, E, I, K, m)	Reports
7. **Record** technical results, and measure progress (ABET Outcomes: G, a, d)	Reports
8. **Complete** (from design to at least the prototype) a significant ECE project (ABET Outcomes: A, B, C, E, G, K, M, d, i)	Reports
9. **Generate** Operational and Technical Documentation for an ECE project (ABET Outcomes: G, a, b, c, d)	Reports
10. **Present** project information succinctly to a technically aware audience (ABET Outcomes: A, G, f)	Reports
11. **Work** effectively in professional multidisciplinary teams utilizing appropriate communication skills (ABET Outcomes: D, G, f)	Reports
12. **Analyze** ethical dilemmas in terms of the impact of engineering solutions in global, economic, environmental, social context (ABET Outcomes: F, H, J)	Reports

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

14. Brief list of topics to be covered.

- Project management fundamentals
- Workplace behavior and ethics
- Project information communication
- Total quality improvement, cycles

ABET Course Syllabi for

1. **Course number and name:** EE-313: Summer Internship
2. **Credits and contact hours:** 3 Credits
3. **Instructor's Name:** Peter Romine, Ph.D.
4. **Textbook:** N/A
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   Students will work part-time to full-time in an electrical engineering related industry. The internship must be approved by the instructor and students will be required to make written reports and prepare oral presentations to appropriate classes as assigned by the instructor.
   b. **Pre-requisites or co-requisites**
   No pre-requisite required
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   EE-313 is a *required* course in the Electrical Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Exercising leadership; addressing colleagues and superiors appropriately.
      - Behaving professionally; behaving ethically; listening effectively; dressing appropriately.
      - Allocating time effectively.
      - Adapting effectively to changing conditions; demonstrating understanding of professional customs and practices.
      - Participating as a member of a team.
      - Developing appropriate workplace attitudes; understanding and managing personal behavior and attitudes.
      - Developing individual responsibility; organizing and maintaining information.
      - Identifying, understanding and working with professional standards.
      - Improving problem-solving and critical thinking skills.
      - Monitoring and correcting performance.
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

Learning Outcomes and Assessment Methods

Measurable Student Learning Outcomes At the completion of the course, students will be able to…	**COURSE MEASUREMENTS**
1. Have a strong understanding of electronic and computer engineering concepts. (ABET outcomes: a, j)	Internship Report
2. Have a strong understanding of electrical modeling. (ABET outcomes: a, j)	
3. Have a strong understanding of ways to solve engineering problems. (ABET outcomes: a, e)	
4. Have a strong understanding of making a favorable decision from different alternatives. (ABET outcomes: a, e)	

Grading Plan:

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

7. Brief list of topics to be covered.

- Students will gain practical experience
- The students will explore engineering related jobs
- Students will learn how to solve engineering problems

ABET Course Syllabi for

1. **Course number and name:** PHY-121: Calculus Based Physics I
2. **Credits and contact hours:** 4 Credits and (Monday/Wednesday) 2:30 PM– 4:10 PM
3. **Instructor's Name:** Abraham Meeles, PhD.
4. **Textbook:** *Physics for Scientists and Engineers*, 9th ed., Serway and Jewette, Brook/Cole 2014.
   ISBN-13: 978-1-133-94727-1
   ISBN-10: 1-133-94727-1
   Course Websites:
   - webwork.navajotech.edu – (alternate: 74.112.229.60)
   - www.engrade.com

   Course websites are used for homework distribution and grades. Any questions please talk to your instructor.
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   The first semester of this calculus-based two-semester introductory sequence in physics uses the workshop physics method. This approach combines inquiry-based cooperative learning with comprehensive use of computer tools. Topics covered include kinematics, Newton's laws of motion, rotational motion, and oscillations. The course includes three hours of discovery lab each week. *This course is only offered in the fall semester. Lab fee $125.00*
   b. **Pre-requisites or co-requisites**
   Pre-requisites: MTH-121: College Algebra, MTH-123: Trigonometry, or MTH-150: Pre-Calculus.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   PHY-121: Calculus Based Physics I is a *selected elective* course in the Electrical Engineering program.

6. Specific goals for the course:
   a. **Specific outcomes of instruction:**
   After successfully completing this course you will learn:
   - A basic understanding of mechanical physics and knowledge of motion (linear, projectile, circular, oscillatory, and rotational) and the fundamental laws that govern said motions.
   - A basic understanding energy, momentum and impulse and the fundamental laws that govern said concepts.
   - A basic understanding of thermodynamics and the fundamental laws that govern it.
   - A basic understanding of electromagnetism and the laws that govern it.

   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

COURSE OUTCOMES	COURSE MEASUREMENTS
Student will apply a basic understanding of units for conversion.	Completion of Homework
Students will develop the intuition to apply laws and theorems to hypothetical situations involving motion in a two-dimensional system.	Completion of Quizzes
Students will aquire the ability to organize information from a hypothetical situation.	Completion of Mid-term and Final
Students will collaborate in an effort to complete a procedure and may or may not collaborate in lab report.	Completion of lab assignments

Grading Plan:	
Tests	25%
Quizzes	25%
Homework	25%
Lab work/reports	25%

7. Brief list of topics to be covered.

- Kinematics
- Newton's laws of motion
- Rotational Motion
- Oscillations

APPENDIX B – FACULTY VITAE

FACULTY VITAE

1. Name: Dr. Peter L. Romine
2. Education

Degree	Discipline	Institution	Year
B.S.	Electrical Engineering	University of Alabama, Tuscaloosa	1982
M.S.	Electrical & Computer Engineering	University of Alabama, Huntsville	1987
Ph.D.	Computer Engineering	University of Alabama, Huntsville	1992

3. Academic experience

Institution	Rank	Title	Dates Held	FT/PT
Navajo Technical University	Associate Professor	Coordinator EE Program	2014-present	FT
Alabama A&M University	Professor		2009-14	FT
Alabama A&M University	Professor	Chairman	2004-09	FT
Alabama A&M University	Assistant Professor	Coordinator EET Program	1996-2004	FT
Florida International University	Assistant Professor	Visiting Professor & Research Professor	1993-96	FT
University of Alabama, Huntsville	Instructor		1985-1992	PT
University of Alabama, Huntsville	Graduate Teaching Assistant		1983-1985	PT

4. Non-academic experience:

Organization	Title	Duties	Dates	FT/PT
Jacobs Engineering (Sverdrup)	Senior Engineer	NASA MSFC Metallic Materials & Processes Modeling simulation & Control	1998-2006	PT

5. Certifications or professional registrations: None

6. Membership in professional organizations
   a. Member, Institute of Electrical & Electronic Engineers
   b. Member, American Society of Engineering Education

7. Honors and awards
   a. NASA Group Achievement award in September 2008 for his contributions in sensor development for the Ares I Upper Stage Development Hardware Team.
   b. Researcher Award, Alabama A&M University, 2007
   c. NASA Space Flight Awareness award 2003-2005 for development of the Friction Stir Welding process for use in improving the quality, cost and manufacturability of the Shuttle External Tank.
   d. NASA Group Achievement Award in November 1997 for Data Acquisition and Instrumentation innovations in the Shuttle Nozzle Erosion Study.

8. Service activities
   a. National Science Foundation Reviewer, 2007, 2009, 2016
   b. Chair, Professional Skills Division of the ASEE, SE Section 2007-2008
   c. Chair, Electrical Engineering Division of the ASEE, SE Section 1998-1999
   d. Editorial Review Board Member, Journal of STEM Education: Innovations and Research, Laboratory for Innovative Technology and Engineering Education (LITEE), 2002-2009.

9. Publications and presentations from past five years
   a. None in last 5 years

10. Recent professional development activities
   a. Exploring Computer Science (ECS) Teacher Training, Colorado School of Mines, July 2016.
   b. Maker Education Workshop, ASEE National New Orleans, June 2016.

FACULTY VITAE

1. Name: Edwin Z. Crues

2. Education

Degree	Discipline	Institution	Year
B.S.	Aerospace Engineering	University of Texas at Austin	1983
M.S.	Aerospace Engineering	University of Texas at Austin	1985
Ph.D.	Aerospace Engineering	University of Texas at Austin	1989

3. Academic experience

Institution	Rank	Title	Dates Held	FT/PT
Navajo Technical University (NTU)	Visiting Professor (Distance Learning)	Professor	Spring 2016	PT
Southwest Indian Polytechnic Institute (SIPI)	Visiting Professor (Distance Learning)	Professor	Summer 2015	PT
Salish Kootenai College (SKC)	Visiting Professor	Professor	Summer 2015, Summer 2012	PT
University of Houston - Clear Lake	Adjunct Professor	Professor	Fall 1994, Spring 1995, Fall 1996, Spring 1997 and Fall 1997	PT

4. Non-academic experience:

Organization	Title	Duties	Dates	FT/PT
German Aerospace Research Establishment (DLR)	Researcher	Developed launch trajectory optimization programs for the European Space Agency.	Sept 1989 – Oct 1991	FT

University of Texas at Austin	Staff Researcher	Research into Guidance, Navigation and Control. General support for computer labs and software systems.	Jan 1992 – Apr 1992	FT
LinCom Corporation	Aerospace Engineer	Contractor supporting software and simulation technology development and mission support at NASA JSC.	Apr 1992 - Apr 2004	FT
NASA Johnson Space Center	AST Simulation Specialist	Research, design and develop human space systems simulations.	Apr 2004 - present	FT

5. Certifications or professional registrations: None
6. Membership in professional organizations
    a. Senior Member, American Institute for Aeronautics and Astronautics (AIAA)
    b. Member, Society for Modeling and Simulation International (SCS)
    c. Member, Simulation Interoperability Standards Organization (SISO)
7. Honors and awards
    a. SISO Outstanding Paper Awards, 2008, 2009 and 2016,
    b. 2015 NASA Tech Brief Award, Morpheus Vehicle Flight Software (MSC-25240-1)
    c. 2014 JSC Exceptional Software Award, JSC Engineering Orbital Dynamics
    d. 2014 NASA Major Space Act Award, JSC Engineering Orbital Dynamics
    e. Outstanding JSC Mentor, Spring 2011
    f. NASA JSC Director's Commendation Award, 2008.
    g. NASA Group Achievement Award, 2008.
    h. 2007 NASA Certificate of Recognition, ANTARES software
    i. Industrial Advisory Board (IAB): Embry-Riddle Aeronautics University at Prescott Aerospace Engineering Department. Appointed in the Spring of 2005.
    j. 2003 NASA/JSC Exceptional Software Award: Trick Simulation Environment.
    k. External Advisory Committee (EAC) (formerly Departmental Visiting Committee (DVC)): University of Texas at Austin Aerospace Engineering and Engineering Mechanics Department. Appointed in Fall 2002 to a 3-year term.
    l. NASA Certificate of Recognition: Hyperman Documentation Viewing System.
    m. NASA Certificate of Recognition: Trick Simulation Development Environment.
    n. NASA Certificate of Recognition: Generic Kalman Filter computer code.
8. Service activities
    a. Originator of the Simulation Exploration Experience (formerly Simulation Smackdown). This is a student simulation coopetition that started in Spring 2011 and has run yearly through Spring 2016 (http://www.exploresim.com).

b. Member, Simulation Interoperability Standards Organization (SISO) Product Development Group (PDG) for the Space Reference Federation Object Model (FOM) standard. Lead editor on this standards document. Started in Fall 2015. This standard activity is expected to go to balloting in Fall 2017.

c. Developed the "Introduction to Modeling and Simulation" course in the Fall of 2011. This is the basis for the courses currently being taught to the Tribal College and University Engineering Working Group participating institutions.

9. Publications and presentations from past five years

a. B. Möller, B., A. Garro, E. Crues, and D. Dexter, "Promoting a-priori interoperability of HLA-based Simulations in the Space domain: the SISO Space Reference FOM initiative", The 20th IEEE/ACM International Symposium on Distributed Simulation and Real Time Applications, London, England, 21-23 September 2016.

b. B. Möller, B., A. Garro, E. Crues, D. Dexter, A. Skuratovskiy and A Vankov, "A First Look at the Upcoming SISO Space Reference FOM", 2016 Simulation Innovation Workshop, Orlando, Florida, USA, 11-16 September 2016. Outstanding Paper Award.

c. Z. Li, M. Moore, E. Crues, and P. Bielski, "Lighting Condition Analysis for Mars' Moon Phobos", 2016 IEEE Aerospace Conference, Big Sky, Montana, USA, 5-12 March, 2016.

d. M. Gernhardt, S. Chappell, O. Bekdash, A. Abercromby, E. Crues, P. Bielski, Z. Li, and K Beaton, "Human Exploration Missions to Phobos Prior to Crewed Mars Surface Missions", 2016 IEEE Aerospace Conference, Big Sky, Montana, USA, 5-12 March, 2016.

e. A. Howe, M. Gernhardt, D. Lee, E. Crues, D. Dexter, A. Abercromby, S. Chappell, and H. Nguyen, "Small Body Hopper Mobility Concepts", AIAA SPACE 2015 Conference and Exposition, Pasadena, California, 31 Aug-2 Sep 2015.

f. A. Jackson, D. Murri, M. Hill, M. Jessick, J. Penn, D. Hasan, E. Crues, R. Flack, T. McCarthy, N. Vuong, and C. Zimmerman, "Assessment of the Draft AIAA S-119 Flight Dynamic Model Exchange Standard", AIAA Modeling and Simulation Technologies Conference, Portland, Oregon, 8 -11 August 2011.

10. Recent professional development activities (last 5 years)

a. Principles of Success in Spaceflight, NASA Johnson Space Center, September 27, 2016.

b. GIT Fundamentals and Workflows, NASA Johnson Space Center, April 20, 2016.

c. Introduction to Inclusion and Innovation, NASA Johnson Space Center, December 11, 2013.

d. System Engineering Overview, NASA Johnson Space Center, June 20, 2013.

e. Human Spaceflight: Mission Analysis & Design, NASA Johnson Space Center, March 28, 2013.

f. Introduction to Productview MCAD Professional 9.1, NASA Johnson Space Center, October 16, 2012.

g. Design Patterns Workshop in C++, NASA Johnson Space Center, September 14, 2011.

h. Software Product Lines, NASA Johnson Space Center, September 1, 2011.

i. Python Training, NASA Johnson Space Center, June 3, 2011.

j. Future Flight Propulsion, NASA Johnson Space Center, May 18, 2011.

Faculty Vitae

1. Name: Daniel Z. Frank
2. Education

Degree	Discipline	Institution	Year
M.S.	Mechanical Engineering	University of Florida, Gainesville, FL	2011-2012
B.S.	Mechanical Engineering	Lehigh University, Bethlehem, PA	2005-2009

3. Academic Experience

Institution	Rank	Title	Dates Held	FT/PT
Navajo Technical University	Instructor	AST	2016-Present	PT
University of Florida	Instructor	AST	2011-Present	PT
St. Michael Indian School	Teacher		2010-Present	PT
Lehigh University	Research AST	AST	1-10/07-10	PT

4. Non-academic experience: None
5. Certifications or Professional registrations: None
6. Membership in professional organizations: None
7. Honors and awards
    a. University of Florida Impact Award: Extraordinary Student
    b. Attributes of a Gator Engineer Award: Service to Global Community
    c. National Honor Societies Tau Beta Pi, Phi Eta Sigma, and Pi Tau Sigma
8. Service activities
    a. Teaching a special topics course on autonomous systems NTU
    b. Mentor for NTU's NASA Swarmathon Competition team
9. Publications and presentations from past five years: None
10. Recent professional development activities: None

Faculty Vitae

1. Name: Julian K. Boateng

2. Education

Degree	Discipline	Institution	Year
M.S.	Electrical Engineering	Manhattan College, Riverdale, NY	May 2007
B.S.	Electrical and Computer Engineering, Minor: Computer Science	Manhattan College, Riverdale, NY	May 2005
A.A.S., A.S.	Computer Science, Computer Networking, Liberal Arts Math and Science	SUNY Westchester Community College, Valhalla, NY	May 2002

3. Academic Experience

Institution	Rank	Title	Dates Held	FT/PT
Westchester Community College, Vallalla,NY	Adjunct Professor		2005 to Present	FT
Westchester Community College, Vallalla,NY	Technical Assistant		2001-Spring 2004	FT

4. Non-academic experience: None
5. Certifications or Professional registrations: None
6. Membership in professional organizations: None
7. Honors and awards: None
8. Service activities: None
9. Publications and presentations from past five years: None
10. Recent professional development activities: None

FACULTY VITAE

1. Name: **Harry S. Whiting, MSIE, PE**

2. Education

Degree	Discipline	Institution	Year
PhD	Integrated Engineering	Ohio University, Athens, OH	ABD
MS	Industrial Engineering	Texas A&M University, Kingsville, TX	2002
BA	Mechanic Engineering	Texas A&M University, Kingsville, TX	1983

3. Academic experience

Institution	Rank	Title	Dates Held	FT/PT
Navajo Technical University	Assistant Professor, Engineering Math and Technology Department	Member General Education Committee, Adviser for: Engineering Club, Environmental Sustainability Club, and Industrial Engineering Adviser, Created new Scheduling Scheme for School, Created Engineering Seminar Series, Submitted NASA NICE-T Grant, Recruitment, Revised IE Curriculum.	August 2012 - Present	FT
Texas A&M University	Adjunct Professor	For ITEN 3313 “Energy & Power” for Industrial Technology Department	January – May 2012	PT
Russ College of Engineering	PhD Student/Graduate Assistant	Research, Facilitator for “Statistics for Engineering management	Sept. 2007 – August 2014	PT

4. Non-academic experience:

Organization	Title	Duties	Dates	FT/PT
Tejas Lean	Consultant	Training seminars for Small business Development Center. Consultation on business and efficiency to local businesses	June 2011 – Present	
Kirtland Air Force Base	Assistant Project Manager for PnPSats and NanoSats/Researcher	Create concepts for manufacture of PnpSats and NanoSats.	June – August 2008	
Texas Engineering Experiment Station (TEES)	Lean Manufacturing Facilitator	Lackland CPSG Demil of ComSec Project	May 2007 – August 2007	

5. Certifications or professional registrations:
    a. Online Facilitator Training, Ohio University 2011
    b. Licensed professional Engineer State of Texas No. 96441
    c. Boeing Lean manufacturing Facilitator Training 2006
    d. TEEX Facilitator Training 2005
    e. IIE Six Sigma Green Belt certified 2004
6. Membership in professional organizations
    a. Senior Member, American Society of Mechanical Engineers
7. Honors and awards
    a. First Vice Chairman of Ergonomics Committee for the Ohio Safety Congress 2011
    b. Inducted Alpha Pi Mu (Industrial Engineering Honor Society) 2009
    c. 2007 – 2009 Stocker Fellowship to study integrated Engineering at Ohio University Russ College of Engineering and Technology
8. Service activities
    a. Tejas Lean *(Registered Engineering Firm # 13815 in State of Texas)*, June 2011 - Present
9. Publications and presentations from past five years
    a. Young, W., Weckman, G., Hari, V., Whiting, H. & Snow A. (2012) Using Artificial Neural Networks to enhance CART, *Journal of Neural Computing and Applications (NCA)*, Vol. 21, Issue. 7, pp. 1477-1489, DOI: 10.1007/s00521-012-0887-4
10. Recent professional development activities
    a. Tejas Lean *(Registered Engineering Firm # 13815 in State of Texas)*, June 2011 – Present

FACULTY VITAE

11. Name: Bei Xie, PhD

12. Education

Degree	Discipline	Institution	Year
B.S.	Electrical Engineering	East China Normal University, China	2002
M.S.	Electrical Engineering	East China Normal University, China	2005
Ph.D.	Electrical Engineering	Virginia Tech, Blacksburg, VA	2012

13. Academic experience

Institution	Rank	Title	Dates Held	FT/PT
Navajo Technical University	Assistant Professor	Assistant Professor of Electrical Engineering	02/2017-present	FT
Virginia Tech	Graduate Research/Teaching Assistant		2007-2012	PT

14. Non-academic experience:

Organization	Title	Duties	Dates	FT/PT
IBM	Software Engineer	Software development	2012-2015	FT

15. Certifications or professional registrations: None

16. Membership in professional organizations
    a. Member, Institute of Electrical & Electronic Engineers

17. Honors and awards
    a. Best paper award, IEEE VTC 2016-Spring Conference, 05/2016

18. Service activities

    a. Reviewer for Conferences: Globecom 2015, ICCCN 2015, ICC 2016, Globecom 2016, InfoCom 2016, etc
    b. Reviewer for Journals and Magazines: Wireless Communications and Mobile Computing, IEEE Transactions on Wireless Communications, IEEE Transactions on Vehicular Technology, KSII Transactions on Internet and Information Systems, etc
    c. Technical Program Committee Member EUSIPCO 2016, VTC 2017-Spring

19. Publications and presentations from past five years

    a. Bei Xie, Zekun Zhang, Rose Qingyang Hu, Geng Wu, and Apostolos Papathanassiou, "Joint Spectral Efficiency and Energy Efficiency in FFR based Wireless Heterogeneous Networks," Manuscript accepted by IEEE Transactions on Vehicular Technology
    b. Bei Xie, Zekun Zhang, Rose Qingyang Hu, and Yi Qian, "Outage and Spectral Efficiency Study in Cooperative Wireless Heterogeneous Networks", in Proceedings of IEEE ICC 2017
    c. Bei Xie, Zekun Zhang, Rose Qingyang Hu, and Yi Qian, "Spectral efficiency analysis in wireless heterogeneous networks", in Proceedings of IEEE ICC 2016
    d. Bei Xie, Zekun Zhang, and Rose Qingyang Hu, "Performance Study on Relay-Assisted Millimeter Wave Cellular Networks", in Proceedings of IEEE VTC 2016 Spring
    e. Haijian Sun, Bei Xie, Rose Qingyang Hu, Yi Qian, and Geng Wu, "Non-orthogonal Multiple Access with SIC Error Propagation in Downlink Wireless MIMO Networks", accepted to IEEE VTC 2016 Fall
    f. Bei Xie and Tamal Bose, "Partial Update Least-Squares Adaptive Filtering", Morgan & Claypool Synthesis Lecture Communications Series, 2014
    g. Bei Xie and Tamal Bose, "Modified partial update EDS algorithms for adaptive filtering", Analog Integrated Circuits and Signal Processing, Vol. 78, No. 3, pp. 657–667, 2013
    h. Bei Xie and Tamal Bose, "Modified Partial Update EDS Algorithms for Adaptive Filtering", in Proceedings of SDR-WInnComm, 2012

20. Recent professional development activities

    a. ABET symposium, Maryland, April 2017

APPENDIX C – EQUIPMENT

Equipment located in the EE mod:

Computers: desktops

Instruments:

- Function generator
- Oscilloscope
- Digit multi-meter
- Power supply
- Soldering/Desoldering station
- Resistance decade box
- Capacitance decade box

FPGA board: development board for FPGA
myDAQ: data acquisition device for LabVIEW
Arduino UNO: microprocessor

Software:

- LabVIEW: systems engineering software for applications that require test, measurement, and control with rapid access to hardware and data insights
- Quartus II Web Edition: programmable logic device design software
- Wireshark: packet analyzer software
- Arduino IDE: software development tool for Arduino microprocessor

Equipment located in the Fabrication Lab:

Instruments:

- Rockwell hardness tester
- Instron Tensile/Compression tester
- Portable Profilometer/roughness tester

Additive manufacturing:

Additive Manufacturing Machines	Materials	Build Box Size X" x Y" x Z"	Process
ZCorp 650	Full Color Powder Binder (ceramic type product)	14 x 10 x 8	3D Printing
Objet Prime30	Simulated Engineering Plastic	11 x 7 x 8	Polyjet – UV Cured
MakerBot	PLA ABS plastics Including conductive graphene and magnet attracting (Ferrous infused) filament	4 x 4 x 4	FDM 1.75mm filament
MarkForged	Nylon with imbedded fibers -	10.5 x 5 x 6	FDM – Nylon

Mark 2	Carbon Fiber/Kevlar/Fiberglass		Embeds Carbon Fiber/Kevlar/fiberglass filament
MarkForged Mark 2	Onyx material – Carbon infused Nylon with imbedded fibers - Carbon Fiber/Kevlar/Fiberglass	10.5 x 5 x 6	FDM – Carbon infused Nylon Embeds Carbon Fiber/Kevlar/fiberglass filament
Projet MJP 3600	Multijet high throughput 3D printer – high definition parts	8 x 10 x 8	UV Cured Multijet high definition 3D printer with melt away material

Subtractive:

- Roland desktop CNC machine.
- Kent Vertical Milling Machine – CNC Machine with 24 tool turret changer
- Desktop Milling Machine (hobby style)
- Desktop Lathe (hobby style)
- ShopBot – CNC Router – wood, foam, plastics etc.
- Laser Cutter
- Smithy Combination Lathe/Mill (precision machining)
- Grinders
- Sheet Metal Brake Press

Equipment	Process	Usage	Data
Faro Focus 3D	Phase Based Laser Scanner	Medium to large scale industrial metrology Capture as-built conditions. Reverse Engineering	Point Cloud
Faro Laser Tracker	Laser Tracker Portable Coordinate Measurement Machine	Small to large scale industrial Metrology Inspection and Quality Control – GDT, Alignments and reverse engineering.	Discrete Points
Faro TrackerArm	Portable Coordinate Measurement Machine – touch probe and laser scanning attachment	Small to Medium manufactured part inspection and reverse engineering	Discrete Points
HDI White Light Scanner	White Light/Structured Light scanner	Medium to small metrology/reverse engineering	Point cloud/mesh
Hexagon Metrology Coordinate Measurement Machine	4.5.4 Coordinate Measurement Machine – touch probe	High quality measurements for manufactured parts or reverse engineering	Discrete Points

Metrology Equipment:

Software	Usage	
SolidWorks	3D Modeling, 3D simulation, Computational Fluid Dynamics	
AutoCAD	2D Drafting software – primarily BIM and floor plans	
Autodesk Revit	3D Architectural Modeling software – Primarily BIM	
Autodesk Inventor	3D Modeling, 3D simulation, Computational Fluid Dynamics	
Faro Scene	Point Cloud Processing software and Alignment	
Geomagic Design X	Reverse engineering – point cloud processing	
Geomagic Control	Point cloud processing/inspection	
CAM 2 Measure 10	Inspection – Laser Tracker	
Flexscan3D	Inspection/Reverse engineering – HDI white light scanner	
Kubit/Virtusurv	Plug in software for Point cloud processing in Autocad and Revit	
PC-DIMIS	CMM programming software	

Coming to the FabLab:

CT Scanner – Computed Tomography X-ray scanner for plastic parts inspection (ordered)

Instron Tensile/compression tester (new – update) (in process)

Instron Fatigue testing machine (in process)

APPENDIX D – INSTITUTIONAL SUMMARY

Programs are requested to provide the following information.

1. The Institution

a. Name and address of the institution

   Navajo Technical University
   Post Office Box 849
   Crownpoint, New Mexico 87313-0849

   (Physical Address: Lowerpoint Road, State Highway 371, Crownpoint, NM)

b. Name and title of the chief executive officer of the institution

   Dr. Elmer Guy, President of NTU

c. Name and title of the person submitting the Self-Study Report.

   Peter Romine, Associate Professor of Electrical Engineering

d. Name the organizations by which the institution is now accredited, and the dates of the initial and most recent accreditation evaluations.

2. Type of Control

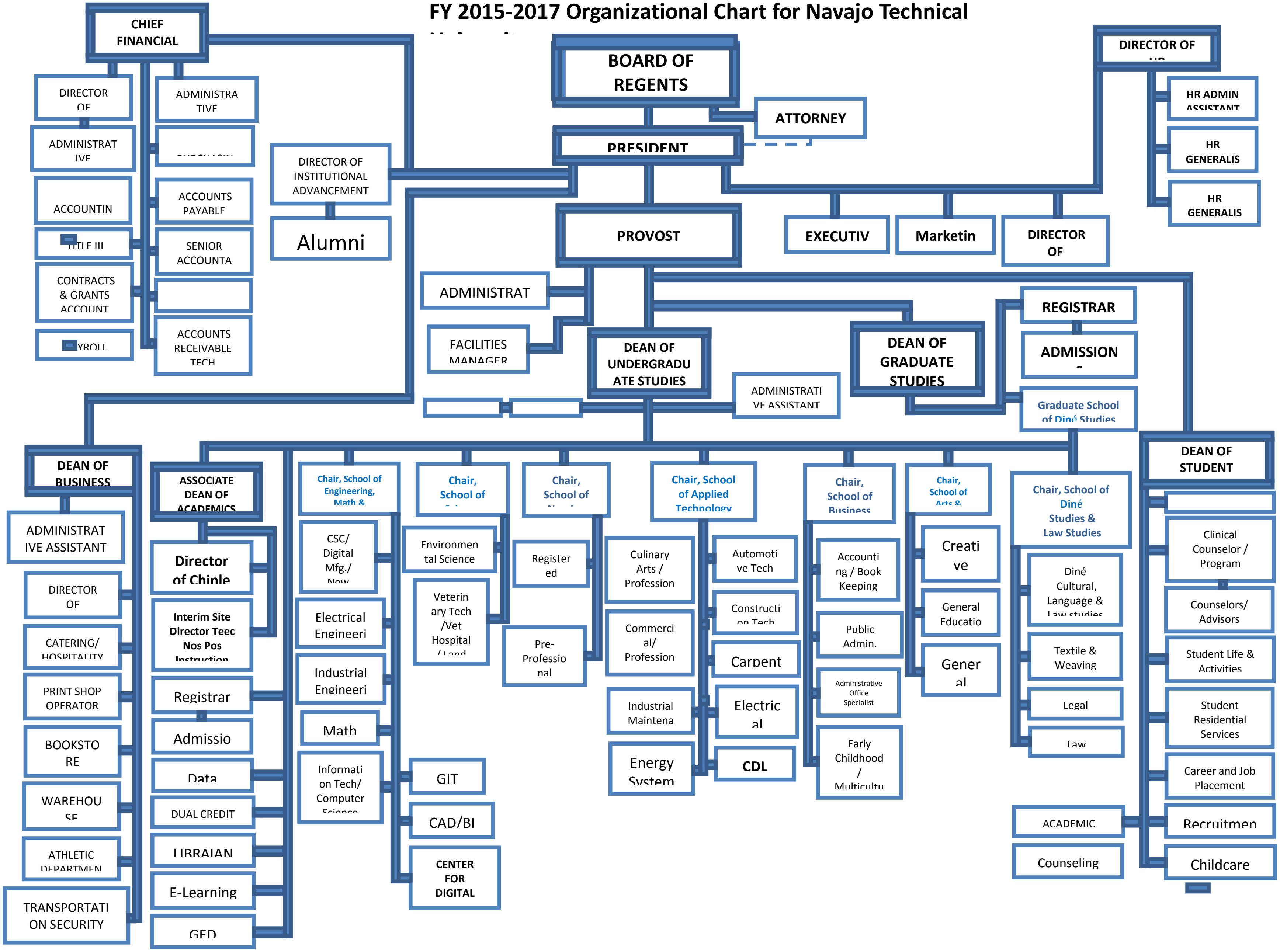
Description of the type of managerial control of the institution, e.g., private-non-profit, private-other, denominational, state, federal, public-other, etc.

NTU is a public institution owned by the Navajo Nation. It has a Board of Regents appointed by the President of the Navajo Nation with the President of the University being the executive head of the school.

3. Educational Unit

Dr. Peter Romine is supervised by the Department Chair, Gholam Ehteshami. Dr. Ehteshami is subordinated to the Dean of Instruction, Casmir Agbaraji who reports to the President of NTU, Dr. Elmer Guy. An organizational chart for the Navajo Technical University appears on the next page with the Department of Engineering, Math and Technology included.

FY 2015-2017 Organizational Chart for Navajo Technical



4. Academic Support Units

List the names and titles of the individuals responsible for each of the units that teach courses required by the program being evaluated, e.g., mathematics, physics, etc.

Instructors are categorized by the subject areas in which they teach. They may appear in more than one category and have their teaching load listed if they teach less than a full load.

Engineering Subjects:

- Dr. Peter Romine, Associate Professor of Electrical Engineering
- Dr. Bei Xie, Assistant Professor of Electrical Engineering
- Julian Boateng, Adjunct of Electrical Engineering

Computer Science Subjects:

- Dr. Frank Stomp, Associate Professor of Information Technology (Computer Science)
- Mark Trebian, Assistant Professor of Information Technology (Computer Science)

Mathematical Subjects:

- Dr. Carlos Paez-Paez, Assistant Professor of Mathematics
- Robert Nacorda, Assistant Professor of Mathematics
- Shasha Han, Assistant Professor of Mathematics

Physics:

- Ramsey Seweingyawma, Assistant Professor of Geographic Information Systems
- Dr. Abraham Meles, Assistant Professor of Physics

Chemistry:

- Dr. Thiagarajan Soundappan, Assistant Professor of Chemistry

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.

- Heather Kinalacheeny, Head of the STEAM LAB, tutoring services
- Clyde Hendersen, Head Librarian
- Coleen Arviso, Head of Online Learning and Moodle Lab
- Juanita Tom, Head of Placement Services
- Shania Gamble, Data Assessment
- Jason Arviso, Director of Development & Head of Information Technology Services

6. Credit Unit

One semester credit hour represents one class hour or three laboratory hours per week.

One academic year is composed of 30 weeks of classes, exclusive of final examinations.

7. Tables

Complete the following tables for the program undergoing evaluation.

Table D-1. Program Enrollment and Degree Data

Electrical Engineering

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
Current Year	2016/2017	FT	20	23				43		0	1	0	0
		PT	3	3				6					
1	2015/2016	FT	13	23				36		0	1	0	0
		PT	1	1				2					
2	2014/2015	FT	10	12				22		0	0	0	0
		PT	0	0				0					
3	2013/2014	FT	3	6				9		0	0	0	0
		PT	0	0				0					
4	2012/2013	FT	0	5				5		0	0	0	0
		PT	0	1				1					

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.

FT--full time
PT--part time

Note, 1st corresponds to the fall semester and 2nd corresponds to spring semester. Therefore, the 3rd, 4th and 5th columns are blank. There may be duplicate data. For example a student may have enrolled as a part-time student for the fall and also enrolled as a full-time student in the spring. That student will be count once in the 1st column as PT and once again in the 2nd column as FT.
All data shown reflects the census (3rd week) freeze data.

Table D-2. Personnel

Electrical Engineering

Year[1]: Fall 2016

	HEAD COUNT		FTE[2]
	FT	PT	
Administrative[2]	0	2	1
Faculty (tenure-track)[3]	0	0	0
Other Faculty (excluding student Assistants)	1	2	2
Student Teaching Assistants[4]	0	8	4
Technicians/Specialists	1	1	1.5
Office/Clerical Employees	0	0	0
Others[5]	/	/	/

Report data for the program being evaluated.

1. Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

2. Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

3. For faculty members, 1 FTE equals what your institution defines as a full-time load

4. For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit-hours (or 24 quarter credit-hours) per term of institutional course work, meaning all courses — science, humanities and social sciences, etc.

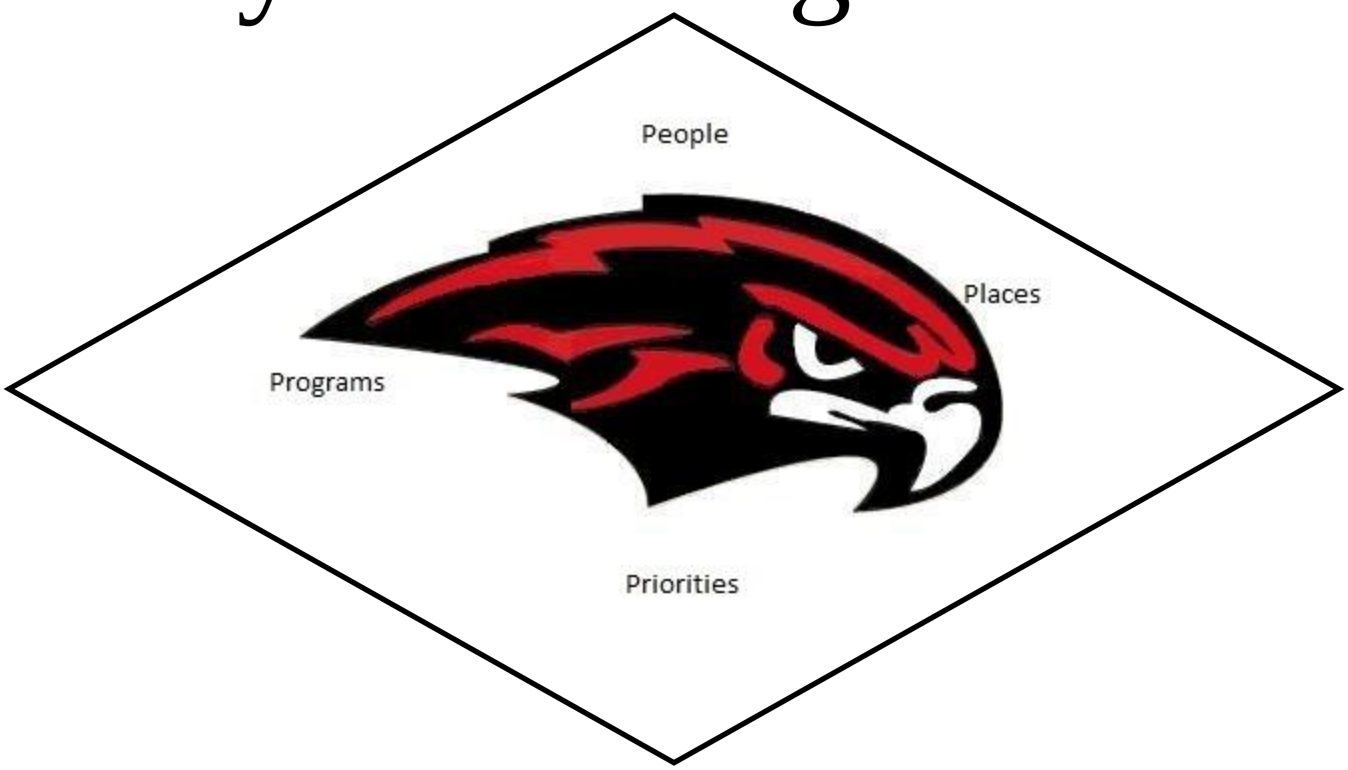
5. Specify any other category considered appropriate, or leave blank.

APPENDIX E – NTU ENGINEERING 5- YEAR STRATEGIC PLAN

Navajo Technical University

Engineering

5- year Strategic Plan



2017-2022

Crownpoint, NM

This 2017-2022 strategic plan recognizes the core values and mission of the Navajo Technical University and delineates the goals and strategies for the school of engineering.

NTU Vision, Mission and Philosophy

The vision of Navajo Technical University is to educate Navajo individuals; utilize state-of-the-art technology; and to enhance desirable character traits of integrity, self-discipline, loyalty, and respect which give the Navajo people hope, courage, and the resiliency essential to their survival as a people, using the strengths inherent in the Navajo cultural values and traditions

Navajo Technical University's mission is to provide university readiness programs, certificates, associate, baccalaureate, and graduate degrees.

Students, faculty, and staff will provide value to the Diné community through research, community engagement, service learning, and activities designed to foster cultural and environmental preservation and sustainable economic development.

The University is committed to a high quality, student-oriented, hands-on learning environment based on the Diné cultural principles: **NITSÁHÁKEES, NAHÁTÁ, IÍNA, SIIHASIN**.

Navajo Technical University believes that every student has the innate ability and intelligence to learn and acquire technical skills. Students have knowledge about their abilities and skills to enhance their personal, social, economic and cultural values. A disciplined learning environment, with innovative and viable community-based academic and vocational curricula, will produce a competent, educated, and self-reliant participant of the Navajo Nation in the world of work.

This Strategic Plan gives three strategic goals (educate, advance knowledge, and build the Navajo economy) and specific objectives to achieve these goals through actions relating to our people, programs and places. The concluding strategic roadmap provides guidance for all stakeholders.

5-year Strategic Plan

2017-2022

Engineering | Navajo Technical University

Setting the stage for excellence in engineering at Navajo Technical University

VISION

The Navajo Technical University Engineering (NTUE) aspires to educate students for business, industry, and research to create economic development and harmonious sustainment.

STRATEGIC GOALS

1. Educate engineers with the engineering skills, desire, and courage to tackle large challenges in the environment facing the Navajo Nation and the world.
2. Advance the state of knowledge and practice in engineering through graduate education and research, finding and communicating innovative solutions to challenges in the nation and the world, balanced from the basic to the applied research.
3. Educate students using hands-on training and native ways of knowing in the theories and modern tools of engineering.

OBJECTIVES

NTUE has specific objectives to achieve our goals through actions relating to:

- People
- Programs
- Places
- Priorities

PEOPLE

Our students, staff, and faculty are critical to our success.

OBJECTIVE 1

Increase student enrollment by encouraging achievement and self-confidence and increase quality by demanding high standards.

IMPERATIVES

- Plan to enroll 10 electrical engineering and 10 industrial engineering undergraduate students per year.

- Create graduate programs in industrial and electrical engineering.
- NTUE attract a broader, more diverse student population by creating and increasing student scholarships and fellowships.

ENABLERS

- To achieve a larger, more diverse student population, NTUE is vigorously engaging in high school recruitment efforts.
- NTUE will communicate and promote the fact that students can expect to find an enriching academic experience through internships, interaction with practicing engineers, service learning, and study abroad programs.
- NTUE will continue to actively develop the Navajo Technical University Engineering honors programs.
  - Alpha Pi Mu
  - Order of the Engineer
  - Eta Kappa Nu
  - Tau Beta Pi
- NTUE is increasing fellowship, research, and teaching assistantship resources for top graduate and undergraduate students.

OBJECTIVE 2

Promote academic excellence by hiring outstanding faculty.

IMPERATIVES

- NTUE will hire four additional tenure-track professors and two instructors in an effort to improve research opportunities and the academic experience.
- With the assistance of the NTU Foundation, alumni, and friends, NTUE will seek to endow five additional faculty fellowships, professorships, or chairs.

ENABLERS

- NTUE is dedicating resources to retaining current faculty and securing additional tenure track faculty and instructor lines. Some of the actions needed for this purpose:
  - More and better Faculty Housing
  - Lower teaching loads to enable research and service efforts
  - Incentives for grants and research
  - Greater collaboration opportunities for research and cross college teaching
  - Encouraging social events for all faculty and staff in the NTU Crownpoint community

OBJECTIVE 3

Hire additional staff in order to further the strategic mission.

IMPERATIVES

- NTUE plans to increase staff to support student learning, research excellence, and communications and outreach.
- NTUE plans to hire a Dean of Engineering in 2019

ENABLERS

- With a higher staff budget, NTUE plans to recruit the best staff members who can support the strategic mission of extraordinary research, education, and service.
  - Project coordinator
  - Laboratory Assistants

OBJECTIVE 4

Recruit more students from High Schools and in the Western parts of the Navajo Nation.

IMPERATIVES

- NTUE needs to spread education and opportunities to the Navajo Nation.

ENABLERS

- Expanding online and distance learning classes.
- Opportunities such as robotics outreach and maker faire type demonstrations at High Schools.

PROGRAMS

Opportunities for world-class research and enrichment.

OBJECTIVE 1

Enroll more top students to create a richer and more rewarding academic environment.

IMPERATIVES

- NTUE is promoting and developing programs with diverse and qualified students in the spirit of "engineering for a global society."

ENABLERS

- NTUE will build on programs of research and innovation, Water Quality and Uranium Remediation, and Advanced Manufacturing in order to increase student quantity and quality.
- NTUE will build on the visibility and outreach of the Advanced Manufacturing Corporation in Developing Communities to multiply the impact of its faculty and student strengths.
- NTUE will continue to work with the Navajo Center for the Environment on building research into problems of remediating effects of all kinds of pollution.

OBJECTIVE 2

Enhance research with greater activity and funding.

IMPERATIVES

- In order to improve research efforts, NTUE will establish three new research centers in areas that impact local, state, national, and global needs.

ENABLERS

- NTUE will systematically pursue large collaborative proposals by creating a standing research committee.
- NTUE will continue to create partnerships with federal, state, Navajo Nation, and Non-Government Organizations, and the industry to provide a broader funding base and greater opportunities.
- NTUE will urge Navajo Technical University to create an Office of Grants and Research to put enablers in place for faculty.

OBJECTIVE 3

Improve the student experience by creating innovative enrichment experiences.

IMPERATIVES

- As part of NTUE, every student will have the opportunity to participate in at least one major enrichment experience, including internships, discovery learning, service learning, or study abroad.

ENABLERS

- For a more valuable student experience, NTUE will implement a formal and self-sustaining undergraduate internship program.

  NTUE will encourage Navajo Technical University to create an office of co-ops and internship.

PLACES

Showcase NTUE across campus' and around the world.

OBJECTIVE 1

NTUE will broaden its research efforts as it takes on international research and educational collaborations

IMPERATIVES

- For improved research, NTUE is committed to establishing and sustaining three national and international research or education relationships.

ENABLERS

- NTUE will better support an international degree designator by creating formal relationships with universities and the NTUE administrative structure,
- NTUE intends to explore new opportunities by promoting established graduate exchange programs in Canada and Mexico.
- NTUE plans to distribute incentives and rewards to faculty members who actively promote nationalization.

OBJECTIVE 2

Continuously improve laboratory and instructional facilities.

IMPERATIVES

- Laboratory space will be expanded to accommodate teaching and research programs for the enhancement of the overall academic and research experiences.
- NTUE strives to enhance the quality of graduate and undergraduate facilities by working with the university to increase the undergraduate classroom space and graduate student research space.

ENABLERS

- Secure additional funds to fulfill NTUE building and space improvement plans.
- Establish minimum standards for laboratory safety, security and quality.
- Sensor, instrumentation, chemical and water filtering process automation/control are opportunistic areas that NTUE research is nearing.
- Work with Navajo Nation Economic Development Council to build a Manufacturing Center.
- Build a Metrology Center. (In progress)

OBJECTIVE 3

Expand the Navajo Center for the Environment to give students a more valuable educational experience.

IMPERATIVES

- NTUE will support the improved/increased sustainable infrastructure program by providing faculty resources for new and exciting experiences in the environmental field.
- NTUE will develop a second Center of Excellence in manufacturing to allow students to explore the production of parts and assemblies for commercial purposes and to allow students to work on entrepreneurial activities.

ENABLERS

- Inspired faculty members will be responsible for promoting the second Center of Excellence. Work with Navajo Nation Economic Development Council to build a Manufacturing Center.
- Work with Navajo Nation Economic Development Council to build a Manufacturing Center.

PRIORITIES

Endowment fund for engineering and technology.

IMPERATIVES

- NTUE and the Advisory Board will identify opportunities to create an endowment fund to ensure that it's work will be able to continue whatever the vagaries of the general economic situation may be.
- NTUE will develop a second Center of Excellence in manufacturing to allow students to explore the production of parts and assemblies for commercial purposes and to allow students to work on entrepreneurial activities.

ENABLERS

- The Dean of Engineering, Faculty and Advisory Board members will pursue grants from foundations and individuals to build an adequate endowment fund to sustain NTUE facilities, faculty and staff.

STRATEGIC ROADMAP

The NTUE aspires to lead in extraordinary education and research for the sustainable development, management and safety of engineering systems — serving society in harmony with our natural resources.

ENABLERS AND PREREQUISITES

PEOPLE

- Engage in high school recruitment efforts.
- Establish an Engineering Honors program.
- Establish industrial engineering professional society student chapters.
- Establish Institute of Environmental Professionals student chapter.
- Enrich student academic experience through internships, interaction with practicing engineers, and study abroad programs.
- Increase fellowship, research, and teaching assistantship resources.
- Retain current faculty and secure additional tenure-track faculty and instructor lines.
- Increase staff budget.
- Establish a professional development center for faculty.
- Establish career counseling and placement office for students in engineering.

PROGRAM

- Build on successes of Advanced Manufacturing and Metrology Center to increase student quantity and quality.
- Retain Accreditation for Industrial and Electrical engineering.
- Develop ABET Accreditation for Computer Science and Chemical Engineering programs.
- Establish a standing research committee to systematically pursue large collaborative proposals.
- Establish a Master's of Science (M.S.) for industrial and electrical engineering.
- Establish Computer Science and Chemical Engineering Programs
- Create Environmental Engineering Program in conjunction with the Navajo Center for the Environment.
- Craft partnerships with federal, state, Navajo Nation, and Non-Government Organizations, and industry to broaden our funding base.
- Build on funding success with federal research agencies, such as the Department of Energy or DOD.
- Implement a formal and self-sustaining undergraduate internship program.
- Establish a Grant Writing support program.

PLACES

- Procure funding to fulfill NTUE building plans necessary to fulfill activities described herein.
- Identify faculty members to champion second Center of Excellence.
- Establish Materials Science Lab.

- Establish Human Factors/Ergonomics Lab.
- Establish NTU Navajo Center for the Environment.
- Establish a research, grant and contract office.

PRIORITIES

- Create an endowment fund for engineering and technology programs.
- Expand environmental programs
- Expand manufacturing programs

STRATEGIC GOALS AND IMPERATIVES

PEOPLE

- Increase enrollment of NTU undergraduate students with above-average quality metrics in the college and among our peers.
- Increase student scholarships and fellowships.
- Increase faculty by four tenure-track professors and two instructors.
- Endow five additional faculty fellowships, professorships, or chairs.
- Increase staff to have greater support and guidance for students working on projects and research.

PROGRAM

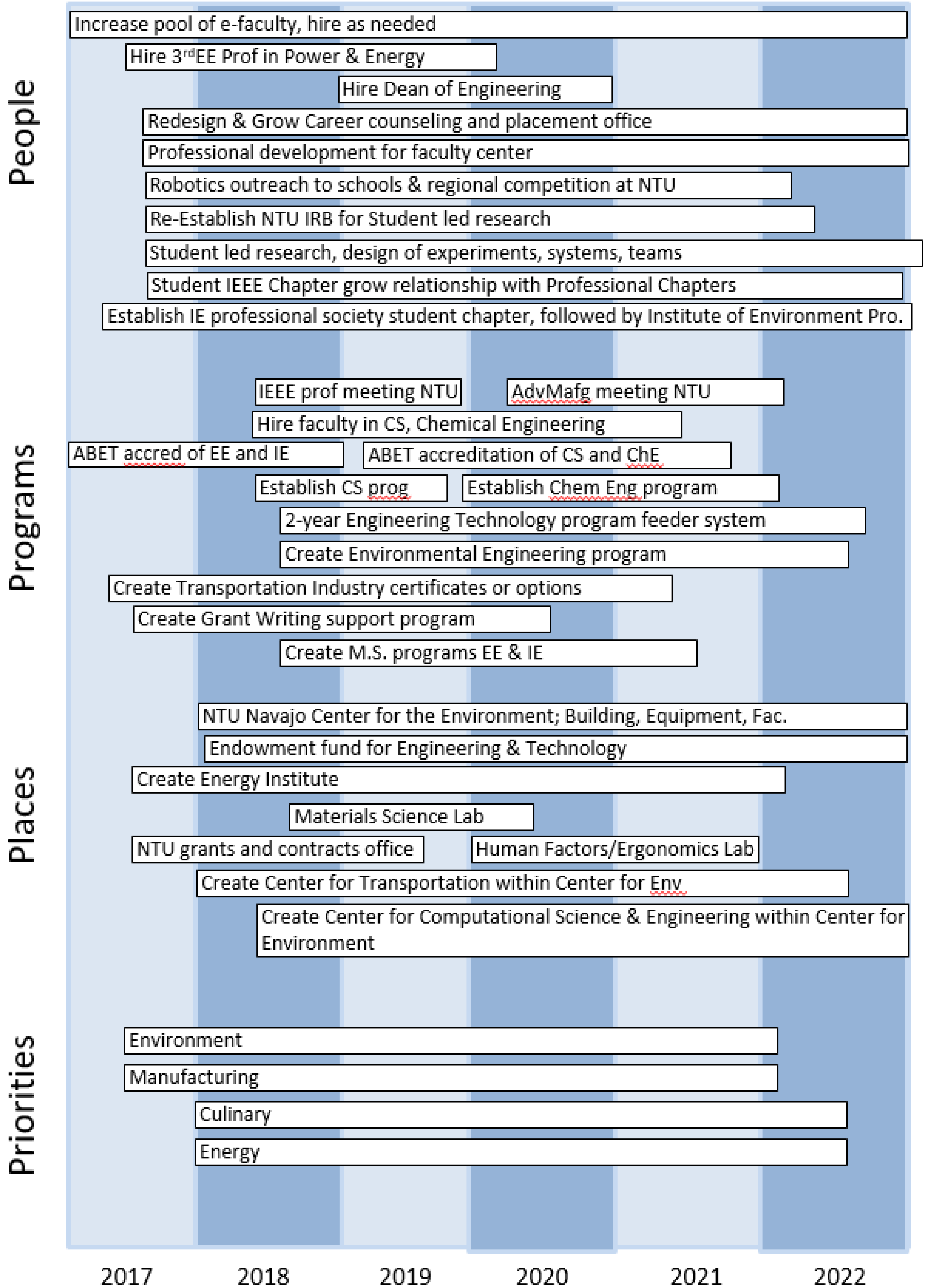
- Promote and develop programs in the spirit of "engineering for a global society."
- Establish three new research centers in areas that impact local, state, national, and global needs.
- Enable every student to participate in at least one major enrichment experience (internship, discovery learning, service learning, and/or study abroad).
- Develop sustainable and diverse funding for NTU engineering programs

PLACES

- Establish and sustain three international research and/or education relationships.
- Expand laboratory space for teaching and research programs.
- Industrial Engineering (IE) program greatly increase connection between curriculum, fabrication lab, and advanced manufacturing programs.
- Enhance the quality of graduate and undergraduate facilities.
- Develop a second Center of Excellence for Manufacturing.

PRIORITIES

- Enhance the endowment fund
- Expand environmental programs
- Expand manufacturing programs


People
Increase pool of e-faculty, hire as needed
Hire 3rd EE Prof in Power & Energy
Hire Dean of Engineering
Redesign & Grow Career counseling and placement office
Professional development for faculty center
Robotics outreach to schools & regional competition at NTU
Re-Establish NTU IRB for Student led research
Student led research, design of experiments, systems, teams
Student IEEE Chapter grow relationship with Professional Chapters
Establish IE professional society student chapter, followed by Institute of Environment Pro.
Programs
IEEE prof meeting NTU
AdvMafg meeting NTU
Hire faculty in CS, Chemical Engineering
ABET accred of EE and IE
ABET accreditation of CS and ChE
Establish CS prog
Establish Chem Eng program
2-year Engineering Technology program feeder system
Create Environmental Engineering program
Create Transportation Industry certificates or options
Create Grant Writing support program
Create M.S. programs EE & IE
Places
NTU Navajo Center for the Environment; Building, Equipment, Fac.
Endowment fund for Engineering & Technology
Create Energy Institute
Materials Science Lab
NTU grants and contracts office
Human Factors/Ergonomics Lab
Create Center for Transportation within Center for Env
Create Center for Computational Science & Engineering within Center for Environment
Priorities
Environment
Manufacturing
Culinary
Energy
2017
2018
2019
2020
2021
2022

Signature Attesting to Compliance

By signing below, I attest to the following:

That **Electrical Engineering** 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 Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual*.

Casmir Agbaraji, PhD
Dean's Name (As indicated on the RFE)

______________________ ______________________

Signature **Date**