ABET
Self-Study Report

for the

Industrial Engineering Program

at

Navajo Technical University

Crownpoint, New Mexico

July 1, 2017

CONFIDENTIAL

CONTENTS

Industrial Engineering Program Self-Study Report
for
EAC of ABET
Accreditation

BACKGROUND INFORMATION

A. Contact Information

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B. Program History

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. Subsequently the name was changed to Navajo Technical College in 2006 and to Navajo Technical University in 2013 when our first graduate program was inaugurated in Diné (Navajo) studies. The NTU Industrial Engineering program started in the spring of 2012 with one Instructor, our present Dean of Instruction Dr. Casmir Agbaraji. We now have our first three graduates, one graduating in Fall of 2015, one graduating in Spring of 2016 and one in Fall of 2016. One more graduate is anticipated in Summer 2017, one in Fall 2017 and another in Spring 2018. This will be our first general review and are requesting that this review be retroactive by two years as allowed under ABET rules. All previous graduates have been made aware of deficiencies under ABET rules of their previously awarded degrees and told how to rectify that. We have had some slight changes of curriculum since the program was originally going to be launched as a Mechanical Engineering program and have incorporated more Industrial Engineering specific courses with a few curriculum changes. A curriculum revision was done in Spring of 2016 to bring the program into better alignment with ABET guidelines. No further changes are contemplated a this time except to begin requiring students take the FE exam for further assessment and to allow 'Special Topics' courses to occasionally be offered.

C. Options

At the moment there is only one track for Industrial Engineering, a Bachelor's of Science in Industrial Engineering. 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 purpose of the Pre-engineering Certificate program was to allow high school students to take some of the early engineering courses they would need to start in the Industrial Engineering program, the Electrical Engineering program or to start an engineering program at another school. Currently, we are creating an Associate's Degree in Engineering Technology to introduce a 2 + 3 program, where students would take courses from the Industrial Engineering, Electrical Engineering and Advanced Manufacturing Technology programs along with General Education classes. This will allow students who are interested in engineering and technology to be able to sample the different programs available prior to their choosing one or create credits that would be transferrable to other colleges which have programs that the students would like to study. It would also still fulfill the goal of preparing students who would like to study engineering at another school.

D. Program Delivery Modes

The present delivery methodology is slanted heavily toward traditional lecture/laboratory methods with most engineering classes only offered 8 AM-5 PM Monday through Friday. This reflects the reality of a small faculty and the fact that many students have to use the Navajo Transit System or other modes of transportation. The Navajo Transit System which effectively leaves students at the Crownpoint campus before 8:00 A.M. and picks them up after 5:00 P.M. on Monday through Thursday. Friday classes are sometimes difficult to organize because of the lack of public transportation availability on that day.

In the Fall of 2017, NTU is planning to offer engineering classes by Distance Learning methodology and to have more online classes. Once the distance education program is fully implemented, students can enroll at NTU from off-campus computer labs at area high schools or industrial concerns or at home for at least the first two years of classes. We are hoping to have our first home-grown Distance Learning (Virtual Presence) classes, ENGR-103 Introduction to Engineering and ENGR-123 Computer Skills for Engineers in Fall of 2017.

E. Program Locations

Utilizing an NSF grant we are planning to be able to offer some of the IE 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, Pre-engineering and Industrial Maintenance. Eventually this will also be offered at the

Teec Nos Pos campus, but before that is possible 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/industrial-engineering

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

The IE 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 IE Program has graduated two BSIE majors in May 2015 and December of 2015 with two anticipated in August of 2017 and two in December of 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 Industrial Engineering (IE) 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 Industrial 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 Industrial Engineering classes at any time since some other programs require classes that are taught within the IE 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. Mr. Whiting is the only official Industrial Engineering (IE) advisor for all industrial engineering students. However the new Industrial Engineering Professor hired in the summer of 2017 will also be an official advisor. Some students come to Mr. Whiting 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. Mr. Whiting also advises students on career paths and plans; his experience in Industry as an engineer, manager, and consultant helps 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 Industrial 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 of Science in Industrial Engineering (BSIE) requires **123** 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.

- General Education Requirements: 19 Credits
  - ENG-110: Freshman Composition (3); NAV-101 or 201: Navajo Language (4); HUM-170: History of Native Americans in Media (3); ENG-111: Composition & Research (3); HST-211: Am. Hist. 1877 to present (3); COM-130: Public Speaking (3)
- Mathematics and Sciences: 32 Credits
  - MTH-162: Calculus I (4); ENGR-169: Basic Statistics and Probability (3); MTH-163: Calculus II (4); CHM-120: General Chemistry I (4); ENGR-236: Inferential Engineering Statistics (3); PHY-111: Algebra-Based Physics (4); MTH-410: Linear Algebra (3); MTH-310: Differential Equations (4); IE-363: Design of Experiments (3)
- Engineering Design: 51 credits
  - ENGR-103: Introduction to Engineering (3); IE-235: Lean Production (3); IE-223: Design & Manufacturing Processes I (3); ME-345: Statics (3); ENGR-313: Engineering Economics (3); ME-353: Fluid Mechanics (3); IE-323: Human Factors in Product Design (3); IE-343: Design & Manufacturing Processes II (3); IE-380: Project Management (3); ME-354: Thermodynamics (3); IE-413: Quality Control (3); IE-433: Metrology & Instrumentation (3); IE-453 Engineering Optimization (3); IE-424: Capstone (3); IE-463: Facility Planning & Design (3);

IE-473: Inventory Control & Production Plan (3); IE-494: System Simulation (3); and Technical Elective (3)

- Core IE Requirements: 18 Credits
    - ENGR-123:Computer Skills for Engineering (3); IT-105: Introduction to Programming (3); ENGR-130: Engineering Graphics (3); ENGR-143: Characteristics of Engineering Materials (3); ENGR-230: Advanced Engineering Graphics (3); and IE-312: Summer Internship (3)
- Technical Electives: 3 Credits selected from the following:
    - AMT-311: Laser Scanning Methods (3); AMT-370: Robotics & Offline Programming (3); IE-483: Rapid Prototyping (3); PHY-121: Calculus Based Physics (3); and Special Topics in IE or Course approved by advisor (3)

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 current 2016 degree checklist is included below:

Navajo Technical University

Industrial Engineering-BSIE Degree Program as of Fall 2016

Student:____________________________________ **ID Number:**____

Advisor:_____________________________________ **Catalog Year Entered:**________________________________

Educational Requirements	Credit	Prerequisites	Semester/Year	Grade
Semester 1:	**16**			
ENGR-123: Computer Skills for Engineering	3			
ENG-110: Freshman Composition	3			
MTH-162: Calculus I	4	*MTH-121/MTH-123*		
IT-105: Introduction to Programming	3			
ENGR-103: Introduction to Engineering	3			
Semester 2:	**16**			
NAV-101 or 201: Navajo Language	4			
HUM-170: History of Native Americans in Media	3			
ENGR-130: Engineering Graphics	3			
ENGR-169 Basic Statistics and Probability	3			
ENGR-143: Characteristics of Engineering Mat'ls	3			
Semester 3:	**17**			
MTH-163: Calculus II	4	*MTH-162*		
CHM-120: General Chemistry I	4	*MTH-120*		
ENG-111: Composition & Research	3	*ENG-110*		
ENGR-230: Advanced Engineering Graphics	3	*ENGR-130*		
ENGR-236: Inferential Engineering Statistics	3	*ENGR-169*		
Semester 4:	**13**			
HST-211: Am. Hist. 1877 to present	3			
PHY-111: Algebra-Based Physics	4			
IE-235: Lean Production	3			
COM-130: Public Speaking	3			
Semester 5:	**12**			
IE-223: Design & Manufacturing Processes I	3	*ENGR-143*		
ME-345: Statics	3	*MTH-123*		
MTH-410 Linear Algebra	3			
ENGR-313: Engineering Economics	3			
Semester 6:	**16**			
MTH-310: Differential Equations	4	*MTH-163*		
ME-353: Fluid Mechanics	3	*PHY-111 & MTH-163*		
IE-323: Human Factors in Product Design	3	*ENGR-236*		
IE-343: Design & Manufacturing Processes II	3	*ENGR-143*		
IE-363: Design of Experiments	3	*ENGR-236*		
Semester 7:	**15**			
IE-380: Project Management	3	*Junior Standing*		
ME-354: Thermodynamics	3	*PHY-111/MTH-162*		
IE-413: Quality Control	3	*IE-363*		
IE-433: Metrology & Instrumentation	3			
IE-453: Engineering Optimization	3	*ENGR-236*		
Semester 8:	**15**			
IE-424: Capstone	3	*IE-380 or ITS-280*		
IE-463: Facility Planning & Design	3	*ENGR 313*		
IE-473: Inventory Control & Production Plan	3	*ENGR 313*		
IE-494: System Simulation	3	*ENGR-236*		
Technical Elective	3	*Approved by Advisor*		
Summer Semester:	**3**			
IE-312: Summer Internship	3			
Total Credit Hours required for degree is:	**123**			

Technical Electives: AMT-311 Laser Scanning Methods; AMT-370 Robotics & Offline Programming; IE-483 Rapid Prototyping, PHY-121 Calculus Based Physics, Special Topics in IE or Courses approved by advisor

	Signatures	Date
Student:		
Advisor:		
Registrar:		

This checklist is to be used as information and NTU reserves the right to change at any time without notification.

G. Transcripts of Recent Graduates

The program will provide unofficial transcripts of program graduates to date. A transcript from our first ABET eligible student is included in the application package with instructions to interpret it and a checklist to show attainment of ABET goals.

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).

Industrial Engineering Mission Statement:
The mission of the Industrial 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/industrial-engineering

Our industrial 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 Industrial Engineering program fulfills the first portion of the mission of Navajo Technical University by providing the baccalaureate program B.S.I.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 IE 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 IE program will encourage membership and participation of graduates in the Alumni group which will serve to represent this constituency.

Employers of NTU IE Graduates

Employers from across the United States will learn to find NTU as a source of well qualified Native American Industrial Engineers to help address the extreme shortage present in the work force. We have been working with Arizona Public Service (utility) and the Dine Raytheon facility, both of whom 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 will not 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 every three years. We have made an alumni survey to be used and expect to launch that next year (Spring 2018) when we will have a more representative sample of graduates. 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	Twice annually at EAB	Employers, industrial

discussions	meetings	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

Formerly the NTU IE program had its own student outcomes, but these were changed to the ABET a-k student outcomes since there was only a difference in the way they were worded. Every semester, the program is evaluated in terms of its attainment of the established student outcomes. Results of this periodic assessment (i.e., ABET evaluation) will be used as inputs in Educational Planning and Programming at NTU. These student outcomes, with their associated ABET criterion, are shown below.

(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

We have linked these student outcomes to performance indicators as given in Table 3.A.1 below.

Table 3.A.1 Performance Indicators linked to Assessment of Student Outcomes

a-k	Student	Performance Indicators
a	An ability to apply knowledge of mathematics, science, and engineering	1. Chooses a mathematical model of a system or process appropriate for required accuracy 2. Applies mathematical principles to achieve analytical or numerical solution to model equations 3. 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	1. Observes good lab practice and operates instrumentation with ease 2. Determines data that are appropriate to collect and selects appropriate equipment, protocols, etc. for measuring the appropriate variables to get required data 3. 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	1. Produces a clear and unambiguous needs statement in a design project 2. Identifies constraints on the design problem, and establishes criteria for acceptability and desirability of solutions 3. Carries solution through to the most economic/desirable solution and justifies the approach
d	An ability to function on multi-disciplinary teams	1. Recognizes participant roles in a team setting and fulfills appropriate roles to assure team success 2. Integrates input from all team members and makes decisions in relation to objective criteria 3. Improves communication among teammates and asks for feedback and uses suggestions
e	An ability to identify, formulate, and solve engineering problems	1. Problem statement shows understanding of the problem 2. Solution procedure and methods are defined. 3. Problem solution is appropriate and within reasonable constraints

f	An understanding of professional and ethical responsibility	1. Knows code of ethics for the discipline 2. Able to evaluate the ethical dimensions of a problem in the discipline
g	An ability to communicate effectively	1. Writing conforms to appropriate technical style format appropriate to the audience 2. Appropriate use of graphics 3. Mechanics and grammar are appropriate 4. 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	1. Evaluates conflicting/competing social values in order to make informed decisions about an engineering solution. 2. Evaluates and analyzes the economics of an engineering problem solution 3. 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	1. Expresses an awareness that education is continuous after graduation 2. Able to find information relevant to problem solution without guidance
j	A knowledge of contemporary issues	1. Identifies the current critical issues confronting the discipline 2. 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.	1. Selects appropriate techniques and tools for a specific engineering task and compares results with results from alternative tools or techniques 2. Uses computer-based and other resources effectively in assignments and projects

B. Relationship of Student Outcomes to Program Educational Objectives

The 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	**X**		

economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability			
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		**X**	

life-long learning			
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 4.A.

A. Student Outcomes

The evaluation of and degree to which the learning outcomes for the Industrial 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.10.

Satisfactory Performance is indicated by achieving 80 to 90% scoring on Figures 4.A.1 through 4.A.10.

Learning Performance is indicated by 60 to 70% scoring on Figures 4.A.1 through 4.A.10.

Performance Needing Improvement is indicated by anything below 60% scoring on Figures 4.A.1 through 4.A.10.

Table 4.A.1 is a summary of the Industrial 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 IE program.

Table 4.A.1. Summary of Industrial 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 Six Year Program Level Assessment Plan for Industrial Engineering Program						
	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.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 and in what years. This is true for all classes except Capstone, where we will try to be able to measure all Student Outcomes every time the class is held. All other courses we expect to measure a maximum of four outcomes per class with three outcomes being usual.

Table 4.A.3 Student Outcome Measurement in Specific Industrial Engineering Courses

Student Outcomes:	a	b	c	d	e	f	g	h	i	j	k
ENGR-123: Computer Skills for Engineering							2017/2020		2018/2021		2019/2022
ENGR-103: Introduction to Engineering	2019/2022			2017/2020		2017/2020					
ENGR-130: Engineering Graphics	2019/2022						2017/2020				2019/2022
ENGR-169 Basic Statistics and Probability	2019/2022	2019/2022		2017/2020							
ENGR-143: Characteristics of Engineering Mat'ls	2019/2022				2019/2022						
ENGR-230: Advanced Engineering Graphics	2019/2022						2017/2020				2019/2022
ENGR-236: Inferential Engineering Statistics		2019/2022			2019/2022		2017/2020				2019/2022
IE-223: Design & Manufacturing Processes I			2018/2021		2019/2022			2018/2021			
IE-235 Lean Production			2018/2021					2018/2021		2018/2021	
ME-345: Statics			2018/2021		2019/2022						
ENGR-313: Engineering Economics			2018/2021		2019/2022		2017/2020				2019/2022
ME-353: Fluid Mechanics	2019/2022				2019/2022						2019/2022
IE-323: Human Factors in Product Design	2019/2022		2018/2021					2018/2021			2019/2022
IE-343: Design & Manufacturing Processes II			2018/2021		2019/2021			2018/2022			
IE-380: Project Management						2017/2020	2017/2020		2018/2021	2018/2021	
ME-354: Thermodynamics	2019/2022				2019/2022						
IE-413: Quality Control			2018/2021		2019/2022						2019/2022
IE-433: Metrology & Instrumentation	2019/2022			2017/2020							2019/2022
IE-453: Engineering Optimization			2018/2021		2019/2022						2019/2022
IE-424: Capstone	2019/2022	2019/2022	2018/2021	2017/2020	2019/2022	2017/2020	2017/2020	2018/2021	2018/2021	2018/2021	2019/2022
IE-463: Facility Planning & Design			2018/2021				2017/2020	2018/2021			
IE-473: Inventory Control & Production Plan			2018/2021		2019/2022						2019/2022
IE-494: System Simulation		2019/2022	2018/2021				2017/2020				2019/2022

Each outcome has been mapped to the industrial engineering courses where it is measured and is depicted in Table 4.A.3. This map is used to make decisions about where the summative data is collected.

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	X	X	X	X
Evaluate assessment data including processes	X			X		
Report findings	X	X	X	X	X	X
Take action where necessary	X	X	X	X	X	X

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

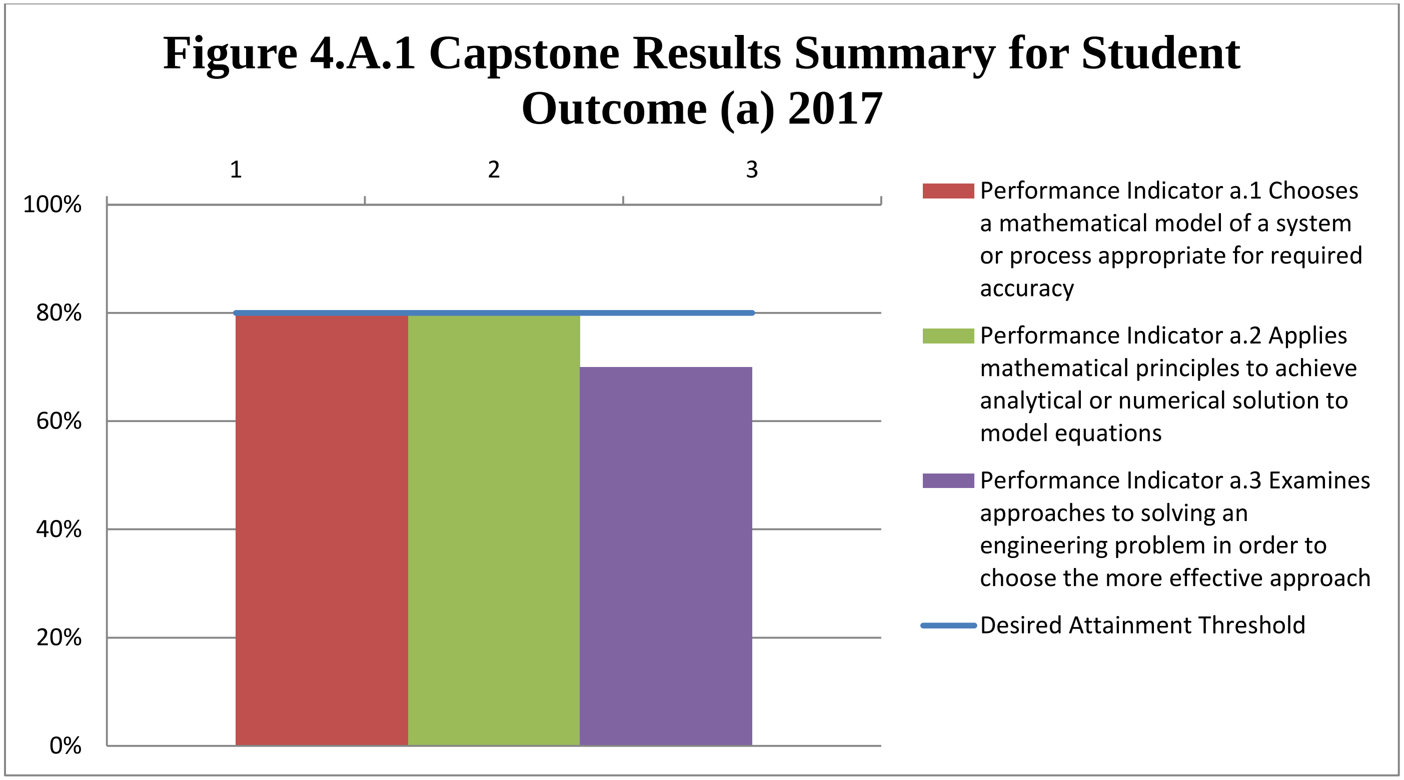
Results for each student outcome are reported in tables like the example for student outcome a in Table 4.A.5 These tables are completed as far as possible, but incomplete records from assessment in past years and poor evaluation techniques previously used limit their value. All supporting documentation 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 IE 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.

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

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) of data collection**	**Target**
Chooses a mathematical model of a system or process appropriate for required accuracy	ENGR-103; ENGR-130; ENGR-169; ENGR-143; ENGR-230; ME-353; IE-323; ME-354; IE-433; IE-424	Quiz, Test and Homework problems, Course Projects, Final Design Project Report (Rubric)	IE 424	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	ENGR-103; ENGR-130; ENGR-169; ENGR-143; ENGR-230; ME-353; IE-323; ME-354; IE-433; IE-424	Quiz, Test and Homework problems, Course Projects, Final Design Project Report (Rubric)	IE 424	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	ENGR-103; ENGR-130; ENGR-169; ENGR-143; ENGR-230; ME-353; IE-323; ME-354; IE-433; IE-424	Quiz, Test and Homework problems, Course Projects, Final Design Project Report (Rubric)	IE 424	3 years	2019, 2022 for all listed classes but Capstone where attempt to collect	80%

effective approach					every year is made	

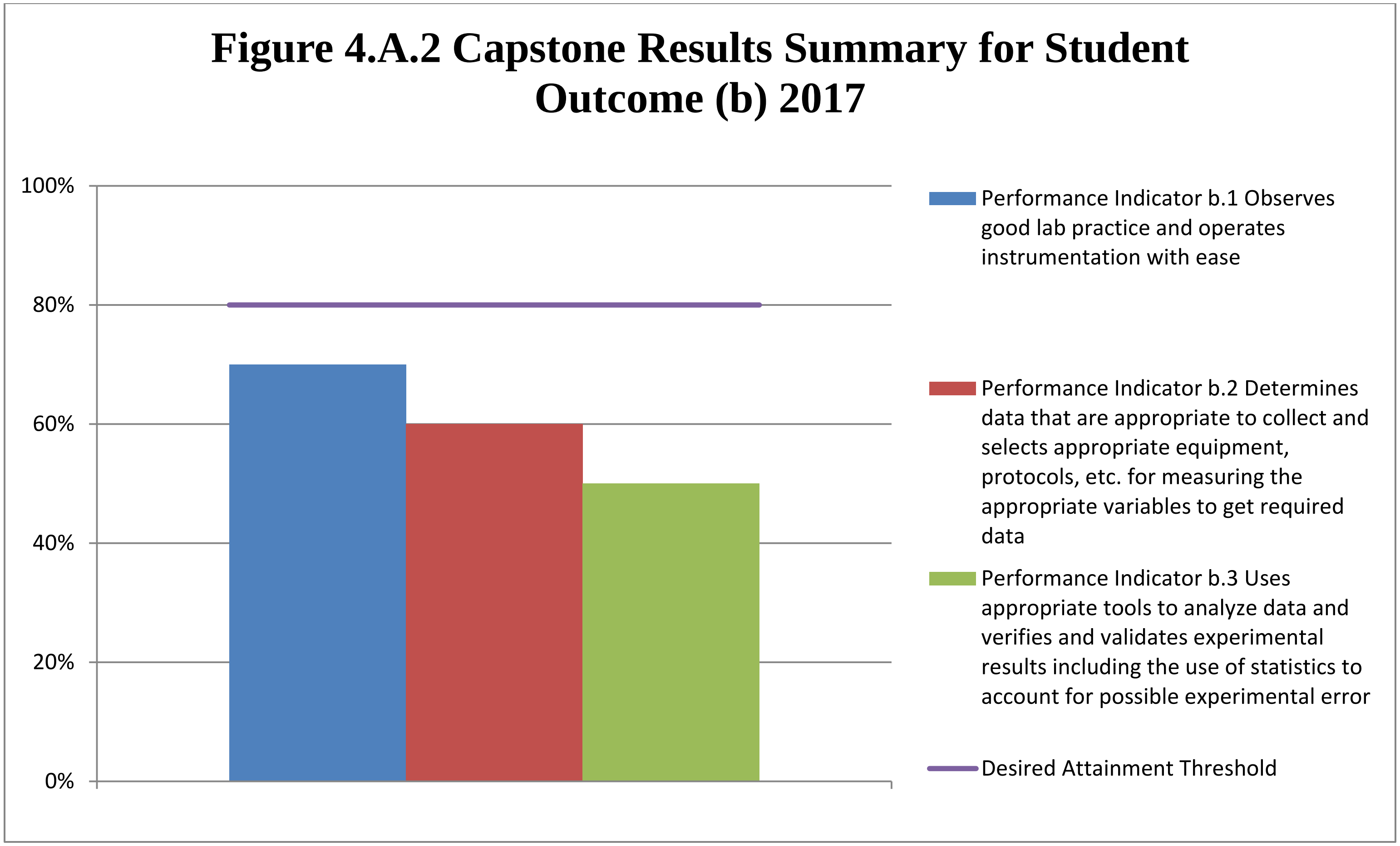


Assessment Results Summary (2017): The results from Capstone show that students were in satisfactory level (80%) for Indicators a.1 and a.2, and students achieved learning level (70%) for Indicator a.3.

Evaluation and Actions (2017): Evaluation was performed during the Assessment Workshop on May 15 & 16. The department will ask faculty members to improve students learning related to 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) of data collection**	**Target**
Observes good lab practice and operates instrumentation with ease	ENGR-169; ENGR-236; IE-424; IE-494	Faculty developed examination	IE-424	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	ENGR-169; ENGR-236; IE-424; IE-494	Faculty developed examination	IE-424	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	ENGR-169; ENGR-236; IE-424; IE-494	Quiz, Test and Homework problems, Course Projects, Final Design Project Report (Rubric)	IE-424	3 years	2019, 2022 for all listed classes but Capstone where attempt to collect every year is made	80%

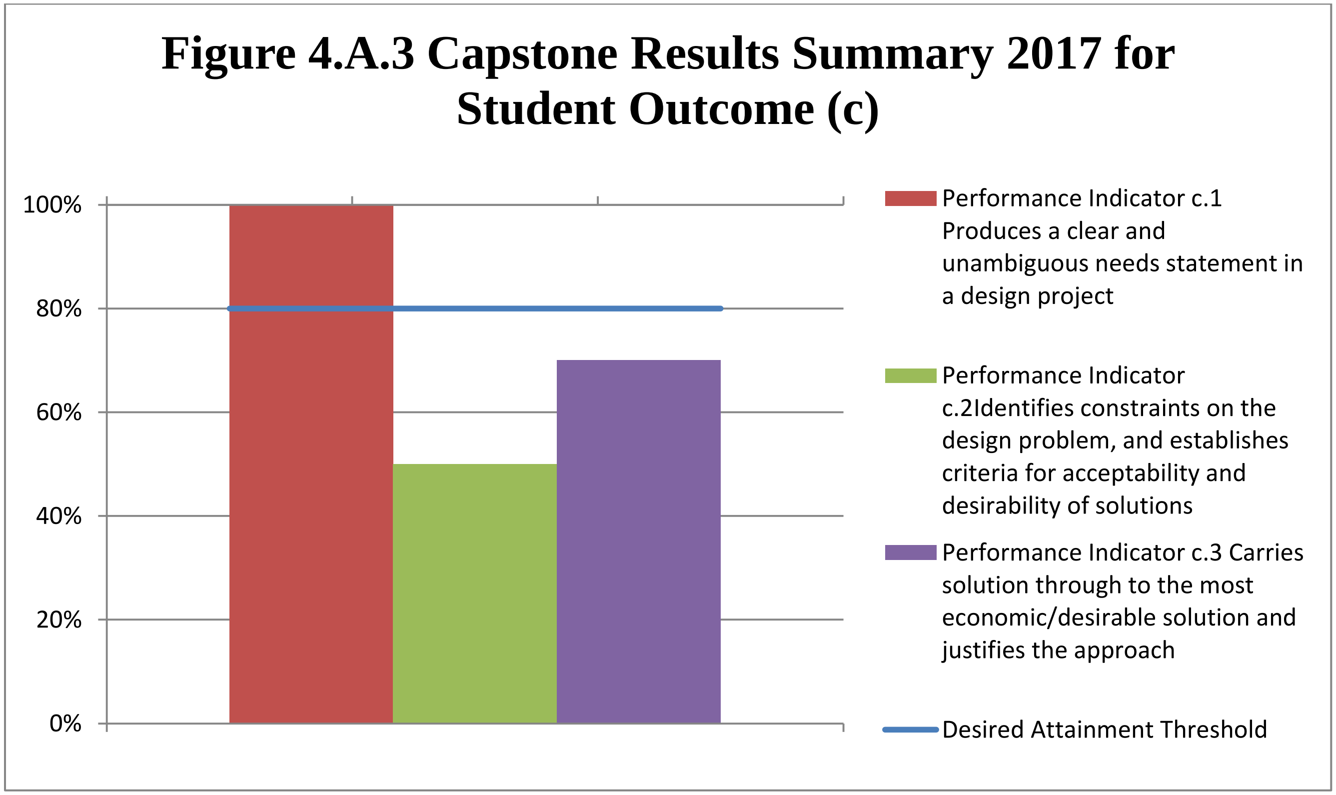


Assessment Results Summary (2017): The Capstone results are not satisfactory for Indicators b.1, b.2 or b.3. Students achieved learning level for Indicators b.1 (60%), and b.3 (70%) and only needs improvement level for b.2 (50%).

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**
Produces a clear and unambiguous needs statement in a design project	IE-223; IE-235; ME-345; ENGR-313; IE-323; IE-343; IE-413; IE-453; IE-424; IE-463; IE-473; IE-494	Final Design Project (Rubric)	IE-424	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	IE-223; IE-235; ME-345; ENGR-313; IE-323; IE-343; IE-413; IE-453; IE-424; IE-463; IE-473; IE-494	Final Design Project (Rubric)	IE-424	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	IE-223; IE-235; ME-345; ENGR-313; IE-323; IE-343; IE-413; IE-453;	Final Design Project (Rubric)	IE-424	3 years	2018, 2021 for all listed classes but Capstone where	80%

	IE-424; IE-463; IE-473; IE-494				attempt to collect every year is made	



<u>Assessment Results Summary (2017):</u> 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 level for c.3 (70%).

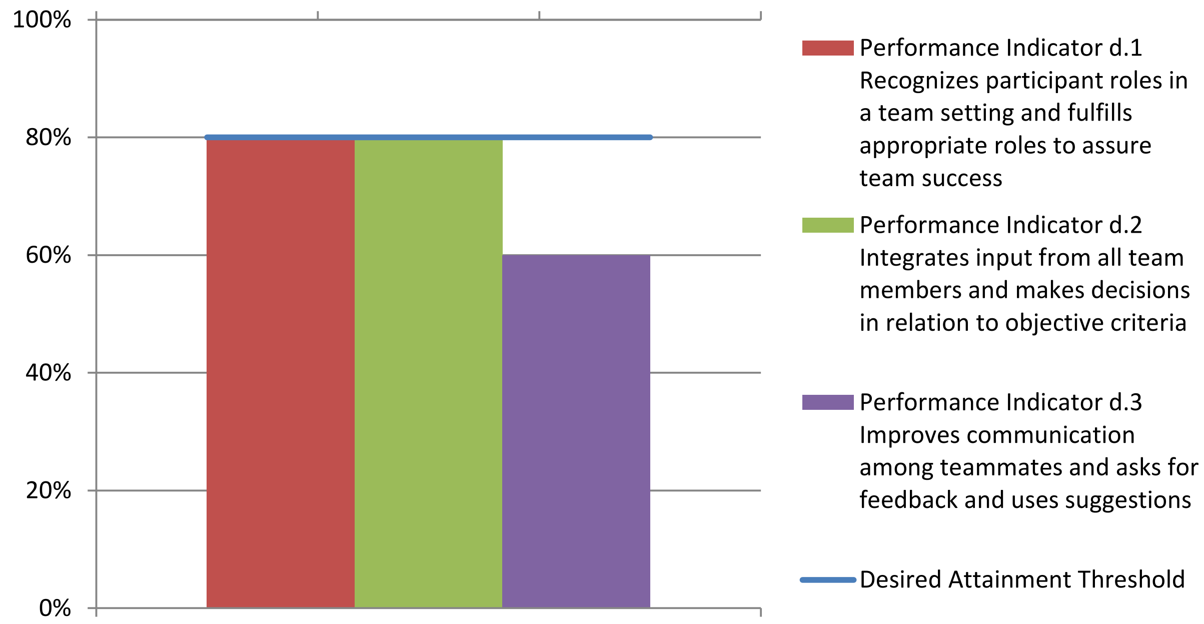
<u>Evaluation and Actions (2017):</u> Evaluation was performed during the Assessment Workshop on May 15 & 16. The department will ask faculty to improve student learning related to these Indicators. It was decided to work with Faculty on identifying constraints and justification on economic and desirability 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
Recognizes participant roles in a team setting and fulfills appropriate roles to assure team success	ENGR-103; IE-424	Faculty Observation, Design Projects and Faculty developed exam	IE-424	3 years	2017/2020 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; IE-424	Faculty Observation, Design Projects and Faculty developed exam	IE-424	3 years	2017/2020 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; IE-424	Faculty Observation, Design Projects and Faculty developed exam	IE-424	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%

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

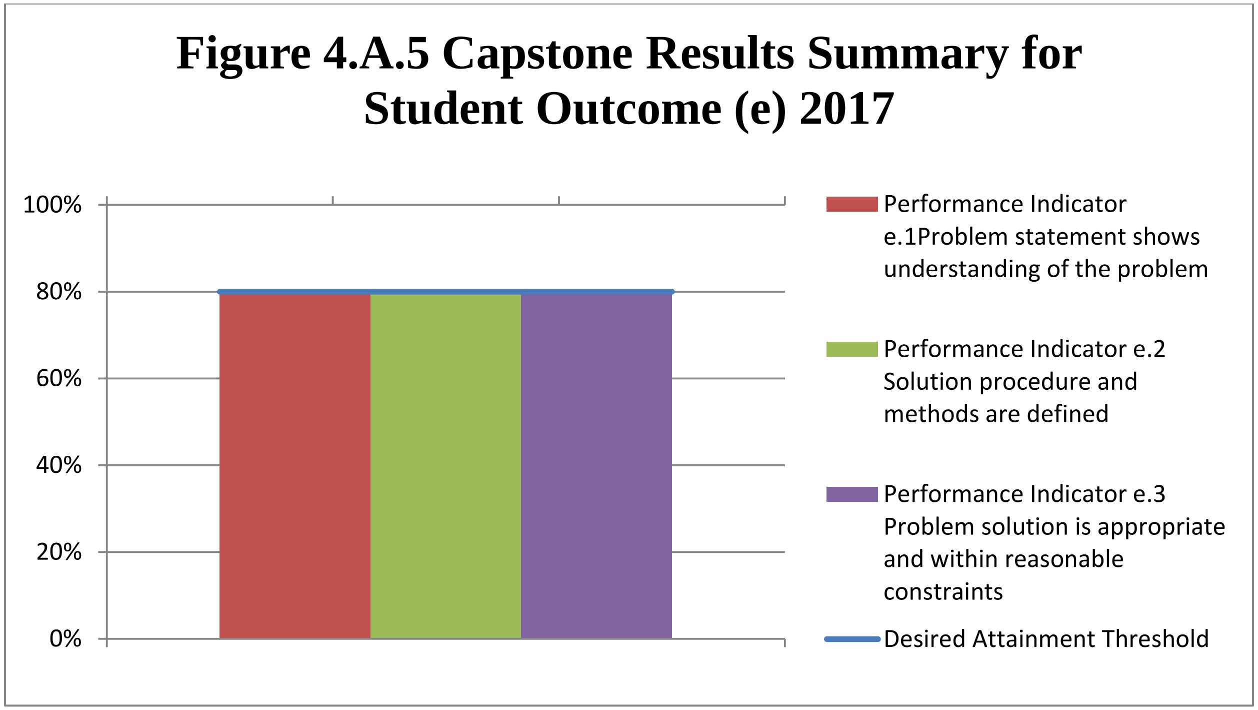


<u>Assessment Results Summary (2017):</u> The results show that students achieved satisfactory level (80%) for Indicator d.1 and d.2. Indicator d.3 (60%) was at learning level.

<u>Evaluation and Actions (2017):</u> 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.

Table 4.A.9 Student Outcomes (e) - An ability to identify, formulate, and solve engineering problems						
Performance Indicators	**Educational Strategy**	**Method(s) of Assessment**	**Where data are collected (summative)**	**Length of assessment cycle (yrs)**	**Year(s) of data collection**	**Target**
Problem statement shows understanding of the problem	ENGR-143; ENGR-236; IE-223; ME-345; ENGR-313; ME-353; IE-343; ME-354; IE-413; IE-453; IE-424; IE-473	Final Project report analysis using rubric	IE-424	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	ENGR-143; ENGR-236; IE-223; ME-345; ENGR-313; ME-353; IE-343; ME-354; IE-413; IE-453; IE-424; IE-473	Final Project report analysis using rubric	IE-424	3 years	2019/2021 for all listed classes but Capstone where attempt to collect every year is made	80%

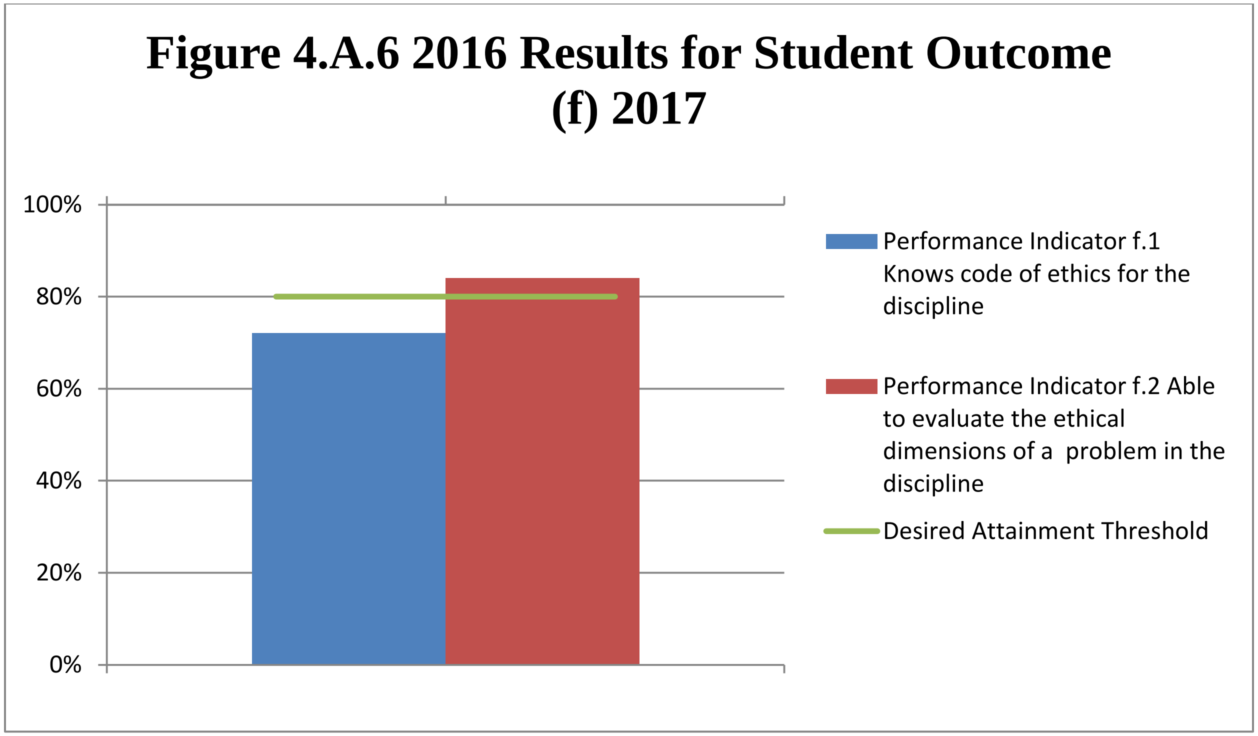
Problemsolution is appropriate and within reasonable constraints	ENGR-143; ENGR-236; IE-223; ME-345; ENGR-313; ME-353; IE-343; ME-354; IE-413; IE-453; IE-424; IE-473	Final Project report analysis using rubric	IE-424	3 years	2019/2021 for all listed classes but Capstone where attempt to collect every year is made	80%



Assessment Results Summary (2017): The Capstone results show that students achieved satisfactory level (80) for Indicators e.1, e.2, and e.3.

Evaluation and Actions (2017): 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 Strategy**	**Method(s) of Assessment**	**Where data are collected (summative)**	**Length of assessment cycle (yrs)**	**Year(s) of data collection**	**Target**
Knows code of ethics for the discipline	IE-103; IE-380; IE-424	Questions from Quizzes, Tests and Homework	IE-424	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	IE-103; IE-380; IE-424	Questions from Quizzes, Tests and Homework and Design Project	IE-424	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%

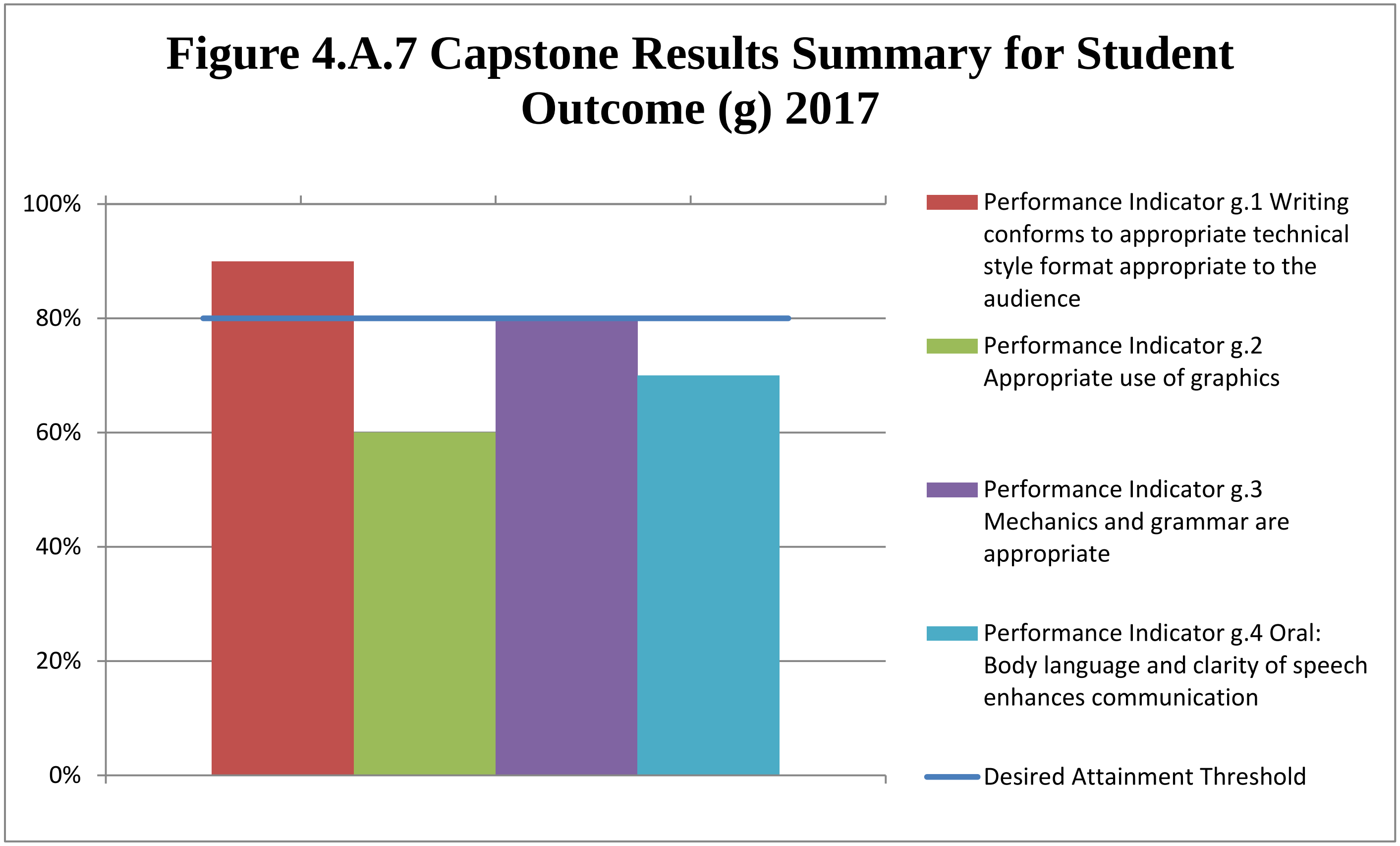


Assessment Results Summary (2016): Results presented here are from Introduction to Engineering (ENGR-103) showing that students achieved satisfactory level (84%) for Indicator f.2. Indicator f.1 achieved only a learning level (72%). These were scored from a homework assignment for f.1 and a question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

Evaluation and Actions (2017): Evaluation was performed after Introduction to Engineering class and approved 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 Strategy**	**Method(s) of Assessment**	**Where data are collected (summative)**	**Length of assessment cycle (yrs)**	**Year(s) of data collection**	**Target**
Writing conforms to appropriate technical style format appropriate to the audience	ENGR-123; ENGR-130; ENGR-230; ENGR-236; ENGR-313; IE-380; IE-424; IE-463; IE-494	Final Project report analysis using rubric	IE-424	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%
Appropriate use of graphics	ENGR-123; ENGR-130; ENGR-230; ENGR-236; ENGR-313; IE-380; IE-424; IE-463; IE-494	Final Project report analysis using rubric	IE-424	3 years	2017/2020 for all listed classes but Capstone where attempt to collect every year is made	80%
Mechanics and grammar are appropriate	ENGR-123; ENGR-130; ENGR-230; ENGR-236; ENGR-313; IE-380; IE-424; IE-463; IE-494	Final Project report analysis using rubric	IE-424	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	ENGR-123; ENGR-130; ENGR-230; ENGR-236; ENGR-313; IE-380;	Final Project Presentation using rubric	IE-424	3 years	2017/2020 for all listed classes but Capstone where attempt to	80%



<u>Assessment Results Summary (2017):</u> The results from Capstone show that students achieved satisfactory level (90%) or excellent level (80%) for the Indicators g.1 and g.3. Indicators g.2 (60%) and g.4 (70%) are rated as needs improvement.

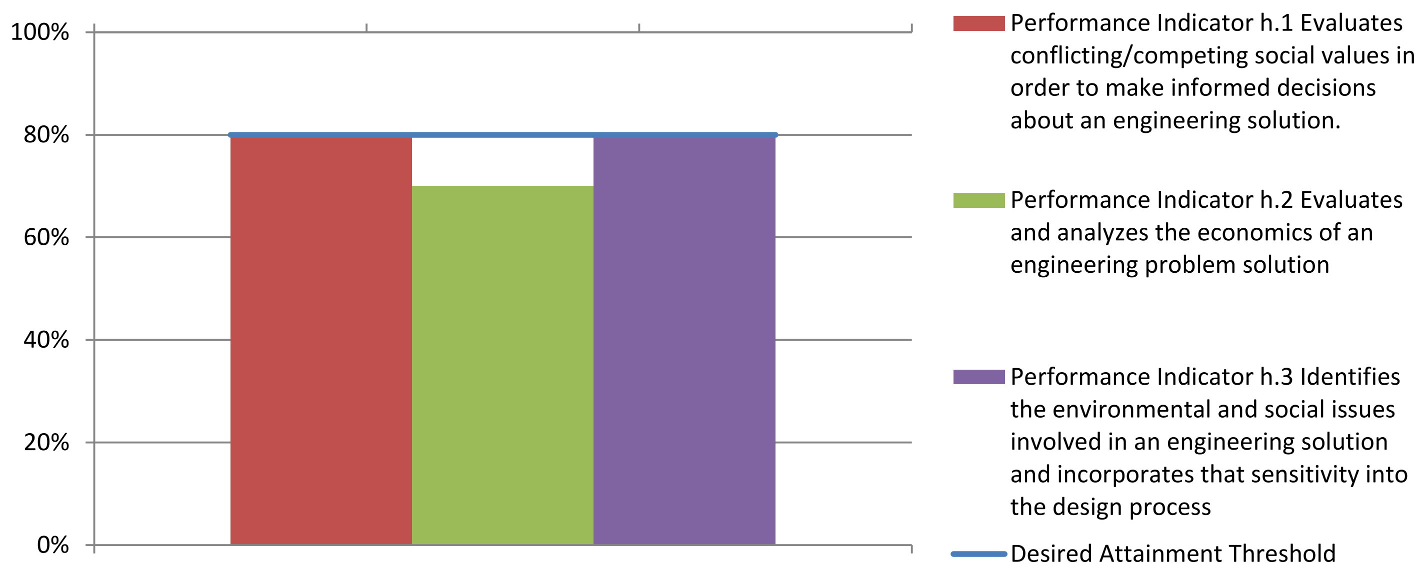
<u>Evaluation and Actions (2017):</u> Evaluation was performed during the Assessment Workshop on May 15 & 16. Indicator 2 showed insufficient ability to communicate through figures, drawings and graphs, which will be addressed in ENGR-123 and all design courses possible will require CAD type drawings. Information for Indicator 4 was that overall some students did not have good oral presentation skills. This will be addressed in ENGR-123. The new Rubric for evaluating Performance Indicators of Student Outcomes will be provided to faculty for guidance.

Table 4.12 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
Evaluates conflicting/competing social values in order to make informed decisions about an engineering solution	IE-223; IE-235; IE-323; IE-343; IE-424; IE-463	Final Design Projects (Rubric)	IE-424	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
		Senior Survey	On-line survey			
Evaluates and analyzes the economics of an engineering problem solution	IE-223; IE-235; IE-323; IE-343;	Final Design Project (Rubric)	IE-424	3 years	2018/2021 for all listed classes but	80%

	IE-424; IE-463	Senior Survey	On-line survey		Capstone where attempt to collect every year is made	
Identifies the environmental and social issues involved in an engineering solution and incorporates that sensitivity into the design process	IE-223; IE-235; IE-323; IE-343; IE-424; IE-463	Final Design Project (Rubric)	IE-424	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is	80%
		Senior Survey	On-line survey			

Figure 4.A.8 Capstone Results Summary for Student Outcome (h) 2017

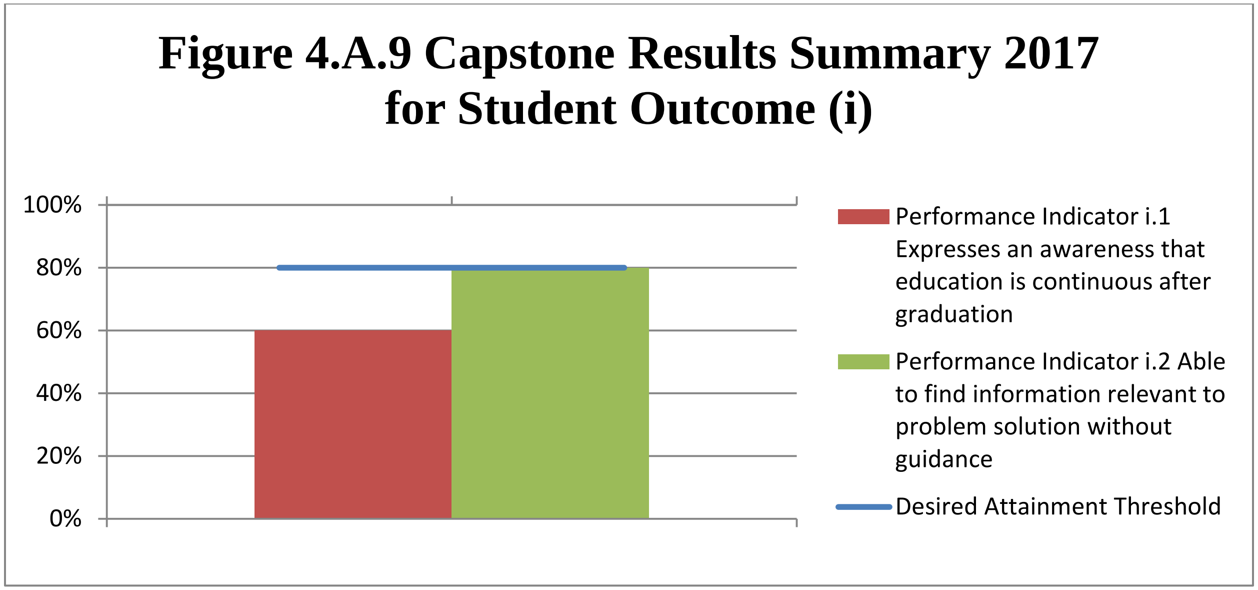


Assessment Results Summary (2017): The Capstone results show that students achieved satisfactory (80%) levels for Indicators h.1 and h.3. Students achieved learning level (70%) for Indicator h.2.

Evaluation and Actions (2017): Evaluation was performed during the Assessment Workshop on May 15 & 16. More emphasis on improving student learning related to Indicator h.2, particularly in ENGR-313 (Engineering Economy). 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

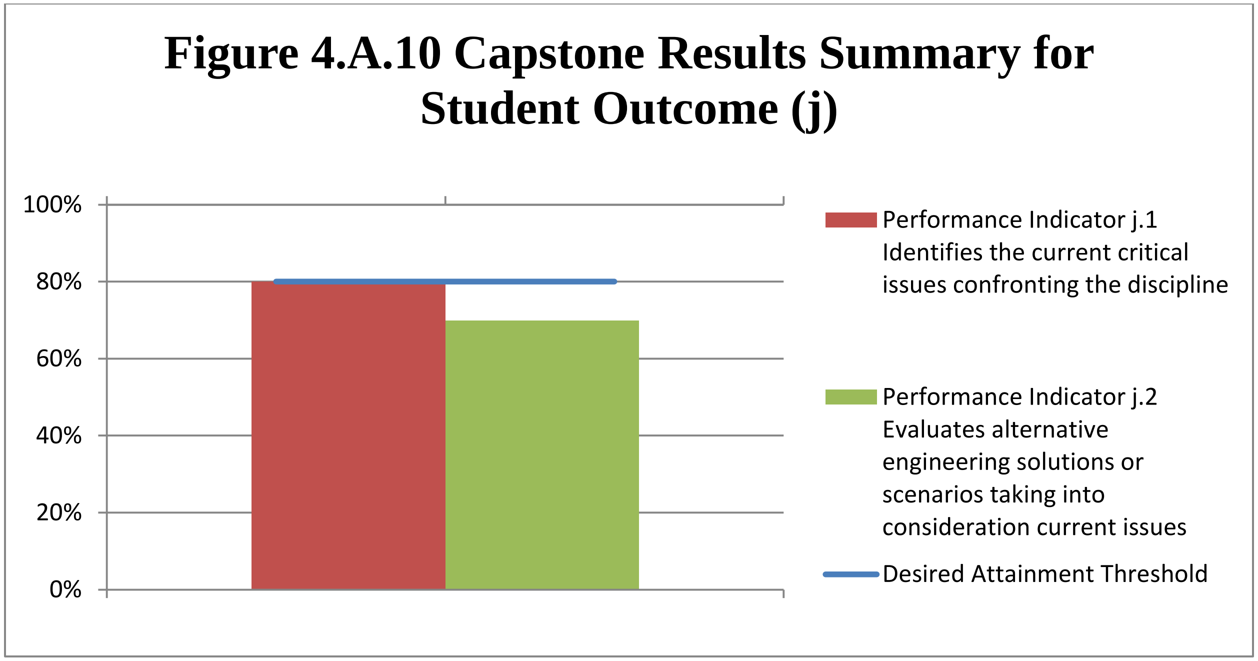
Performance Indicators	Educational Strategy	Method(s) of Assessment	Where data are collected (summative)	Length of assessment cycle (yrs)	Year(s) of data collection	Target
Expresses an awareness that education is continuous after graduation	ENGR-123; IE-380; IE-424	Final Design Project	IE-424	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
		Senior Survey	On-line survey			
Able to find information relevant to problem solution without guidance	ENGR-123; IE-380; IE-424	Faculty developed examination	IE-424	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
		Senior Survey	On-line survey			



<u>Assessment Results Summary (2017):</u> The Capstone results 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.

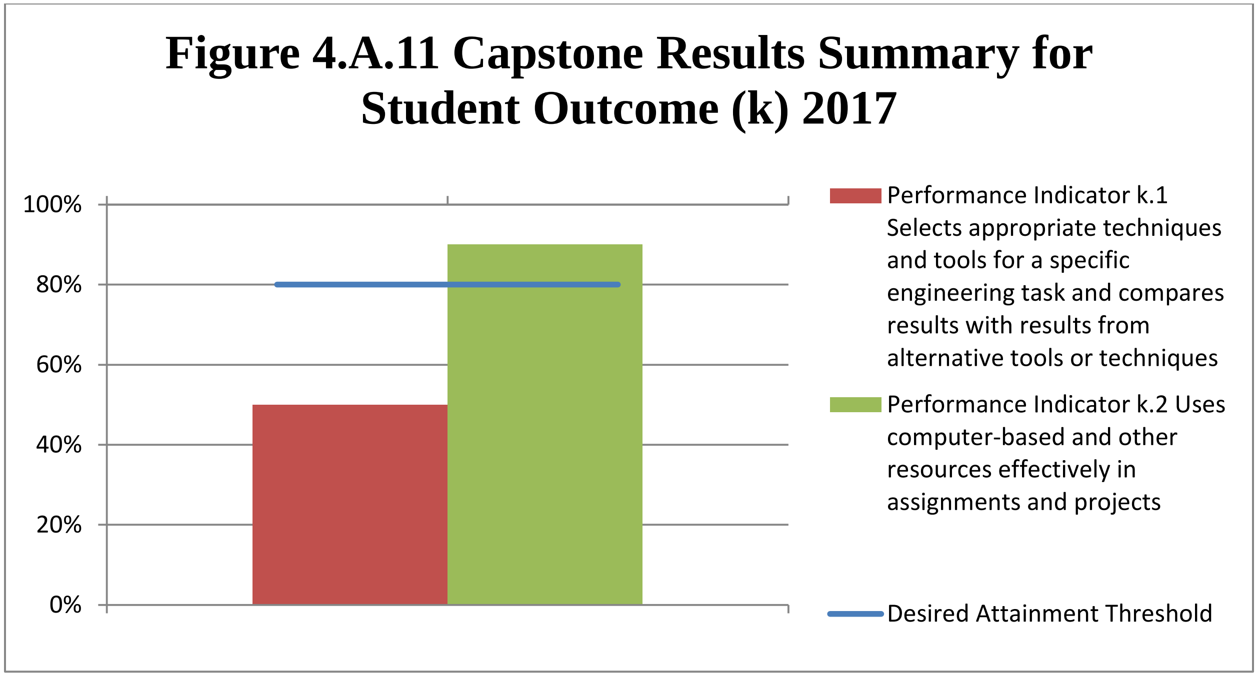
Table 4.14 Student Outcomes (j) - A knowledge of contemporary issues						
Performance Indicators	**Educational Strategies**	**Method(s) of Assessment**	**Where data are collected (summative)**	**Length of assessment cycle (yrs)**	**Year(s) of data collection**	**Target**
Identifies the current critical issues confronting the discipline	IE-235; IE-380; IE-424	Quizzes, Tests, Homework and Final Design Project	IE-424	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
		Senior Survey	On-line survey			
Evaluates alternative engineering solutions or scenarios taking into consideration current issues	IE-235; IE-380; IE-424	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%
		Senior Survey	On-line survey			



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

Evaluation and Actions (2017): 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 4.15 Student Outcomes (k) - An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice						
Performance Indicators	**Educational Strategy**	**Method(s) of Assessment**	**Where data are collected (summative)**	**Length of assessment cycle (yrs)**	**Year(s) of data collection**	**Target**
Selects appropriate techniques and tools for a specific engineering task.	ENGR-123; ENGR-130; ENGR-230; ENGR-236; ENGR-313; ME-353; IE-323; IE-413; IE-433; IE-453; IE-424; IE-473; IE-494	Quizzes, Tests, Homework and Final Design Project	IE-424	3 years	2018/2021 for all listed classes but Capstone where attempt to collect every year is made	80%
Uses computer-based and other resources effectively in assignments and projects	ENGR-123; ENGR-130; ENGR-230; ENGR-236; ENGR-313; ME-353; IE-323; IE-413; IE-433; IE-453; IE-424; IE-473; IE-494	Quizzes, Tests, Homework and Final Design Project	IE-424	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 needs improvement level (50%) for Indicator k.1. Indicator k.2 was at a satisfactory level (90%).

<u>Evaluation and Actions (2017):</u> Evaluation was performed during the Assessment Workshop on May 15 & 16. 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 <u>in a separate file</u> 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, **<u>program outcomes</u>**, 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.)
Results
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.

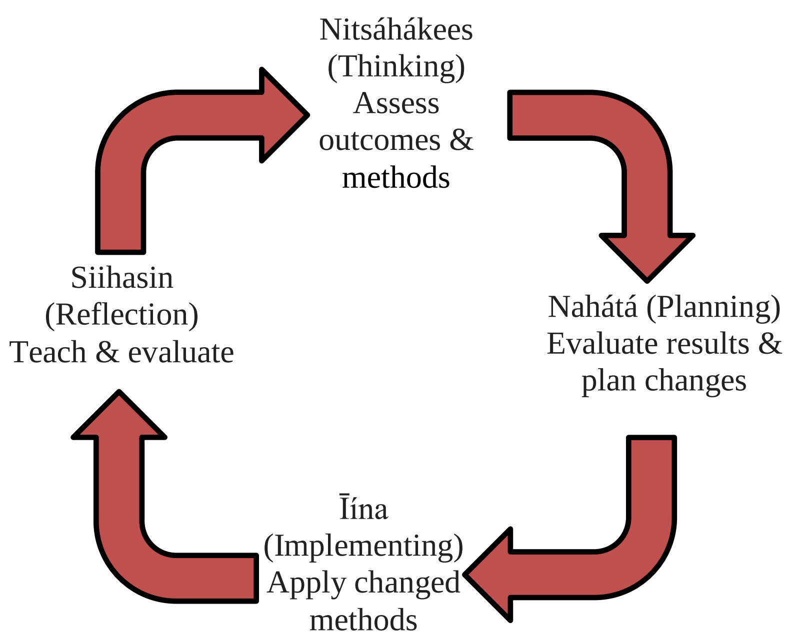


Figure 4.B.1 The Continuous Improvement Process NTU IE program

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 IE 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.2

● 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 Table 4.A.2.

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 implemented having Engineering 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 slight changes of curriculum since the program was originally going to be launched as a Mechanical Engineering program and subsequently we have been able to incorporate more Industrial Engineering specific courses (Changes 1, 2, 3 & 8) with a few curriculum changes. A curriculum revision was done in Spring of 2016 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) Additional of course in Lean Production (IE-235): Lean Production derived from the Toyota Production System is an important methodology in today's business and industrial environment. Many employers expect students to have at least basic knowledge of Lean Manufacturing on graduation and since this is Mr. Whiting's area of study he took responsibility for adding this course. In the course theoretical and hands on knowledge of the subject is covered. Methods of creating a holistic system for production are emphasized.
2) Replacement of Advanced Manufacturing Analysis by Lean Production and Computer Aided Manufacturing: Advanced Manufacturing Analysis had never been taught and was ill defined as to its purpose. The concepts it would cover are incorporated into Lean Production and Quality Control. Computer Aided Manufacturing is useful in giving students many of the basic concepts of automated or semi-automated systems and teaching the calculations necessary to design and use these systems as part of an integrated system. System Simulation has since replaced Computer Aided Manufacturing as a requirement but as Computer Aided Manufacturing is incorporated into the Advanced Manufacturing Technology program, it may be taken by IE students as an elective. This decision was made by Faculty after discussion with the Dean, Dr. Agbaraji.
3) Replacement of Computer Aided Manufacturing by System Simulation. For a short time Computer Aided Manufacturing was listed as a requirement in the IE Program while we were working on getting a multi-seat academic license for ARENA to teach simulation class. More businesses and industries are using simulation to test and refine ideas for new systems and want graduates who have those skills. This is one of the modern engineering tools that is considered necessary for graduates and was desired by Faculty teaching both in the IE and AMT programs.
4) 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. Whiting asked for this change because of the many concepts that were poorly covered in Engineering Statistics as one course.
5) 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.

6) Elimination of Humanities Elective: Recently the Governor of New Mexico asked that schools reduce all Bachelor's degree programs to 120 credit hours if possible. Presently the IE program requirements for graduation are 123 credit hours, 19 credit hours of which classes are in general education and humanities without counting mathematics and science courses. Eliminating the specific Humanities elective was part of the reduction to 123 credit hours.
7) Splitting Fluid Mechanics and Thermodynamics class into Fluid Mechanics class and Thermodynamics class. Faculty considered that this was too much material to comfortably cover in one course except cursorily.
8) Consolidation of Structure and Properties of Materials Class and Strength of Materials class into Characteristics of Materials Class: These classes were left over from the original creation of the IE program which was originally envisioned as a Mechanical Engineering program. To have more flexibility for more 'pure' IE classes these classes were consolidated into one class, which is included in the Pre-Engineering Certificate program and the proposed Engineering Technology two year program, both for dual credit high school students and it continues to be a required course for our IE students.

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 IE Curriculum has courses divided into the following categories:

Math/Science

Math and Science courses for a total of 32 credit hours, which includes 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, Physics and three courses in Statistics since that is the area of math that is often the most needed in Industrial Engineering.

Engineering Design

Engineering Design courses for a total of 51 credit hours, which include design of Quality Control systems, Facility Layout and Design, and other courses which are intended to emphasize the importance of systems integration and design in Industrial Engineering. Design knowledge is an integral part of achieving success as defined by the PEOs. Table 5.A.1 summarizes classes where design experience projects are taught.

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

IE Design Courses	Design Content
ENGR-103: Introduction to Engineering	• Design Process & use of Design Notebook • Final Semester Design Project
IE-235: Lean Production	• Final Semester Project to identify problem area, gather data on present state, define requirements for future state, conduct 6S or 3P event implementing change with use of standards
IE-223: Design & Manufacturing Processes I	• Innovate a design or improve a product from scratch, using your intuition, judgment and the design considerations taught in class. The design has to appeal to the day-to-day customer as well as entrepreneurs who might wish to commercialize your product
ENGR-313: Engineering Economics	• Final Semester Project to gather data, analyze & compare three alternatives on PW, FW or AW basis and make a decision as to which would be most economically desirable
IE-323: Human Factors in Product Design	• Final Semester Project incorporating

	research into an aspect of Human Factors design
IE-343: Design & Manufacturing Processes II	• Students create parts in the Fab Lab using CNC machine and rapid prototyping machine. Students create parts using silicone and polyurethane
IE-380: Project Management	• Students must find a theoretical or actual multiyear project of benefit to the Navajo Nation and design a project management plan which will include: work breakdown structure, budget, schedule, risk matrix and mitigation strategies
IE-413: Quality Control	• Design of quality control charts suitable to given specifications, type of production and critical characteristics
IE-453: Engineering Optimization	• Design of optimal production given restrictions such as production rates and costs
IE-424: Capstone	• Students must engage in a 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
IE-463: Facility Planning & Design	• Design of facility given requirements and use of standards for type & number of office, production & laboratory spaces, auxiliary space requirements, calculation of building size and shape, required size of lot, and specification of types of material handling equipment with design of workstations if applicable
IE-473: Inventory Control & Production Plan	• Students must design a production plan for given demand and production rate
IE-494: System Simulation	• Design of a simulation that could be a basis for a system given requirements with specification for elements within the system and overall system requirements of demand and time

General Education/Humanities

General Education/Humanities courses for a total of 19 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.

Skills Courses

Skills courses for a total of 21 credit hours include skill classes like Engineering Graphics, Computer Skills for Engineers and other topics of interest to the advancement of an engineer's training and career. The curriculum is expected to support the ability to go on to bigger and better attainments in their careers and personal certifications. While these courses couldn't necessarily be classified as having design content, they support the abilities needed for other engineering coursework, including design courses.

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 Industrial Engineering graduate after they obtain a BSIE degree. It is considered that the current curriculum gives the graduate skills and knowledge that will support this.

NTU Program Educational Objectives for Industrial 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 integrate manpower, machines materials, methods and measurement which allows them to understand the systems and to thus manage them. This understanding leads naturally to greater supervisory tasks, managerial responsibility and increasing 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 systems integration and industrial engineering design. No program can cover every subject applicable to Industrial Engineering in a 120 to 130 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, Lean Manufacturing and Six Sigma are both considered important improvement methods in our modern business and industry. In our curriculum, IE-235 Lean Production teaches the students as much as we can of the theory and practice of Lean, but it stops short of certifying the student as an expert. That would take more hands on activity, experience in gathering background information and follow up that there is not enough time for in a 3 credit hour course. Six Sigma is a mathematical improvement tool that we study in IE-413 Quality Control and discuss versus some other quality/improvement methods in other courses. Students passing IE-413 already have the mathematical background to take a Six Sigma certification course successfully.

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., Lean Production, Project Management and Engineering Economy), technical design and accomplishment (e.g., Facilities Design, Quality Control and Design & Manufacturing Processes I & II). 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 Industrial 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 our statistically oriented course work, ENGR-169 Basic Statistics and Probability, ENGR-236 Inferential Statistics and IE-363 Design of Experiments. 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 Industrial Engineering program students are taught to examine the design of all elements as part of a system. Design of a single workstation, design of a process, design of a component must all be viewed as part of a whole, which must function together for the greater good. Systems design emphasized in classes such as, Lean Production, Project Management and Facility Design.

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 Industrial 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 and Project Management 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 Industrial Engineering curriculum requires end of semester class projects requiring a presentation and report. Additionally the Computer Skills for Engineers course added specifically to the curriculum to improve student skills in communication is required for all students starting in 2016 or later.

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 and struggles 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 Industrial Engineering, we incorporate tools such as Minitab, Arena and CAD 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 (21 credit hours) are there to increase the students' skills and knowledge to make them better more broadly educated engineers.

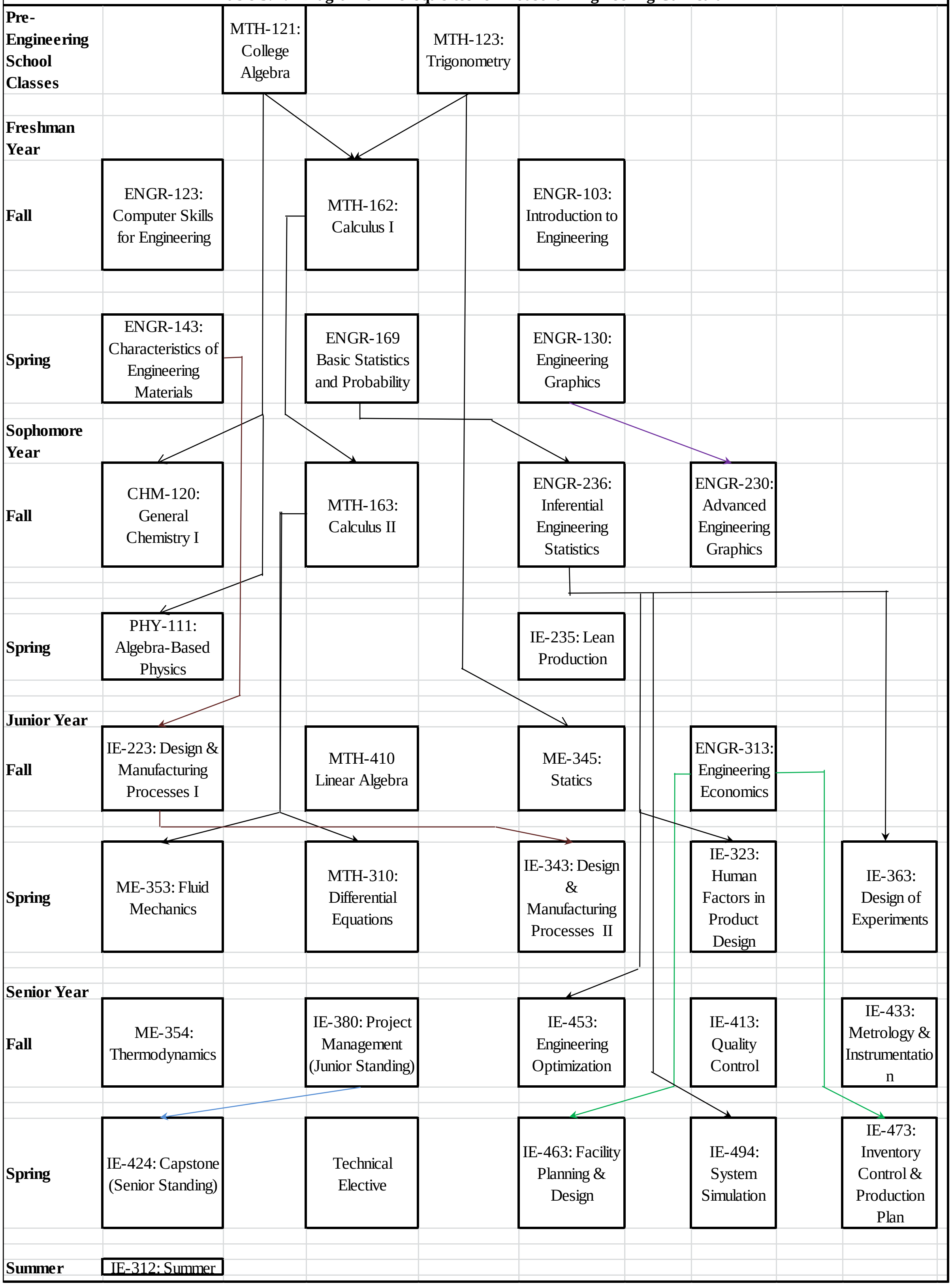
Curriculum and Prerequisites

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 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 Industrial 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.

Table 5.A.2 below graphically shows the Prerequisite structure in place for the Industrial Engineering program.

Table 5.A.2 Diagram of Prerequisites for Industrial Engineering Curriculum



Major Design Experience While we have design incorporated into many courses in the Industrial 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. We are planning to combine with the Advanced Manufacturing Technology programs Capstone in the future if possible. (That is waiting for a curriculum revision of the AMT program.)

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 classes 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 Industrial 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

4) Minutes of Engineering Assessment Meetings

5) Minutes of Engineering Advisory Board meetings

6) Bylaws of the Engineering Advisory Board

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

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

B. Course Syllabi

Table 5.B.1 Curriculum (ABET 5-1)

Industrial Engineering Program

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	Skills	Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Maximum Section Enrollment for the Last Two Terms the Course was Offered[2]
1st Year/ 1st Semester:							
ENGR-123: Computer Skills for Engineering	R				3	*Fall 2017*	*15*
ENG-110: Freshman Composition	R			3		*Fall 2016* *Summer 2016*	*20* *20*
MTH-162: Calculus I	R	4				*Fall 2016* *Spring 2017*	*20* *25*
IT-105: Introduction to Programming	R				3	*Fall 2016* *Spring 2016*	*20* *20*
ENGR-103: Introduction to Engineering	R		3			*Fall 2016* *Fall 2015*	*15* *20*
1st Year/ 2nd Semester:							
NAV-101 or	R			4		*(Both):*	*(Both)*

201: Navajo Language						*Fall 2016 (Both): Spring 2017*	*25 (Both) 20*
HUM-170: History of Native Americans in Media	R			3		*Fall 2016 Spring 2017*	*20 20*
ENGR-130: Engineering Graphics (Changed from DFT-111: Mechanical Drafting)	R				3	*Spring 2016 Spring 2017*	*20 20*
ENGR-169: Basic Statistics and Probability	R	3				*Spring 2017*	
ENGR-143: Characteristics of Engineering Materials	R				3	*Fall 2016 Spring 2017*	*15*
2nd Year/ 3rd Semester:							
MTH-163: Calculus II	R	4				*Fall 2016 Spring 2017*	*15 25*
CHM-120: General Chemistry I	R	4				*Summer 2017 Spring 2017*	*20 15*
ENG-111: Composition & Research	R			3		*Fall 2016 Spring 2017*	*20 20*
ENGR-230: Advanced Engineering Graphics (Changed from DFT-211: Advanced Mechanical Drafting)	R				3	*Fall 2016 Fall 2015*	*15 15*
ENGR-236: Inferential Engineering Statistics	R	3				*Fall 2017*	
2nd Year/ 4th Semester:							

HST-211: American History 1877 to Present	R			3		*Fall 2016 Spring 2017*	*25 20*
PHY-111: Algebra Based Physics	R	4				*Spring 2016 Spring 2017*	*20 15*
IE-235: Lean Production	R		3			*Spring 2016 Spring 2015*	*15 15*
COM-130: Public Speaking	R			3		*Fall 2016 Spring 2017*	*25 25*
3rd Year/ 5th Semester:							
IE-223: Design & Manufacturing Processes I	R		3(√)			*Spring 2016 Spring 2017*	*15 15*
ME-324: Statics (Changed from IT-345: Statics)	R		3			*Spring 2016 Spring 2017*	*20 15*
MTH-410: Linear Algebra	R	3				*Spring 2017*	
ENGR-313: Engineering Economics	R		3			*Fall 2016 Spring 2017*	*20 15*
3rd Year/ 6th Semester:							
MTH-310: Differential Equations	R	4				*Spring 2016 Spring*	*20 20*

						2017	
ME-353: Fluid Mechanics	R		3			*Fall 2016* *Fall 2015*	*15* *15*
IE-323: Human Factors in Product Design	R		3(√)			*Spring 2016* *Spring 2015*	*15* *15*
IE-343: Design & Manufacturing Processes II	R		3(√)			*Fall 2016* *Fall 2015*	*15* *20*
IE-363: Design of Experiments	R	3				*Fall 2015* *Spring 2017*	*15*
4th Year/ 7th Semester:							
IE-380: Project Management	R		3			*Fall 2016* *Fall 2017*	*15* *15*
ME-354: Thermodynamics	R		3			*Spring 2016* *Fall 2015*	*20* *20*
IE-413: Quality Control	R		3(√)			*Fall 2016* *Fall 2014*	*15* *15*
IE-433: Metrology & Instrumentation	R		3			*Spring 2015* *Spring 2017*	*15* *20*
IE-453: Engineering Optimization	R		3			*Fall 2016* *Fall 2015*	*15* *20*
4th Year/ 8th Semester:							
IE-424: Capstone	R		3(√)			*Spring 2017* *Fall 2016*	*15* *15*
IE-463: Facility Planning & Design	R		3(√)			*Fall 2016* *Fall 2015*	*15* *15*

IE-473: Inventory Control & Production Plan	R		3			*Spring 2016 Spring 2017*	*15 15*
IE-494: System Simulation	R		3(√)			*Spring 2017*	
Technical Elective	SE				3		
Summer:							
IE-312: Summer Internship	R				3	*Summer 2017*	*15*
Technical Electives-Choice of One:							
AMT-311: Laser Scanning Methods (Changed from IT-311: Laser Scanning Methods and Techniques)	SE					*Fall 2016 Spring 2016*	*15 20*
AMT-370: Robotics & Offline Programming (Changed from IT-370: Robotics/Offline Programming)	SE					*Spring 2016 Spring 2015*	*15 15*
IE-483: Rapid Prototyping	SE					*Fall 2016 Fall 2017*	*15 15*
PHY-121: Calculus Based Physics	SE					*Spring 2017 Fall 2017*	*20 20*
Special Topics in IE or Courses approved by advisor	SE						
Add rows as needed to show all courses in the curriculum.							
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32 Hours	51 Hours	19 Hours	21 Hours		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE	1						

PROGRAM		2 3						
PERCENT OF TOTAL			26%	42%	15%			
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours		32 Hours	51 Hours				
	Minimum Percentage		26%	39%				

CRITERION 6. FACULTY

A. Faculty Qualifications

Table 6.A.1. Faculty Qualifications Industrial Engineering

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment 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	Professional	Consulting/summer work in industry
Harry S. Whiting II	MSIE-IE-2002	AST	NTT	FT	10	6	5	PE-State of Texas 96441	M	M	M
Gholam Resa Ehteshami, PhD.	PhD-ChemE-1995	ASC	NTT	PT	10 +	2 5	4		H	M	H
Casmir I. Agbaraji, PhD.	Ph.D-IE-2008	AST	NTT	PT	4	1 4	5	--	L	M	L
Vincent J. Vohnout, PhD.	PhD-IE-1998	ASC	NTT	PT	25	9	3	PE-State of Ohio 52984	M	M	H
Frank Stomp, PhD.	PhD-CS-1989	ASC	NTT	PT	2.5	2 5	4	None	L	H	L

Scott Halliday	AAS General Studies	I	NTT	PT	5	14	14	None	M	H	H
Ramsey Sewingyawma	MS-GIS-2013	AST	NTT	PT	1	6	7	Cert.-GIS National	L	M	H
Abraham Meeles, PhD	PhD-N.Phy-2015	AST	NTT	PT	10+	10+	1	None	M	M	M
Elisha Wortham	BS-Int. Des-2012	AST	NTT	PT	1	5	5	None	L	H	H

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.

B. Faculty Workload

Faculty are expected to teach 14 to 16 credit hours per semester unless release is given for research purposes. The most recent workload for faculty who teach major courses in Industrial Engineering is given in Table 6.B.1 (ABET 6-2) on the next page.

Table 6.B.1 Faculty Workload Summary Industrial Engineering

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]	
Harry S. Whiting II, PE	FT	**Spring 2015:** ENGR-234/3; IE-235/3; IE-323/3; IE-424/3; IE-473/3; ITS (*)-280/3 **Fall 2015:** ENGR-234/3; ENGR-313/3; ENGR-103/3; IE-380/3; IE-463/3; IE-483/3 **Spring 2016:** ENGR-234/3; IE-235/3; IE 323/3; IE-473/3; IE-484/3; **Fall 2016:** ENGR-103/3; ENGR 234/3, IE-380/3; IE-413/3; IE-424/3; IE- 463/3 **Spring 2017:** IE-473/3; IE-494/3; ENGR-313/3; IE-363/3; IE-424/3 (*) – Later changed to IE-380	90%	5%	5%	100%
Gholam Resa Ehteshami, PhD	FT	**Spring 2015:** MTH-310/4; IE-424/3; IE-433/3; ME-354/3; IT (*)-345/3	85%	5%	10%	100%

		Fall 2015: IE-213/3; IE-234/3; IE-363/3; ME-353/3; ME-354/3 **Spring 2016:** IE-243/3; ME-354/3; MTH-310/4 **Summer 2016:** CHM-120/4; **Fall 2016:** ME-353/3 **Spring 2017:** No IE classes (*) – Later changed to ME-345				
Casmir I. Agbaraji, PhD	PT	**Spring 2015:** IE-223/3; IT-201/3 **Fall 2015:** IE-343/3 **Spring 2016:** IE-223/3; IT-201/3 **Fall 2016:** IE-343/3 **Spring 2017:** IE-223/3	5%	5%	90%	100%
Vincent J. Vohnout, PhD	FT	**Spring 2016:** ME-345/3; IT (*) -370/3 **Fall 2016:** AMT-210/3; AMT 325/3; ENGR-143/3; IE-213/3; IE-483/3 **Spring 2017:** IE-243/3; IE-484/3; ENGR-143/3	85%	10%	5%	100%

		(*) – Later changed to AMT-370				
Frank Stomp, PhD	FT	**Fall 2015:** IE-453/3; IT-105/3 **Spring 2016:** IT-105/3 **Fall 2016:** IE-453/3	80%	15%	5%	100%
Scott Halliday	FT	**Spring 2015:** DFT (*) -111/3; IT-340/3; IT (****) -370/3 **Fall 2015:** DFT (**) -211/3; IT-340/3 **Spring 2016:** DFT (*)-111/3 **Fall 2016:** ENGR-230/3 **Spring 2017:** ENGR-130/3 (*) – Later becomes ENGR – 130 (**) – Later becomes ENGR – 230 (***) – Later becomes AMT – 311 (****) – Later becomes AMT – 370	5%	90%	5%	100%
ElishaWortham	FT	**Fall 2015:** IT (*)-311/3 **Spring 2016:** IT (*) -311/3 **Fall 2016:** AMT-311/3 (*) – Later changed to AMT – 311	50%	50%	0%	100%

Ramsey Sewingyawma	FT	**Fall 2015:** PHY-121/4	80%	15%	5%	100%
Abraham Meeles, PhD	FT	**Fall 2016:** PHY-111/4; PHY-121/4	85%	5%	10%	100%
Jerry Hyman, PhD	/	**Spring 2016:** PHY-111/4; PHY-112/4; PHY-121/4; PHY-122/4	/	/	/	/

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.

C. Faculty Size

Presently there is one full time faculty member for the Industrial Engineering program, Harry S. Whiting II, PE which together with the leveraging of faculty from other programs has been sufficient to offer all IE courses this year (2016-2017). Mr. Whiting has been the IE advisor since he first started with NTU in the Fall of 2012. Harry's advice as to classes, career advice and personal counseling have been used by students of the IE program. He was asked at that time to take over as Faculty Advisor to the Engineering Club as well. The Engineering Club has participated in a number of activities: touring Sandia Labs and the BioPappel Papermill, running an annual Holiday Food Drive for the benefit of Navajo Nation WIC Program and a number of campus cleanups. We are working with the Raytheon Diné facility and the Arizona Public Service Four Corners Power Plant for purposes of employment in internship and after graduation.

New IE Professor In the summer of 2017 we are hiring another Professor for Industrial Engineering to replace Dr. Ehteshami who was teaching Industrial Engineering classes in areas where he had expertise. This will allow students to progress smoothly through the program without the necessity of having to schedule around classes that are only offered occasionally. Part of the Five Year plan for Engineering & Technology as presently envisioned is to expand full time faculty members for IE as we transition from a teaching college to a research university paradigm.

Several other faculty members teach classes that are required or elective classes within the IE program.

Dr. Gholam Ehteshami, who started teaching purely for Industrial Engineering courses, now teaches Chemical Engineering and some required IE topics such as Fluid Mechanics and Thermodynamics which are within his purview as a Chemical Engineer.

Dr. Frank Stomp offers Introduction to Programming and Engineering Optimization, his education is as a computer scientist and mathematician.

Dr. Vincent Vohnout, an industrial engineer with many years' experience in industry and education, teaches classes which are applicable to both the Advanced Manufacturing Technology program and IE.

Ms. Elisha Wortham teaches Laser Scanning class in the Building Information Modeling program. That class is an elective for IEs.

Mr. Harold Halliday teaches the Engineering Graphics courses in addition to his work as Project Coordinator for certain courses and Director of the Center for Digital Technology.

D. Professional Development

Harry S. Whiting II, PE has participated in several workshops within the past year. He helped organize and participated in the Remedial Math Workshop held in August of 2015 and led by Professors from the University of Hawaii, Kauai, a workshop on Data Management in Shiprock and one on Federal Grant funding held at the NTU Business Incubator, both in July 2016 and was the trainer for a workshop held there in July 2016 on Lean Production. Harry's ability to attend conferences and workshops was curtailed by treatment for cancer, but he has been declared cancer-free now so that his participation in more of these activities in the future is to be expected. Most recently in the spring he attended the 'Wolves Den' Inventors and Entrepreneurs Workshop with students at New Mexico Technical University, the ABET Symposium in Baltimore and the Basics of Assessment Workshop held immediately after. In the summer of 2017 he is working on a grant on lattice structure properties with Lawrence Livermore Laboratory and working on the two year Engineering Technology Program which is expected to be approved by the Curriculum Committee in the Fall of 2017. Harry Whiting is the Chairman of The Remediation of the Environment Committee (TREC), which is working on creating the Navajo Center for the Environment. This committee was organized by six members of the Faculty and Staff and has received support (ex post Facto) from the President of NTU.

Currently NTU is in the process of hiring the second Industrial Engineering faculty member. This process is expected to be completed in time for the new Professor to be ready for the Fall semester which starts in August.

E. Authority and Responsibility of Faculty

Faculty are expected to have a lot of input regarding course creation and modification; we are looking at offering 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. These would be offered on a one per semester or one per year basis. NTU is learning more 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. (This position is being renamed Vice President.) 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.

CRITERION 7. FACILITIES[1]

A. Offices, Classrooms and Laboratories

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 Industrial Engineering professor, along with Dr. Bei Xie of the Electrical 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 Industrial Engineering program on a part-time basis are located in cubicles in Tech 325 and Tech 322 classrooms 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:

An Industrial Engineering Intern is available for tutoring: working 20 hours spread over 5 days a week located in Tech 325. The intern serves as an embedded tutor 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. The STEAM Lab employs an Industrial Engineering student for tutoring in our subjects.

Tutoring is available to all students in the STEAM Lab. The lab offers tutoring services and general use of computers. The STEAM Lab always has a specific tutor for Industrial Engineering courses. 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. Specific hours are posted on the entrance door, on posting boards throughout the campus and in Tech 322 and 325. 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.

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

Classrooms

NTU classrooms are minimally equipped with student accessible computers, monitors, and classroom printers. Presentation systems, such as projectors or touch capable TVs, are installed or can be installed at the request of the instructor. Other IT related equipment may be installed at the request of the instructor and approval from both their department head and IT directors.

Most Industrial Engineering courses are taught and located in the Science and Technology Building Rooms 322 and 325, but due to scheduling issues classes have been moved to other classrooms that were idle and/or relocated to the Center for Digital Technology, AKA Fabrication Lab (“FabLab”), to better accommodate the students that need to use the equipment located there. Due to software programs that are located only on computers in Tech 322, Tech 325 and the FabLab, scheduling is extremely crucial to have the necessary resources available for students. Mr. Whiting usually makes up the schedule for Industrial Engineering, Electrical Engineering, Chemical Engineering, Chemistry and Physics classes since all the rooms and labs for those are in constant use.

Laboratories

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 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. These computers 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 Wifi access is being upgrade in phases. First phase completed the install, testing and commission of the central wireless access controller and Wifi 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, Fab Lab, and engineering classrooms. Phase 3 is to extend and upgrade the managed coverage to the residential facilitates.

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

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.

Science and Technology Building

This building has 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 of maintaining and upgrading computers and software, but due to unevenness in advances in computers and software doesn't have a schedule for replacement. 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. While our present facilities must be closely scheduled to hold classes they are adequate to offering all classes necessary for Industrial Engineering. Additionally the Electrical Engineering program has taken over the old Bookstore so that they now have a dedicated classroom and a dedicated EE lab in it.

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

The leadership of the program has to this point relied on one individual, such as Mr. Whiting or Dr. Agbaraji before him. Part of the five year plan is to eventually expand the size of the IE program faculty which will create continuity and greater ability to pursue research. The addition of another dedicated Industrial Engineering professor in the summer of 2017 will obviously help in this regard.

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 Engineering 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. One is assigned to the IE program. The interns have helped with grading, tutoring and doing independent research in aid of our professors.

The IE program has acted cooperatively with the other engineering and technical programs in use of equipment and facilities for its program. As part of the five year plan the IE program will add a Human Factors laboratory for research. Mr. Halliday has been instrumental in acting as 'Project Coordinator' for classes needing a larger amount of technical support and equipment allowing students to utilize the 'FabLab' and its resources for projects which require more hands on activities.

Luckily, the study of IE requires a low level of resources and equipment. Mr. Whiting has supplied various needed supplies from his equipment used in private consulting for teaching Lean Production and the staff of the 'Fablab' allows students to use equipment and resources for projects and aids them when necessary. More Industrial Engineering specific equipment and tools will be acquired in association with research grant funding to phase out using borrowed personal equipment and tools.

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

Faculty Hiring

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 with advice of the members of that program.
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 does a background investigation of the candidate(s).
9. Human Resources contacts 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

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

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

Industrial Engineering must prepare graduates to develop, design and improve integrated systems including people, materials, information, equipment and energy. We have evolved from a program emphasizing courses as more discrete and self-contained to one that emphasizes integration of concepts from different courses into a unitary whole.

Examples of this are adding courses like Lean Production and System Simulation which approach systems design holistically, viewing activities in facility or a production line as integrated components within a system. Students are taught how to analyze discrete individual components in a system, but only in the context that they will be an integral part of a system.

By working on making sure that students approach course work using prerequisites we reinforce the building nature of IE and the building of understanding so as to give students a broader view and not just a method of examining individual parts of a system.

APPENDICES

APPENDIX A – COURSE SYLLABI

All Navajo Technical University syllabi have these sections 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:** ENGR-123: Computer Skills for Engineering
2. **Credits and contact hours:** 3 Credits and 3:30 PM – 4:50 PM
3. **Instructor's Name:** Harry S. Whiting II, PE
4. **Textbook:** Students will be able to download free textbooks from Bookboon.com
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    This course reviews the use of fundamental operations and features of the Microsoft Windows operating system. A set of projects are assigned to utilize the most commonly used features of Word, Excel, and PowerPoint (or other presentation software) and to introduce other features which are Important to engineering analysis and related report generation. These basic capabilities are utilized to perform calculations, to generate graphs and to solve equations, as well as to organize and document solutions to a variety of engineering analysis problems.
    b. **Pre-requisites or co-requisites**
    There are no required pre-requisites or co-requisites for ENGR-123: Computer Skills for Engineering.
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**

COURSE OUTCOMES	COURSE MEASUREMENTS
A strong understanding of computer operation and interrelation of eleemnts within the computer	Completed reading assignments, homework assignments, exams, projects, and quizzes.
A strong understanding of using WORD, formatting and use of features	
A strong understanding of using EXCEL, how to use formulas, formatting to highlight results and creation of graphical elements to enhance understanding	
A strong understanding of using POWERPOINT, formatting by using Master Slides, how to create a strong presentation	
An ability to communicate ideas in written documents, through presentations, incorporating tables and graphical methods	

ENGR-123: Computer Skills for Engineering is a *required* course in the Industrial 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.**

Grading Plan:	
Homework	15%
Mid-term	20%
Final Exam	20%
Project	15%
Quizzes	15%
Attendance/Class participation	15%
Portfolio (This should be a compilation of the semester's work)	Up to 5%

7. **Brief list of topics to be covered.**
   a. **Parts and Operation of computers**
   b. **Using WORD**
      i. **Features**
      ii. **Formatting**
      iii. **Use of Automatic Features**
   c. **Using PowerPoint**
      i. **Features**
      ii. **Formatting using Master Slide View**
      iii. **Limiting and Aligning bullet points**
      iv. **Automating bullets and figures**
   d. **Using EXCEL**
      i. **Features**
      ii. **Functions in Excel**
      iii. **Creating Tables & Graphs**

ABET Course Syllabi for

1. **Course number and name:** MTH-162: Calculus I
2. **Credits and contact hours:** 4 Credits and (Tuesday/Thursday) 2:30 PM – 4:10 PM
3. **Instructor's Name:** Roberto Nacorda
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 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 Industrial 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:** IT-105: Introduction to Programming
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 8:00 AM – 9:50 PM
3. **Instructor's Name:** Frank Stomp, Ph.D.
4. **Textbook:** *Introduction to JAVA Programming*, Comprehensive Version, 10th Edition, Y. Daniel Liang, Pearson
   ISBN-13: 978-0-13-376131-3
   ISBN-10: 0-13-376131-2
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   This course will introduce students to the basics of programming concepts and techniques. Students will be introduced to the logic of design in programming and fundamentals of working with data types, conditional statements, loops, and simple algorithms. The processing programming language will be used to introduce students to the concepts behind the Java programming language through structured code to create and manipulate graphical objects and animations.
   b. **Pre-requisites or co-requisites**
   There are no required pre-requisites or co-requisites for IT-105: Introduction to Programming.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   IT-105: Introduction to Programming is a *required* course in the Industrial Engineering Program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
   After successfully completing this course:

COURSE OUTCOMES	COURSE MEASUREMENTS
1. Demonstrate proficiency in understanding and creating simple programs	
Reading and creation of JAVA code	Observation, exercises, and projects
2. Demonstrate proficiency in using primitive data types	
Understanding in what context to use which data type.	Observation, exercises, and projects
Understanding how to use some basic build-in classes of JAVA	
Understanding how to use build-in operators	
3. Demonstrate proficiency in using selection statements and switch statements	
Recognizing when to use these kinds of statements	Observation, exercises, and projects

- Students will have an understanding of writing simple programs.
- Students will have an understanding of object oriented concepts.
- Students will have an understanding of construction structured code.

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

4. Demonstrate proficiency in mathematical functions, characters, and strings.	
Understanding how to use mathematical functions by using methods in the Math class	Observation, exercises, and projects
Understanding how to represent characters using the char type	
Understanding how to represent strings in the String class and perform operations on them	
5. Demonstrate proficiency in loops	
Understanding when to use iterations	Observation, exercises, and projects
6. Demonstrate proficiency in methods	
Understanding the difference between formal and actual parameters	Observation, exercises, and projects
Understanding how to define methods with a return value and how to define methods without a return value	
Understanding the scope of variables	
7. Demonstrate proficiency in using single-dimensional arrays	
Understanding when to use arrays	Observation, exercises, and projects
Understanding how to access array elements using indices	
Understanding how to use the java.util.Arrays class	
8. Demonstrate proficiency in using multidimensional arrays	
Understanding when and how to use multidimensional arrays, how to declare them, and how to access the array elements	Observation, exercises, and projects
9. Demonstrate proficiency classes and objects	
Understanding of how to define classes and create objects	Observation, exercises, and projects
Understanding of how to create objects using constructors	
Understanding of reference variables	
10. Demonstrate proficiency in inheritance and polymorphism	
Understanding how to define a sublclass from a superclass using inheritance	Observation, exercises, and projects
Understanding how difference between overriding and overloading	
Understanding polymorphism and its use	
11. Demonstrate proficiency in exception handling	
Understanding the advantages of using exception handling	Observation, exercises, and projects
Understanding when and how to throw an exception	
12. Demonstrate proficiency in event driven programming and animations	
Understanding of events, even sources, and event classes	Observation, exercises, and projects
Understanding how to definehandler classes, register handler objects witht the source object, and write to handle events	
Creating diagrams of attributes and methods	

Grading Plan:	
Assignments & Quizzes	40%
Attendance	5%
Participation	5%
Midterm	25%
Final	25%

ABET Course Syllabi for

1. **Course number and name:** ENGR 103: Introduction to Engineering
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 3:30 PM – 4:50 PM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Engineering Fundamentals: An Introduction to Engineering*, 5th ed., by Saeed Moaveni.
   ISBN-13: 978-1-305-08476-6
   ISBN-10: 1-305-08476-4
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course introduces the students to the engineering profession, ethics, engineering tools, and future trends. The students will work in team projects as well. The student will have a sound understanding of the engineering field and will have begun the mastery of the basic knowledge and skills required for all engineering fields offered at Navajo Technical University.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: MTH 121: College Algebra.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      ENGR 103: Introduction to Engineering is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will be introduced to the engineering design process.
      - Students will be introduced to ethical considerations in engineering and technology.
      - Students will be able to use Word, Excel, and PowerPoint to solve simple problems, give presentations, and write reports.
      - Students will be able to identify some engineering disciplines and the main problems that they solve.
      - Students will be able to solve simple engineering problems.
      - Students will be able to prepare effectively for classes.
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

COURSE OUTCOMES	COURE MEASUREMENTS
The student will be able to consider ethical decisions in engineering and technology.	Assessment will be by problems presented in homework, quizzes, and tests.
Students will be able to use Word, Excel, and PowerPoint to solve simple problems, give presentations and write reports.	
Students will be able to identify the engineering disciplines and the main problems that they solve.	
Students will be able to solve simple engineering problems.	Assessment will be by problems presented in homework or projects.
Students will be able to prepare effectively for classes.	Assessment will be by problems presented in homework, quizzes, and tests.

Grading Plan:	
Homework	15%
Attendance	5%
Participation	10%
Weekly quizzes	15%
Midterm	20%
Final	20%
Project	15%
Total	100%
Porfolio (Extra Credit)	Up to 5 Points on Final Grade

6. **Brief list of topics to be covered.**
   a. **Fundamental Units**
      i. **Fundamental Units**
      ii. **Units derived from Fundamental Units**
      iii. **Mathematical relations and problems**
   b. **Engineering Design process**
      i. **Engineering Notebooks**
      ii. **Drawing and Sketching ideas**

ABET Course Syllabi for

1. **Course number and name:** ENGR-130: Engineering Graphics
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 12:30 PM – 1:50 PM
3. **Instructor's Name:** Harold Halliday
4. **Textbook:** *Technical Drawing*, 5th ed., Goestsch, Chalk, Rickman, & Nelson
   ISBN-10: 1-4018-5760
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      In this course the basic principles of Engineering Graphics, blueprint reading and geometric constructions are reviewed. Multi-view projections and 3D visualization, and basic dimensioning are introduced. This course is intended for but, not restricted to, on-line delivery. The course also introduces students to solid modeling and basic methods of rapid prototyping including 3-D printing.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: DFT-101: Technical Drafting or permission of the instructor.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      ENGR-130: Engineering Graphics is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - To provide students the skills and knowledge needed to create mechanical engineering drawings.
      - To provide students' knowledge and skills to create necessary views and notation of mechanical parts including springs and fasteners.
      - Provide students an introduction to 3D modeling skills needed to create mechanical engineering models and drawings.
   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 demonstrate the ability to produce accurate multi-view drawings.	Evidenced by drawing assignments and exercises
Student will demonstrate the ability to produce sectional views given adequate information.	
Student will be able to create Auxiliary Views given adequate information.	
Student will be able to demonstrate knowledge of threads and springs.	
Student will be able to apply proper dimensions and tolerance to mechanical parts.	
Student will be able to use tables to determine various fits as well as appropriate fasteners.	Evidenced by drawign assignments and in-class observations

Grading Plan:	
80%	Drawings/ Exercise
10%	Quiz(s)
10%	Attendance
100%	TOTAL

7. Brief list of topics to be covered.

- Essentials of Mechanical Drafting
- Orthographic projections
- Sectional views
- Auxiliary views
- Threads
- Fasteners and Springs
- Dimensions

ABET Course Syllabi for

1. **Course number and name:** ENGR-169: Basic Statistics and Probability
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 8:00 AM – 9:20 AM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Applied Statistics and Probability for Engineers*, 6th ed., Montgomery & Runger.
   ISBN-13: 978-1-118-53971-2
   ISBN-10: 1-118-53971-0
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course will introduce students to Descriptive Statistics, presentation of Statistical Data, and the field of Probability. Probability will include manipulation of probability and conditional probabilities. Discrete distributions, Continuous distributions, and Joint probability will also be covered.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: MTH-120: Intermediate Algebra
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      ENGR-169: Basic Statistics and Probability is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will be able to determine permutations and combinations of a sample space and associated probabilities.
      - Students will be able to assess conditional probabilities for dependent and independent events.
      - Students will be able to use probability functions and cumulative probability functions of discrete and continuous variables to compute distribution parameters (Expected value and variance).
      - Students will be able to use tables to calculate probability for Normal, student or chi squired distributions.
      - Students will be able to present statistical data.
      - Students will be able to create Histograms and other statistical charts.
   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
The student will be able to collect data and to use tools to create analysis of data based on data gathered or provided.	Assessment will be by problems presented in homework, quizzes, & tests.
Students will know methods of presentation of statistical data.	
Students will be able to calculate probabilities.	
Students will be able to understand joint distributions.	Assessment will be by problems presented in homework or projects.
Students will be able to manipulate multiple probabilities and conditional probabilities.	Assessment will be by problems presented in homework, quizzes, & tests.

Grading Plan:	
Homework	20%
Attendance & participation	10%
Weekly quizzes	20%
Midterm	20%
Final	20%
Project	10%
Total	100%
Portfolio (Extra Credit)	+

7. Brief list of topics to be covered.

- Introduce students to:
  - Descriptive Statistics,
  - Presentation of Statistical Data
  - Probability.
- Probability will include:
  - Manipulation of probability
  - Conditional probabilities
- Discrete distributions,
- Continuous distributions
- Joint probability

ABET Course Syllabi for

1. **Course number and name:** ENGR-143: Characteristics of Engineering Materials
2. **Credits and contact hours:** 3 Credits
3. **Instructor's Name:**
4. **Textbook:** _Materials Science, Testing, and Properties for Technicians_, 1st ed., Fellers, William O.
   ISBN-13: 978-0-135-60764-0
   ISBN-10: 0-135-60764-7
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   This course introduces the basic features of materials and selected methods of Classification of Materials. Topics include Nature of Materials, Types of Materials, Scale of Materials, Properties of Materials, Application of Materials, Processing of Materials, and Characterization Methods for Classification of Materials.
   b. **Pre-requisites or co-requisites**
   There are no required pre-requisites or co-requisites for ENGR-143: Characteristics of Engineering Materials.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   ENGR-143: Characteristics of Engineering Materials is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
   To introduce students to the basic features of materials and selected methods of Classification of Materials.
   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.**
   - Nature of Materials
   - Types of Materials
   - Scale of Materials
   - Properties of Materials
   - Application of Materials
   - Processing of Materials
   - Characterization Methods for Classification of Materials

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 Industrial 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
Apply appropriate technique to integrate	Formative assessment, Summative assessment, Applications
Apply appropriate technique to solve the limitations	
Solve application problems related to intergration	
Use different strategies to test convergence of a sequence or series	

Grading Plan:	
Quiz	25%
Homeworks/Classwork	20%
Midterms/Finals	40%
Attendance	5%
Class Participation	5%
Presention/Project	5%

Assessment Pieces:

The student will be assessed in a variety of ways:

- Pre-Test/Post Test
- Quizzes/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:** CHM-120: General Chemistry I
2. **Credits and contact hours:** 4 Credits and Lecture (Monday/Wednesday) 2:300 PM – 3:50 PM; Laboratory (Friday) 8:00 AM – 11:00 AM
3. **Instructor's Name:** Thigarajan Soundappar, Ph.D
4. **Textbook:** *Chemistry: The Practical Science*, Kelter, Mosher, and Scott
   Laboratory Manual to Accompany Chemistry: *The Practical Science*, Kelter, Mosher, and Almy
   ISBN-13: 978-0-547-004938
   ISBN-10: 0-547-00493-1
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course introduces students to chemistry measurements, atomic structure, chemical reactions, gases, thermochemistry, and bonding. A lab is also included as part of the course.
   b. **Pre-requisites or co-requisites**
      Prerequisite: MTH-120: Intermediate Algebra. Lab fee: $125.00
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      CHM-120: General Chemistry I is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      The general objective of this course is to gain knowledge on both theoretical and descriptive chemistry. As a supplement, there are various activities that students will engage. Lectures and laboratories are an integral part of the course, so lecture discussion and the experiential learning are expected in order to assist students in the development of problem solving skills and basic chemical concepts.
   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
Describe the process of scientific inquiry	Students complete exercises, quizzes, and exams. Students use simulations to help visualize submicroscopic phenomena. Students conduct laboratory experiments and submit weekly reports.
Solve problems scientifically	Students conduct laboratory experiments and sbumit weekly reports. Laboratory reports include data, graphs, results, and answers to post lab questions. Students complete quizzes and exams.
Communicate scientific information	Students review, write, and present summaries of scientific journal articles. Weekly written lab reports and semester research project are evaluated.
Apply quantitative analysis to scientific problems	Students are observed for appropriate use of laboratory techniques. Students conduct laboratory experiments and submit weekly lab reports. Students use calculators to solve problems in exercises, quizzes, lab reports, and exams.
Apply scientific thinking to real world problems	Students summarize written and film formats of chemistry related case studies. Weekly written lab reports and a semester research project are evaluated.

Grading System: Midterm		**Grading System: Finals**	
Quizzes (lec)	30%	Exams and Quizzes	30%
Midterm Exam (lec and lab)	20%	Final Exam	20%
Lab Reports	25%	Laboratory Reports	25%
Home, Assignments, Quizzes (lab)	10%	Homework, Assignments,	10%
Attendance, Participation	15%	Attendance, Participation	15%
Total	100%	Total	100%

Brief list of topics to be covered.

- **Chapter 1 – The World of Chemistry**
- **Chapter 2 – Atoms: A Quest for Understanding**
- **Chapter 3 – Introducing Quantitative Chemistry**
- **Chapter 4 – Solution Stoichiometry and Types of Reactions**
- **Chapter 5 – Energy**
- **Chapter 6 – Quantum Chemistry: The Strange World of Atoms**
- **Chapter 7 – Periodic Properties of the Elements**
- **Chapter 8 – Bonding Basics**

ABET Course Syllabi for

1. **Course number and name:** ENGR-230: Advanced Engineering Graphics
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 11:00 AM – 12:20 PM
3. **Instructor's Name:** Harold Halliday
4. **Textbook:** *Technical Drawing and Engineering Communication*, 6th ed., Goetsch, Chalk, Nelson, and Rickman
   ISBN-13: 978-1-4283-3583-7
   ISBN-10: 1-4283-3583-8
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course will use 3D mechanical software to explain proper solid modeling techniques used for Rapid Prototyping, analysis and other applications which require 3D models. The students will learn the 3D tools and techniques used by NASA and contractors such as Lockheed Martin, Aerojet, Boeing, as well as others.
   b. **Pre-requisites or co-requisites**
      Pre-requisite is ENGR-130: Engineering Graphics
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      ENGR-230: Advanced Engineering Graphics is a *required* course in the Industrial Engineering program.
7. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - To provide students with advanced tools of Parametric Modeling.
      - To provide students with an interactive model based instruction to reinforce the concepts learned in Mechanical Drafting.
      - To provide students the ability to create Engineering Drawings from Parametric Models.
      - To provide students with an introductory knowledge of Parametric Assemblies.
   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
The student will be able to create Mechanical 3D Models using Parametric Modeling software.	Assessment will be project based, completing several drawings and exercises.
Students will be able to create and annotate Auxiliary Views from Parametric solids and assemblies.	Project based (Model Creation and drawings)
Students will be able to create and annotate Section Views from Parametric Solids.	
Students will be able to create threads and springs.	
Students will be able to create and annotate Assemblies.	

Grading Plan:	
Drawings/models	70%
Attendance	10%
Final Project	20%
Total	100%

7. Brief list of topics to be covered.

ABET Course Syllabi for

1. **Course number and name:** ENGR-236: Inferential Engineering Statistics
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 8:00 AM – 9:20 AM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Applied Statistics and Probability for Engineers*, 6th ed., Montgomery & Runger.
   ISBN-13: 978-1-118-53971-2
   ISBN-10: 1-118-53971-0
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   The new ENGR-236 Inferential Engineering Statistics will have more time that can be spent on Hypothesis testing for single samples and more statistical distributions can be discussed. Understanding of ANOVA and regression can be incorporated which has not been extensively apart of this course in the past. Part of this change will be in switching to a new book which has more material and goes into more depth with examples and techniques not included in the present text/ this book will be used for both course.
   b. **Pre-requisites or co-requisites**
   Pre-requisite: MTH-121: College Algebra and ENGR-169: Basic Statistics and Probability.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   ENGR-236: Inferential Engineering Statistics is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will be able to determine permutations and combinations of a sample space and associated probabilities.
      - Students will be able to assess conditional probabilities for dependent and independent events.
      - Students will be able to use probability functions and cumulative probability functions of discrete and continuous variables to compute distribution parameters (Expected value and variance).
      - Students will be able to use the tables to calculate probability for Normal or chi squared distributions.
      - Students will be able to perform Type I and Type II error and power of test calculations.
      - Students will understand samples and sampling techniques.
   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
The student will be able to collect data and to use tools to create analysis of data based on data gathered or provided.	Assessment will be by problems presented in homework, quizzes, & tests.
Students will be able to use date and tabular information to create confidence intervals, tolerance intervals, and prediction intervals.	
Students will be able to use hypothesis testing to compare data sets.	
Students will be able to use Excel to manipulate and analyze statistical data.	Assessment will be by problems presented in homework or projects.
Students will be able to use regression to create models useful to predicting outcomes.	Assessment will be by problems presented in homework, quizzes, & tests.

Grading Plan:	
Homework	20%
Attendance & participation	10%
Weekly quizzes	20%
Midterm	20%
Final	20%
Project	10%
Total	100%
Porfolio (Extra Credit)	+

7. Brief list of topics to be covered.

- Hypothesis testing for a single sample
- Hypothesis testing for two samples using the normal distributions (z & t),
- Chi-squared distribution
- F distribution
- Simple linear regression
- Multiple regression
- Analysis of Variance (ANOVA)

ABET Course Syllabi for

1. **Course number and name:** PHY-111: Algebra Based Physics I
2. **Credits and contact hours:** 4 Credits and (Tuesday/Thursday/Friday) 11:00 AM – 12:20 AM
3. **Instructor's Name:** Abraham Meles, Ph.D
4. **Textbook:** *Physics: Principles with Applciations*, 7th ed., Gianocoli, C. Douglas, New Yersey: Pearson Prentice Hall: Pearson Education Inc., 2005
   ISBN-10: 0-321-76242-8
   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)**
   This course is the first in a two-semester introduction to algebra-based physics. The broad topics covered in the course include mechanics, vibrations, and wave motion. More specifically, the topics covered involve one-and two-dimensional motion, vectors, work and energy, momentum and collisions, circular motion, rotational equilibrium and dynamics, solids and fluids, vibration and waves, and sound. Mathematical techniques used in the course include algebra, geometry, and trigonometry, but not calculus. Class meetings will be devoted to lecture, discussion, problem-solving, and discovery labs. There will be three hours of discovery lab each week.
   b. **Pre-requisites or co-requisites**
   Prerequisite: MTH-120: Intermediate Algebra or permission of the instructor. This course is only offered in the fall semester. Lab Fee: $100.00
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   PHY-111: Algebra Based Physics I is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - 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 of energy, momentum and impulse, and the fundamental laws that govern said concepts.
      - A basic understanding of thermodynamics and the fundamental 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 an assignement that will be presented in a formal paper.	Completion of lab assignments

Grading Plan:	
Tests (2 at 10%)	20%
Quizzes	25%
Homework	40%
Final Exam	15%

7. Brief list of topics to be covered.

- Units and Conversion
- 1-D Kinematics
- 2-D Kinematics
- Dynamics
- Gravitation (Circular Motion)
- Work and Energy
- Linear momentum
- Rotational Motion
- Static Equilibrium
- Fluids
- Vibrations and Waves
- Sound
- Temperature and Kinetic Theory
- Heat
- The Laws of Thermodynamics

ABET Course Syllabi for

1. **Course number and name:** IE-235: Lean Production
2. **Credit and contact hours:** 3 Credits and (Friday) 8:00 AM – 11:00 AM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *How To Implement Lean Manufacturing*, 2nd ed., Wilson, Lonnie
   ISBN-13: 978-0-07-183573-2
   ISBN-10: 0-07-183573-3
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course will introduce the student to variations of the Toyota Production System as it is used in industry and business to improve efficiency and to build a problem solving culture in an organization. Topics will include: 5S, Value Stream Mapping, SMED, Kanban, Takt Time, Process at A glance and organizational culture change. Course will also compare other manufacturing philosophies and systems for manufacturing and production.
   b. **Pre-requisites or co-requisites**
      There are no pre-requisites or co-requisites for IE-235: Lean Production.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-235: Lean Production is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will be able to discuss different manufacturing philosophies and understand when their application would be useful.
      - Students will be able to calculate Takt Time and understand its use in a manufacturing or administrative environment.
      - Students will be able to understand how to apply 5S.
      - Students will be able to describe how to use Lean methods to reduce cost, increase product quality and to reduce lead time
      - Students will be able the methodologies of SMED, TPM, JIT, Poke Yoke and Jidoka
      - Students will understand basic techniques of facilitating Kaizen events and how they are used.
   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
The student will be able to understand processes and to use tools to improve them.	Assessment will be by problems presented in homework, quizzes, tests, & project.
Students will be able to understand the holisitc nautre of Lean Production and how the different elements work together to strengthen a company, its customer service and profitability.	Assessment will be by problems presented in homework, quizes, & tests.
Students will be able to use some advanced methods to improve processes.	
Students will be able to compare different production philosophies .	Assessment will be by problems presented in homework or projects.

Grading Plan:	
Homework	15%
Attendance & participation	15%
Weekly quizzes	15%
Midterm	20%
Final	20%
Project	15%
Total	100%
Portfolio (Extra Credit)	+

7. Brief list of topics to be covered.

- 5S
- Value Stream Mapping
- SMED
- Kanban
- Takt Time
- Process At A Glance
- Organization culture change

ABET Course Syllabi for

1. **Course number and name:** IE-223: Design & Manufacturing Processes I
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 3:30 PM – 4:45 PM
3. **Instructor's Name:** Casmir I. Agbaraji, Ph.D.
4. **Textbook:** *Manufacturing Engineering and Technology*, 7th ed., Serope Kalpakjian and Steven R. Schmid, 2014, Pearson.
   ISBN-13: 978-0-13-312874- 1
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      An introductory course in manufacturing processes and systems will be covered. In addition, various manufacturing processes will be studied, including casting, forming, machining, and welding. Also, manufacturing systems such as industrial robotics and fundamentals of production lines will be covered. Students will develop hands-on skills through team projects.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: IE-213: Structure and Properties of Materials
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-223: Design & Manufacturing Processes I is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      After successfully completing this course:
      - To introduce students to important concepts in material selection, design, and manufacturing processes.
      - To stimulate creative thinking in students.
      - Conduct laboratory experiment to investigate manufacturing processes.
      - Demonstrate the ability to work as a team member in solving a design problem.
   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.**
   I. General introduction to manufacturing
   II. Fundamentals of materials: their behavior and manufacturing properties
   III. Mechanical behavior, testing, and manufacturing properties of materials
   IV. Physical properties of materials
   V. Metal alloys: their structure and strengthening by heat treatment
   VI. Ferrous metals and alloys: production, general properties, and applications
   VII. Nonferrous metals and alloys: production, general properties, and applications.
   VIII. Polymers, ceramics and composites
   IX. Metal-casting processes
   X. Forming and shaping processes and equipment
   XI. Rolling of metals
   XII. Extrusion and drawing of metals
   XIII. Forging of metals
   XIV. Sheet-metal forming processes

XV. Processing of powder metals, ceramics, glass, and superconductors
XVI. Material-removal processes and machining
Welding and joining

COURSE OUTCOMES	COURSE MEASUREMENTS
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.	Complete reading assignments, homework assignments, exams, projects, and quizzes.
A strong understanding of team projects.	
A strong understanding of creative thinking.	
An ability to identify, formulate, and solve engineering problems.	
A knowledge of contemporary issues.	
An understanding of professional and ethical responsibility.	
An ability to communicate effectively.	
The broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context.	Complete reading assignments, homework assignments, exams, projects, and quizzes.
An ability to use the techniques, skills, and modern engineering tools necessary for engineering	
An ability to apply knowledge of mathematics, sciene, and engineering.	
A recognition of the need for and an ability to engage in life-long learning.	

Grading Plan:	
Homework	20%
Mid-term	20%
Final Exam	25%
Project	10%
Quizzes	20%
Class Participation	3%
Portfolio	2%

ABET Course Syllabi for

1. **Course number and name:** ME-345: Statics
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 9:30 AM – 10:50 AM
3. **Instructor's Name:** Gholam Reza Ehteshami, Ph.D.
4. **Textbook:** *Engineering Mechanics, Statics*, 13th ed., R.C. Hibbeler, Pearson Prentice Hall.
   ISBN-13: 978-0-132-91554-0
   ISBN-10: 0-132-91554-5
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course will introduce students to the science of statics. During the course students will learn how to determine the relationships between forces acting on rigid bodies at rest. Areas covered will be scalar and vector quantities, resultants, analysis of structures, friction, centroids and center of gravity.
   b. **Pre-requisites or co-requisites**
      There are no pre-requisites or co-requisites for ME-345: Statics.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**

ME-345: Statics is a *required* course in the Industrial Engineering program.

6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      After successfully completing this course, students should be able to:
      - Analyze forces and find out the resultant forces in two and three dimension.
      - Differentiate between various types of supports and draw free-body-diagrams.
      - Compute the reaction force, internal forces, and bending moment at a specific point on a simple structure (beam, frame, and truss).
      - Draw bending moment and shear force diagram to simple structure.
      - Obtain center of mass and centroid for deferent engineering shapes & moment of inertia for deferent sections.
   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
A strong understanding of free-body-diagrams	Complete reading assignments, homework, assignments, exams, projects, and quizes.
A strong understanding of application of Statics in solid Mechanics.	
A strong understanding of resultants and moments of forces acting on a rigid body.	
A strong understanding of analysis of the rigid body at rest.	
A strong understanding of active andreactive forces on rigid and non-deformable bodies.	

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.

ABET Course Syllabi for

1. **Course number and name:** MTH-410: Linear Algebra
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 8:00 AM – 9:15 AM
3. **Instructor's Name:** Sasha Han
4. **Textbook:** *Elementary Linear Algebra, 8th ed., Ron Larson*
   ISBN-13: 978-1-305-65801-1
   ISBN-10: 1-305-65801-9
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   An introduction to Linear Algebra will cover systems of equations, matrices, vector spaces, and linear transformations with some applications. At times, the learning process relating to the Navajo culture in the areas of Nitsahakees, Nahatah, Iina, and Sihasin will be covered as well as other cultures (multi-cultural studies).
   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 Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**

COURSE OUTCOMES	COURSE MEASUREMENTS
Analyze and solve systems of equations.	Formative assessment, Summative assessment, and Applications.
Analyze and use the properties of vectors and vector spaces.	
Analyze and use the properties of matrices and linear transformations.	
Solve applied problems	

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

Grading Plan:	
Quiz	25%
Homework/Classwork	20%
Midterms/Finals	40%
Attendance	5%
Class Participation	5%
Presentation/Project	5%

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

- Pre-Test / Post-Test
- Quizzes/Midterms/Finals

- Presentation/Project
- Regular formative assessments like classwork and homework
- Informal assessments like recitation or teacher observation

7. Brief list of topics to be covered.

- Systems of linear equations
- Matrices
- Vector Spaces
- Linear Transformations

ABET Course Syllabi for

1. **Course number and name:** ENGR-313: Engineering Economics
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 8:00 AM – 9:30 AM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Engineering Economy*, 16th ed., Sullivan, Wicks, and Koelling, Prentice Hall, Boston, 2015.
   ISBN-13: 978-0-13-343927-4
   ISBN-10: 0-13-343927-5
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      Topics covered include: cost and worth comparison, capital costs, time value of money, replacement economics, taxes, economic efficiency of alternate designs, minimum costs and maximum benefits, risk and uncertainty. Students will learn how to apply economics to engineering projects in order to ensure projects are feasible and efficiently designed and completed.
   b. **Pre-requisites or co-requisites**
      There are no pre-requisites or co-requisites for ENGR-313: Engineering Economics.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      ENGR-313: Engineering Economics is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Understand simple and compound interest.
      - Move single and annualized cash flows along a time line using a compound interest rate.
      - Move arithmetic and geometric gradient cash flows along a time line using a compound interest rate.
      - Convert between nominal and effective interest rates.
      - Determine an effective interest rate for cash flows with payment periods different from compounding periods.
      - Determine unknown years and interest rates for net present worth (NPW) determination.
      - Convert arbitrary cash flows into NPW, net future worth, or annual worth values.
      - Compare alternatives with same life-cycle, different life-cycles and infinite life using NPW.
      - Compute an Internal Rate of Return (IRR) for a set of cash flows.
      - Identify complex cash flows with multiple IRR values and select the proper IRR.
      - Compare alternatives using Rate-Of-Return (ROR) total and incremental analysis.
      - Perform sensitivity analysis and break/even analysis of economic project.
      - Classify benefits, disbenefits, and cost for Benefit/Cost analysis.
      - Utilize straight line and MACRS depreciation techniques.

- Utilize spreadsheet software for economic analysis.

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

COURSE OUTCOMES	COURSE MEASUREMENT
The student will be able to gather data and to use tools to create analysis of data based on data gathered or provided.	Assessment will be by problems presented in homework, quizzes, & tests.
Students will be able to use data and tabular information to create comparisons between present, annual or future value of projects.	
Students will understand Engineering Economy concepts and be able to apply them in appropriate circumstances.	Assessment will be by problems presented in homework, projects, quizzes, & tests, including Pre and Post Tests for assessment.
Students will be able to convert cash flows to compare projects for equivalence.	Assessment will be by problems presented in homework, projects, quizzes, & tests.
Students will be able to use Excel to analyze data for economic projects.	Assessment will be by problems presented in homework
Students will understand and be able to calculate rates of return.	Assessment will be by problems presented in homework, quizzes, & tests.

Grading Plan:	
Homework	20%
Attendance & participation	10%
Weekly quizzes	20%
Midterm	20%
Final	20%
Project	10%
Total	100
Portfolio (Extra Credit)	+%

7. Brief list of topics to be covered.

- Cost and Worth Comparison
- Capital Costs
- Time Value of Money
- Replacement Economics
- Taxes
- Economic Efficiency of Alternate Designs
- Minimum Cost and Maximum Benefits
- Risk and Uncertainty

ABET Course Syllabi for

1. **Course number and name:** MTH-310: Differential Equations
2. **Credits and contact hours:** 4 Credits and (Tuesday/Thursday) 12:00 PM – 1:40 PM
3. **Instructor's Name:** Sasha Han
4. **Textbook:** <u>*Differential Equations with Boundary – Value Problems*</u>, 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)**
      An introduction to differential equations. Students will be able to classify, construct, and solve different types of differential equations. At times, the learning process relating to the Navajo culture in the areas of Nitsahakees, Nahatah, Iina, and Sihasin will be covered as well as other cultures (multi-cultural studies).
   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 Industrial 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.

COURSE OUTCOMES	COURSE REQUIREMENTS
Verify solutions to differential equations.	Formative assessment, Summative assessment, Applications.
Classify differential equations by order, linearity, and homogeneity.	
Identify an appropriate technique to solve the differential equations.	
Students will solve related application problems.	

      - 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.**

Grading Plan:	
Quiz	25%
Homework/Classwork	20%
Midterms/Finals	40%
Attendance	5%
Class Participation	5%
Presentation/Project	5%

Assessment Pieces:

- Pre-Test / Post-Test
- Quizzes/Midterms/Finals
- Presentation/Project
- Regular formative assessments like class
- Informal assessments like recitation or teacher observation

7. Brief list of topics to be covered.

- Introduction to differential equations
- First-order differential equations
- Application
- Higher-order differential equations

ABET Course Syllabi for

1. **Course number and name:** ME-353: Fluid Mechanics
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 8:00 AM – 9:20 AM
3. **Instructor's Name:** Gholam Reza Ehteshami, Ph.D.
4. **Textbook:** <u>*Applied Fluid Mechanics*</u>, 5th ed., Robert L. Mott, Pearson Prentice Hall.
   ISBN-13: 978-0-13-255892-1
   ISBN-10: 0-13-255892-0
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      Topics include: Fluid properties, turbulent and laminar flow, and gas dynamics will be examined.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: PHY-111: Algebra-Based Physics I & MTH-163: Calculus II
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      ME-353: Fluid Mechanics is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      After successfully completing this course:
      - The students will understand the basic concept of hydraulics.
      - The students will learn dimensional analysis in fluid dynamics.
      - The students will be able to understand and solve engineering problems.
      - They will learn control volume analysis.
   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
A strong understanding of fluid dynamics.	Complete reading assignments, homework assignments, exams, projects, and quizzes.
A strong understanding of dimensional analysis.	
A strong understanding of heat and mass transfer.	

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.**
   - Fluid properties
   - Turbulent and laminar flow
   - Gas dynamics

ABET Course Syllabi for

1. **Course number and name:** IE-323: Human Factors in Product Design
2. **Credit and contact hours:** 3 Credits and (Monday/Wednesday) 12:30 PM – 1:50 PM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Introduction to Human Factors Engineering*, 2nd ed., C. Wickens, J. Lee, Y. Liu & S. Gordon-Becker.
   ISBN-13: 978-0-131-83736-2
   ISBN-10: 0-131-83736-2
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      Students will learn physical and psychological factors which affect human performance in system design. In addition, course material will cover performance as applied to safety, reliability, productivity, stress reduction. The human/equipment interface design will also be discussed.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: ENGR-234: Engineering Statistics
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-323: Human Factors in Product Design is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will understand how to identify human-work problems in occupational and living environments.
      - Students will be able to measure and understand human capacities for work.
      - Students will understand how to measure physical and mental demands on human beings for specific tasks.
      - Students will understand the scientific concepts in designing environments, anthropometry, equipment and work methods for enhancing performance and minimizing stresses on the worker.
      - Students will be introduced to manual materials handling and hand tool design.
      - Student will understand information processing and mental input – mainly visual and auditory.
      - Students will understand how to increase usability of industrial and consumer products.
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

<table>
<tr><th>COURSE OUTCOMES</th><th>COURSE MEASUREMENTS</th></tr>
<tr><td>The student will be able to analyze human factors problems and suggest solutions.</td><td rowspan="3">Assessment will be by problems presented in homework, quizzes, & tests.</td></tr>
<tr><td>Students will be able to use anthropometry data for analysis and design of systems.</td></tr>
<tr><td>Students will be able to distinguish between methods of material handling and use in task design.</td></tr>
<tr><td>Students will be able to use Human Factors tools for design of machine/human interfaces.</td><td>Assessment will be by problems presented in homework.</td></tr>
</table>

Grading Plan:	
Homework	15%
Attendance & participation	15%
Weekly quizzes	15%
Midterm	20%
Final	20%
Project	15%
Total	100%
Portfolio (Extra Credit)	+

7. Brief list of topics to be covered.

- Physical and psychological factors which affect human performance in system design.
- Performance as applied to safety.
- Reliability
- Productivity
- Stress reduction
- Human/machine interfaces

ABET Course Syllabi for

1. **Course number and name:** IE-343: Design & Manufacturing Processes II
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 3:30 PM – 4:45 PM
3. **Instructor's Name:** Casmir I. Agbaraji, Ph.D.
4. **Textbook:** *Manufacturing Engineering and Technology*, 7th ed., Serope Kalpakjian and Steven R. Schmid, 2002, Prentice Hall, Inc.
   ISBN-13: 978-0-133-12874-1
   ISBN-10: 0-133-12874-1
   Reference Textbooks:
   Technical Drawing, Frederick E. Giesecke, Alva Mitchell, Henry C. Spencer, Ivan L. Hill, et al., 14th ed.
   Fundamentals of Tool Design, 4th ed., Society of Manufacturing Engineers.
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course will cover machining, process planning, blueprint reading, geometric dimensioning and tolerancing, and measuring instruments. The students will develop hands-on learning in team projects.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: IE-223: Design and Manufacturing Processes I
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-343: Design & Manufacturing Processes II is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      After successfully completing this course:
      - Students will learn discrete and assembly part manufacturing
      - The students will learn the importance of process planning
      - They will learn reading of blueprints
      - Students will learn how to identify, formulate, and solve engineering problems
   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
A strong understanding of discrete and assembly part manufacturing.	Complete reading assignments, homework assignments, exams, projects, and quizzes.
A strong understanding of process planning.	
A strong understanding of geometric dimensioning and tolerancing.	
A strong understanding of blueprint.	
An ability to identify, formulate, and solve engineering problems.	
A strong ability to apply knowledge of mathematics, science, and engineering.	
A strong ability to function on multidisciplinary teams.	
A strong ability to learn actively.	Complete readinga ssignments, homework assignments, exams, projects, and quizzes.
A strong ability to interact effectively in diverse environments.	
An ability to design and conduct experiments as well as to analyze and interpret data	
An ability to communicate effectively.	

Grading Plan:	
Homework	20%
Mid-term	20%
Final Exam	25%
Project	10%
Quizzes	20%
Class Participation	3%
Portfolio	2%

7. Brief list of topics to be covered.

I. Introduction to design and manufacturing
II. Allowances and fits
III. Surface roughness specification and interpretation
IV. Single and multi-point cutting tools
V. Machining processes fundamentals
VI. Machine tools, tools, and tooling
VII. Process planning
VIII. Machining time calculations
IX. Machining economics
X. Blueprint reading
XI. Measuring instruments
XII. Geometric dimensioning and tolerancing (GDT)

ABET Course Syllabi for

1. **Course number and name:** IE-363: Design of Experiments
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 12:30 PM – 1:50 PM
3. **Instructor's Name:** Gholam Reza Ehteshami, Ph.D.
4. **Textbook:** *Design and Analysis of Experiments*, 8^{th} Edition, by D.C. Montgomery, John Wiley & sons, New York.
   ISBN-13: 978-1-118-14692-7
   ISBN-10: 1-118-14692-1
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      Analysis of variance for different types of factorial designs (single factor, nested, and random factors) will be discussed. Also, different factors during design of experiment, i.e., dependent, independent, and control variables will be explored.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: ENGR-234: Engineering Statistics
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-363: Design of Experiments is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Learn how to plan, design and conduct experiments efficiently and effectively
      - Analyze the resulting data to obtain object conclusions
      - Both design and statistical analysis issues are discussed
      - Opportunities to use the principles taught in the course arise in all phases of engineering work, including new product design and development, process development, and manufacturing process improvement.
      - Applications from various fields of engineering (include chemical, mechanical, electrical, materials science, industrial, etc.) will be illustrated throughout the course.
   b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.**

<table>
<tr><th>COURSE OUTCOMES</th><th>COURSE MEASUREMENTS</th></tr>
<tr><td>Translate an experimental description into statistical model, including indentifying model restrictions and assumptions.</td><td rowspan="5">Complete reading assignments, homework assignments, exams, projects, and quizzes.</td></tr>
<tr><td>Develop appropriate hypothesis tests and statistical comparisons for non-standard designs; assess the appropriateness of computer packages test for nonstandard design.</td></tr>
<tr><td>Communicate experimental designs to a technical audience.</td></tr>
<tr><td>Evaluate and plan a sound experimental design, including randomization and power analysis.</td></tr>
<tr><td>Analyze experiments in the presence of common diculties, including missing and unbalanced data.</td></tr>
</table>

Grading Plan:	
Homework	15%
Attendance & Participation	15%
Weekly Quizzes	15%
Midterm	20%
Final	20%
Project	15%
Total	100%
Portfolio (Extra Credit)	+%

7. Brief list of topics to be covered.

ABET Course Syllabi for

1. **Course number and name:** IE-380: Project Management
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 8:00 AM – 9:20 AM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Project Management: The Managerial Process*, 6th ed., Larson and Gray.
   ISBN-13: 978-1-259-18640-0
   ISBN-10: 1-259-18640-7
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course examines the organization, planning, and controlling of projects and provides practical knowledge on managing project scope, schedule and resources. Topics include project life cycle, work breakdown structure and Gantt charts, network diagrams, scheduling techniques, and resource allocation decisions. Concepts are applied through team projects and tutorials using project management software.
   b. **Pre-requisites or co-requisites**
      Pre-requisite: Junior status
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-380: Project Management is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will be given further information about ethical principles.
      - Students will understand management methods and principles.
      - Students will understand how to organize and manage projects.
      - Students will be able to use project management tools such as work breakdown structure, Gnatt Charts, and network diagrams.
      - Students will understand the concepts of using Critical Path Method, PERT, and other scheduling techniques.
      - Students will be introduced to risk management and mitigation.
      - Students will understand Project Life Cycle design and planning.
      - Students will improve knowledge of managing project culture.
      - Students will be introduced to resource allocation.
   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
The student will be able to analyze project scheduling problems and suggest solutions.	Assesment will be by problems presented in homework, quizzes, & tests.
Students will be able to identify risk management problems.	
Students will be able to create Gantt charts and other scheduling forms.	
Students will be able to use work breakdown structure to define steps needed in the Project Life Cycle.	Assessment will be by problems presented in homework.
Students will be able to allocate resources based on priority and schedule.	Assessment will be by problems presented in homework, quizzes, & tests.

Grading Plan:	
Homework	15%
Attendance	5%
Participation	10%
Weekly quizzes	15%
Midterm	20%
Final	20%
Project	12%
Total	100%
Portfolio (Extra Credit)	Up to 5 Points on Final Grade

7. Brief list of topics to be covered.

- Ethics
- Management
- Organization
- Planning and controlling of projects and provides practical knowledge on managing project scope.
- Schedule and resources
- Project Life Cycle
- Work break down structure
- Gnatt charts
- Network diagrams
- Scheduling techniques
- Resource allocation decision

ABET Course Syllabi for

1. **Course number and name:** ME-354: Thermodynamics
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 3:30 PM – 4:50 PM
3. **Instructor's Name:** Gholam Reza Ehteshami, Ph.D.
4. **Textbook:** *Fundamentals of Engineering Thermodynamics*, 8th ed., Michel J. Moran.
   ISBN-13: 978-1-118-41293-0
   ISBN-10: 1-118-41293-1
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      Topics include: Laws of Thermodynamics, Phase of substances, Processes and cycles, Work and heat, Control Volumes, Entropy and Enthalpy.
   b. **Pre-requisites or co-requisites**
      Pre-requisites: PHY-111: Algebra Based Physics & MTH-163: Calculus II
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      ME-354: Thermodynamics is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Learn about thermodynamic systems and boundaries
      - Study the basic laws of thermodynamics including: conservation of mass, conservation of energy, and second law
      - Understand various forms of energy including heat transfer and work
      - Identify various types of properties (e.g., extensive and intensive properties)
      - Use tables, equations, and charts, in evaluation of thermodynamics properties
      - Apply conservation of mass, first law, and second law thermodynamic analysis of systems (e.g., turbines, pumps, compressors, heat ex-changers, etc.)
      - Use computer software in evaluation of thermodynamic properties and graphical presentation of problem solutions
      - Enhance their problem solving skills
   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
An ability to apply knowledge of mathematics, science, and engineering to solve the problems in thermodynamics.	Complete reading assignments, homework assignments, exams, projects, and quizzes.
An ability to analyze and interpret data, such as thermodynamic tables and empiricial	
An ability to use international units and standards.	
Recognition for the need and an ability to engage in lifelong learning.	
An ability to identify formulates and solves engineering problems, such as those given in the first six chapters of the course material.	

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.**
    - Basic Concept and First Law
    - Second Law
    - Properties of Pure Substance and Steam Power Cycle
    - Ideal and Real Gases and Thermodynamic Relations
    - Psychrometry

ABET Course Syllabi for

1. **Course number and name:** IE-413: Quality Control
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 12:30 PM – 1:50 PM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Introduction to Statistical Quality Control*, 7th ed., Douglas C. Montgomery
   ISBN-13: 978-1-118-14681-1
   ISBN-10: 1-118-14681-6
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course covers digital inspection utilizing computer-aided verification. Geometric dimensioning and tolerance control and basic size inspection will also be covered along with surface inspection and the basics of quality control.
   b. **Pre-requisites or co-requisites**
      Pre-requisites: IE-363: Design of Experiment
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-413: Quality Control is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will understand management of quality.
      - Students will be able to understand and develop control charts.
      - Students will understand how to collect data for monitoring industrial processes.
      - Students will understand the broad context of quality philosophies.
      - Students will understand quality management theory.
      - Students will understand process analysis.
      - Students will understand quality improvement techniques.
      - Students will understand the meaning of statistical control and random variability.
      - Students will understand acceptance sampling techniques.
   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
The student will be able to collect data and to use tools to create analysis of data based on data gathered or provided.	Assessment will be by problems presneted in homework, quizzes, & tests.
Students will be able to create control charts based on data.	
Students will be able to distinguish between different quality management theories.	
Students will be able to use Excel to create charts for projects.	Assessment will be by problems presented in homework or projects.
Students will be able to use Statistical Process Control for industrial processes.	Assessment will be by problems presented in homework, quizzes, & tests.

Grading Plan:	
Homework	15%
Attendance	5%
Participation	10%
Weekly quizzes	15%
Midterm	20%
Final	20%
Project	15%
Total	100%
Portfolio (Extra Credit)	Up to 5 Points on Final Grade

7. Brief list of topics to be covered.

- Introduction to Statistical Control
- Statistical Concepts
- Quality Tools
- Process Capability Analysis
- Measurement System Analysis
- Control Charts for Variables
- Control Charts for Attributes
- Other SPC Techniques
- Acceptance Sampling
- Lean and the Quality Function
- Quality Function Deployment

ABET Course Syllabi for

1. **Course number and name:** IE-433: Metrology & Instrumentation
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 3:30 PM – 4:50 PM
3. **Instructor's Name:** Vincent J. Vohnout, P.E., Ph.D.
4. **Textbook:** *None (Reading/ reference materials will be supplied)*
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   Students will learn different types of measurement techniques, including laser scanning for computer-aided manufacturing and inspection, optical instruments, temperature, pressure, and force measurements. Medium to long range scanners and close range high quality scanners will be used in the course. Students will gain hands-on experience in capturing digital data, registering scan, and processing scans.
   The course covers different aspects of dimensional measurement technology put in a production context. The intention is to give a good competence in industrial metrology, i.e. knowledge about traditional and new instrumentation, how to handle and select appropriate measurement tools, how to estimate and avoid measurement uncertainties and a good understanding of the role of measurement in the production chain.
   b. **Pre-requisites or co-requisites**
   Pre-requisites: IE-223: Design and Manufacturing Processes I
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   IE-433: Metrology & Instrumentation is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - To understand the basic principles of measurements.
      - To learn the various measuring instruments, their principle of operation and applications.
      - To learn about various methods of measuring Mechanical and process parameters.

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

COURSE OUTCOMES	COURSE MESUREMENTS
Understand and respond to the need for rigorous and formal metrology concepts in designing and using measurement systems.	Complete reading assignments, homework assignments, exams, projects, and quizzes.
Ability to interpret measurement data, to estimate measurement uncertainties and to achieve and present traceable measurement results.	
Have knowledge about different measurement methods and instruments, both traditional and modern that are used in industry to measure artifact dimensions and process conditions.	
Understand the main purposes of measurement, such as, to control a production process, assess product function(s) and the product.	
Have a good understanding of the role of measurement in the production chain and how to select appropriate measurement quantities and tools for these purposes.	

Grading Plan:	
Labs/Homework	40%
Mid-term	20%
Final Exam	20%
Quizzes	15%
Class Participation	5%

7. Brief list of topics to be covered.

I. Need for metrology- Metrology concepts in designing and measurement of the systems.
II. Estimate measurement uncertainties and present traceable measurement. Linear and Geometric Tolerances, precision measurement of the devices.
III. Different measurement methods and instruments, how to measure product dimensions, shape and surface structure.
IV. Three main purposes of measurement; production process, the product function and the product design.
V. Measurement in the production chain, computer aided integration and quality control.
VI. Fundamentals of Optical Metrology, Optical interferometry – theory and overview, light sources, detectors and imaging systems.

ABET Course Syllabi for

1. **Course number and name:** IE-453: Engineering Optimization
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 12:30 PM – 1:50 PM
3. **Instructor's Name:** Frank Stomp, Ph.D
4. **Textbook:** *Operations Research – An Introduction*, 9th ed., Hamdy A. Taha, Prentice Hall
   ISBN-13: 978-0-13-255593-7
   ISBN-10: 0-13-255593-X
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      In this course data mining techniques and applications of operations research applied to financial engineering, site selection, and transportation will be learned.
   b. **Pre-requisites or co-requisites**
      Pre-requisites: ENGR-234: Engineering Statistics & MTH-163: Calculus II
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-453: Engineering Optimization is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will have an understanding of the art of describing and modeling certain kinds of problems and the science of solving the model using mathematical techniques.
      - Students will have an understanding of various OR (Operations Research) techniques.
      - Students will have an understanding of the relevance of using algorithms to obtain solutions.
   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
1. Demonstrate proficiency in understanding terminology of OR, including mathematical modeling, feasible solutions, optimization, and the relevance of algorithms.	
Understanding how to create mathematical models to model real life systems under constraints, and how to optimize them.	Observation, exercies, and projects
2. Demonstrate proficiency in using Linear Programming (LP) techniques.	
Understading in what context to use LP.	Observation, exercies, and projects
3. Demonstrate proficiency in the Simplex algorithm and sensitivity analysis.	
Understanding the iterative nature of the simplex method and understand the underlying ideas of sensitivity analysis.	Observation, exercies, and projects
4. Demonstrate proficiency in duality and post-optimal analysis	
Understanding the notion of duality and how to construct a dual problem.	Observation, exercies, and projects
Understanding how to carry out post-optimal analysis	
5. Demonstrate proficiency in the transforamtion model	
Understanding when and how to use the transformation model	Observation, exercies, and projects
Understanding of the transportion algorithm	
6. Demonstrate proficiency in network model	
Understanding when and how to use the network model	Observation, exercies, and projects
Understanding various network algorithms	
7. Demonstrate proficiency in Integar Linear Programming (ILP)	
Understanding the relevance of ILP.	Observation, exercies, and projects
Understanding ILP algorithms.	
Understanding computational intractability.	
8. Demonstrate proficiency heurisitc programming	
Understanding when and how to use heuristics to find good approximate solutions.	Observation, exercies, and projects

Grading Plan:	
Assignments & Quizzes	40
Attendance	5
Participation	5
Midterm	25
Final	25

7. Brief list of topics to be covered.

ABET Course Syllabi for

1. **Course number and name:** IE-424/EE-423: Capstone
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 2:00 PM – 3:20 PM
3. **Instructor's Name:** Peter Romine, Ph.D. and Harry Whiting
4. **Textbook:** *No Text Required*
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    The capstone course will provide the students an opportunity to utilize the skills gained from courses taken during their course of study in their program. Students will propose and execute a semester project containing elements from many classes including project management. Students must work in multidisciplinary groups each group containing at least one Industrial Engineering student and/or one Electrical Engineering student. The initial project proposal will contain the research and planning of the project along with a project proposal complete with deliverables. Students will provide weekly project reports, a final project report, a final presentation and deliverables as agreed upon in the project proposal.
    b. **Pre-requisites or co-requisites**
    Pre-requisites: IE-380: Project Management
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
    IE-424: Capstone is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
    a. **Specific outcomes of instruction:**
    Upon successfully completing this course, the student should:
        - Students will show ability to integrate learning from multiple courses into a project.
        - Students will show ability to work with a team and make valuable contributions to a team effort.
        - Students will create a Project Schedule for their project.
        - Students will show ability to work well on team and individual tasks.
        - Students will show communication skills in a final presentation of their project and written report.

    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
The student will be able to work in teams to achieve a goal of a completed project.	Assessment will be by Professors and Peer Review.
Students wil be able use skills gained in multiple courses to complete a project needing expertise from different classes.	
Students will be able to make and alter a Project Plan and Schedule.	
Students will be able to demonstrate communication skills to present their project through oral, graphical, and written means.	

Grading Plan:	
Weekly Peer Assessment	10%
Weekly Reports	15%
Weekly Professor Assessment	25%
Presentation	25%
Report	25%

7. Brief list of topics to be covered.

ABET Course Syllabi for

1. **Course number and name:** IE-463: Facility Planning & Material Handling
2. **Credit and contact hours:** 3 Credits and (Tuesday/Thursday) 9:30 AM – 10:50 AM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Manufacturing Facilities Design & Material Handling*, 4th ed., Stephens & Meyers.
   ISBN-13: 978-0-135-00105-9
   ISBN-10: 0-135-00105-6
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   Students will be able to learn how to plan a facility, location, layout models, design, analysis, supply chain relationships, and improvement of warehousing operations. Students will also study how to handle materials within the context of planning and implementation of processes.
   b. **Pre-requisites or co-requisites**
   Pre-requisites: ENGR-313: Engineering Economics
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   IE-463: Facility Planning & Material Handling is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will learn facilities design modeling incorporating the 5Ms.
      - They will learn to make decisions on facilities location problems.
      - They will learn concepts of time study.
      - They will learn warehousing and selection of material handling systems.
      - They will learn Activity Relationships and their application in Facility Planning and Design.
      - They will review the basics of Lean Production.
      - They will learn layout of production, warehouse or office spaces.

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

<table>
<tr><th>COURSE OUTCOMES</th><th>COURSE MEASUREMENTS</th></tr>
<tr><td>A strong understanding of elements and their interrlation in facility planning.</td><td>Assessment will be by problems presented in Project.</td></tr>
<tr><td>A strong understanding of decisions and factors in choosing material handling methods and equipment.</td><td rowspan="2">Assessment will be by problems presented in homework, quizzes, & tests.</td></tr>
<tr><td>A strong understanding of decision-making processes for design of production facilities and warehouses.</td></tr>
<tr><td>A strong understanding of facilities location issues and how to weight them for optimal decision making.</td><td>Assessment will be by problems presented in homework.</td></tr>
</table>

Grading Plan:	
Homework	15%
Attendance	5%
Participation	10%
Weekly quizzes	15%
Midterm	20%
Final	20%
Project	15%
Total	100%

7. Brief list of topics to be covered.

- Planning facilities
- Location
- Layout models
- Design
- Analysis
- Supply chain relationships
- Improvement of warehouse operations

ABET Course Syllabi for

1. **Course number and name:** IE-473: Inventory Control & Production Planning
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 2:00 PM – 3:20 PM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** *Supply Chain Focused Manufacturing Planning and Control*, 1st ed., W.C. Benton, Jr.
   ISBN-13: 978-1-133-58671-5
   ISBN-10: 1-133-58671-6
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      In this course, manufacturing support systems and production planning are discussed. Different approaches to the planning of material and capacity as well as the differences between push system and pull systems and Theory of Constraint will be explored.
   b. **Pre-requisites or co-requisites**
      Pre-requisites: ENGR-313: Engineering Economics
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-473: Inventory Control & Production Planning is a *required* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will be able to understand forecasting systems and methods.
      - Students will understand operation schedules.
      - Students will understand the broad context of inventory control and effect on markets.
      - Students will understand EOQ, Order Point Systems, Safety and Buffer stocks.
      - Students will be introduced to supply chain management theory.
      - Students will understand production schedules and scheduling.
      - Students will understand pull systems & JIT.
      - Students will understand MRP, Push and CONWIP systems.
   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
The student will be able to use tools to create analysis of data based on data gathered or provided.	Assessment will be by problems presented in homework, quizzes, & tests.
Students will be able to create forecasts & complete MRP charts based on data.	
Students will be able to distinugish between different inventory management systems and their uses.	
Students will be able to use capacity planning for projects.	Assessment will be by problems presented in homework.
Students will be able to calculate EOQ, Order Point, Safety and Buffer stock.	Assessment will be by problems presented in homework, quizzes, & tests.

Grading Plan:	
Homework	20%
Attendance & participation	10%
Weekly quizzes	20%
Midterm	20%
Final	20%
Project	10%
Total	100%
Portfolio (Extra Credit)	+

7. Brief list of topics to be covered.

ABET Course Syllabi for

1. **Course number and name:** IE-494: System Stimulation
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 9:30 AM – 10:50 AM
3. **Instructor's Name:** Harry S. Whiting II
4. **Textbook:** Simulation with ARENA, Kelton Sadowski & Zupick, 6th ed.
   ISBN-13: 978-0-07-340131-7
   ISBN-10: 0-07-340131-5
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course will introduce the use of ARENA to create simulations to test improvements in a virtual environment. Students will learn the methods to create a simulation of a system, validation of the simulation and how to interpret results.
   b. **Pre-requisites or co-requisites**
      Pre-requisite ENGR-123: Computer Skills for Engineering & IE-236: Inferential Engineering Statistics.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-494: System Stimulation is a required course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Students will understand the use of entities, queues, attributes and statistical accumulation within a simulation modelling environment.
      - Students will understand modelling of a system, limitations and advantages.
      - Students will understand the use of ARENA computer software to create System Simulations.
      - Students will understand the modelling of both basic and advanced systems.
      - Students will understand the use of steady state analysis with simulation to model systems.
   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 be able to model systems to analyze systems, anticipate problems and test improvements.	Assessment will be by problems presented in homework, quizzes, tests & project.
Students will be able to validate their model.	Assessment will by by problems presented in homework, quizzes & tests.
Students will understand setting up measures to count statistics going through the system.	
Students wil understand how to use simulation for testing new improvements.	Assessment will be by problems presented in homework or projects.

Grading Plan:	
Homework	20%
Attendance & participation	10%
Weekly quizzes	20%
Midterm	20%
Final	20%
Project	10%
Total	100%
Portfolio (Extra Credit)	+%

7. Brief list of topics to be covered.

ABET Course Syllabi for

1. **Course number and name:** AMT-311: Laser Scanning Methods
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 9:30 AM – 11:00 AM
3. **Instructor's Name:** Elisha Wortham and Harold "Scott" Halliday
4. **Textbook:** PDF documents provided by instructor
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    Students will learn the basics of laser scanning for digital manufacturing and inspection. Medium to long range scanners and close range high quality scanners will be used in the course. Students will gain hands-on experience in capturing digital data, registering scans and processing scans.
    b. **Pre-requisites or co-requisites**
    There are no required pre-requisites or co-requisites for AMT-311: Laser Scanning Methods
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
    AMT-311: Laser Scanning Methods is a *selected elective* course in the Industrial Engineering program.
6. **Specific goals for the course:**
    a. **Specific outcomes of instruction:**
    The objectives of this course are to:
        - Introduce students to the theory of laser scanning
        - Introduce students to the different types of laser scanning systems
        - Introduce students on how to process scan data to produce a finished product
        - Instruct students on how to manage scan data and file formats
        - How to specify a laser scanning job
    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 be able to demonstrate proper use of long range scanners	Students will perform scans using Faro Photon 120 scanner
Students will demonstrate proper use of short range white light scanners	Students will perform scans using the ATOS white light scanner
Students will be able to successfully register and process digital data	Students will complete several registrations of scanned data
Students will demonstrate proper scanning techniques to ensure a quality scan	Students will perform many scans and demonstrate procedures to ensure quality scans

Grading Plan:	
Homework	20%
Mid-term	20%
Final Exam	25%
Project	10%
Quizzes	20%
Class Participation	3%
Portfolio	2%

7. Brief list of topics to be covered.

ABET Course Syllabi for

1. **Course number and name:** AMT-370: Robotics & Offline Programming
2. **Credits and contact hours:** 3 Credits and (Tuesday/Thursday) 1:00 PM – 2:-00 PM
3. **Instructor's Name:** Harold Halliday
4. **Textbook:** Online – Tooling U
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
   This course will cover the basics of industrial robotics and how to develop offline programming through simulations. Applications of robots, programming of robots, robot axes and kinematics will be explored.
   b. **Pre-requisites or co-requisites**
   There are no required pre-requisites or co-requisites for AMT-370: Robotics & Offline Programming.
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
   AMT-370: Robotics & Offline Programming is a *selected elective* course in the Industrial Engineering program.
6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      - Introduce students to industrial robotics.
      - Introduce students to robotic axis and movements.
      - Introduce students to robot safety.
      - Introduce students to applications of robots.
      - Introduce students to concepts of programming.
   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 be able to demonstrate knowledge of robotic axis and movements	Students will complete exercises and quizzes
Students will demonstrate knowledge of robotic safety	
Students will be able to demonstrate knowledge of robotic applications	
Students will demonstrate knowledge or robotic components	

Grading Plan:	
Tests/Quizzes	25%
Homework Assignments	25%
Project(s)	25%
Attendance/Participation	25%
Total	100%

7. **Brief list of topics to be covered.**

ABET Course Syllabi for

1. **Course number and name:** IE-483: Rapid Prototyping
2. **Credits and contact hours:** 3 Credits and (Monday/Wednesday) 2:00 PM – 3:20 PM
3. **Instructor's Name:** Harry S. Whiting II, PE
4. **Textbook:** Online Material will be used (a list of websites will be provided).
5. **Specific Course Information:**
    a. **Brief description of the content of the course (catalog description)**
    Different methods of rapid prototyping processes used in product design will be introduced. The operating principles and characteristics of current and developing rapid prototyping process will be discussed.
    b. **Pre-requisites or co-requisites**
    Pre-requisite: IE-223: Design and Manufacturing Processes I
    c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
    IE-483: Rapid Prototyping is a *selected elective* course in the Industrial Engineering program.
6. **Specific goals for the course:**
    a. **Specific outcomes of instruction:**
        - Enhance students' 3D modeling skills
        - Introduce students to Rapid Prototyping Technology
        - Introduce students to laser scanning technology
        - Introduce students to the process of utilizing 3D computer models for prototyping
        - Introduce students to the process of utilization of scanned data
    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 be able to create an accurate 3D model using the NTU prototyping machines.	Students will "build" several models during the semester.
Students will know the pros and cons of different prototyping technologies.	Students will create a report for different models determining the best process to use.
Students will be able to scan objects and use the collected data.	Students will be required to create objects from scans and create a report of data used for
Students will be able to create models optimized for prototyping.	Quality of models will be inspected for proper builds.

Grading Plan:	
Homework	15%
Attendance & participation	10%
Weekly quizzes	20%
Midterm	20%
Final	25%
Project	10%
Total	100%
Portfolio (Extra Credit)	+

7. Brief list of topics to be covered.

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:** <u>*Physics for Scientists and Engineers*</u>, 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 Industrial 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

ABET Course Syllabi for

1. **Course number and name:** IE-484: Computer Aided Manufacturing & Robotics
2. **Credits and contact hours:** 4 Credits and (Monday/Wednesday) 9:30 AM– 11:00 AM
3. **Instructor's Name:** Vincent J. Vohnout, P.E., PhD.
4. **Textbook:** *Automation, Production Systems and Computer-Integrated manufacturing*, 4th ed., Mikell P. Grover, Pearson Education Inc.
   ISBN-13: 978-0-13-349961-2
   ISBN-10: 0-13-349961-8
5. **Specific Course Information:**
   a. **Brief description of the content of the course (catalog description)**
      This course will introduce the use of computers as a tool to aid in manufacturing, distribution and service environments with computer numerically controlled machines, automated storage systems and robotics.
   b. **Pre-requisites or co-requisites**
      Pre-requisites: CMP-101: Introduction to Computers
   c. **Indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program.**
      IE-484: Computer Aided Manufacturing & Robotics is a *selected elective* course in the Industrial Engineering program.

6. **Specific goals for the course:**
   a. **Specific outcomes of instruction:**
      After successfully completing this course you will learn:
      - Students will know the characteristics of the principle types of manufacturing systems.
      - Students will know how various automation methods are applied to manufacturing engineering problems.
      - Students will learn to identify the optimal level of automation to maximize the economic benefit of a manufacturing and related processes.
   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
A strong understanding of principle manufacturing systems.	Complete reading assignments, homework, assignments, exams, projects, and quizzes.
A strong understanding of automation and robotics as applied to manufacturing and related processes.	

***Sum of points of all tests, quizzes and assignments / 400 (course total)*100 = Letter Grade**

Grading Plan:	
Quizzes	90
Homework Assignments	120
Midterm	100
Final	100
Participation	10

7. Brief list of topics to be covered.

APPENDIX B – 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,	Instructor Assistant Professor Chair of Engineering Math and Technology Department	August 2012 May 2015 to Present 2014 – 2015	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	PhD Candidate Teaching Assistant Facilitator Human Factors Graduate Assistant Chair Student Academic Honor Council 2009	Sept. 2007 – August 2014	PT

4. Non-academic experience:

Organization	Title	Duties	Dates	FT/PT
Tejas Lean	Consultant	Head Engineer and Proprietor	June 2011 – Present	PT

Kirtland Air Force Base	Assistant Project Manager for PnPSats and NanoSats/Researcher	Create concepts for manufacture of PnpSats and NanoSats.	June – August 2008	FT
Texas Engineering Experiment Station (TEES)	Lean Manufacturing Facilitator	Lackland CPSG Demil of ComSec Project	May 2007 – August 2007	PT
Texas Engineering Experiment Station (TEES)	Facilitator & Trainer	AMSED Business Development Project	April 2007– May 2007	FT
Texas Engineering Experiment Station (TEES)	Chief Engineer/Lean Manufacturing Facilitator & Trainer, CCAD Office	▪ Review work of Texas A&M Engineering engineers for CCAD Office ▪ Assisted CCAD in winning Shingo Prize	June 2006 – March 2007	FT
Corpus Christ Army Depot Office	Engineering Site Manager Promoted to Research Engineering Associate IV	Supervise up to 27 Engineers and Analysts (FY2006 Contract authorized 28 FTEs)	April 2004 – June 2006 September 2005	FT

5. Certifications or professional registrations:
    a. Licensed professional Engineer State of Texas No. 96441
    b. IIE Six Sigma Green Belt certified 2004
6. Membership in professional organizations
    a. Member, American Society of Engineering Educators
    b. Member, Sigma Xi
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. Chairman of the Student Academic Honor Council, 2008 – 2009 School Year
    d. 2007 – 2009 Stocker Fellowship to study integrated Engineering at Ohio University Russ College of Engineering and Technology
    e. 2004 Applied Ergonomics Conference Runner Up Educational Presentation Category "Instant Replay"
    f. 2003 CHPPM Coin for "Methods and Standards Success Story"

8. Service activities
    a. Advisor, Engineering Club at Navajo Technical University participated in Holiday Food Drive
    b. Advisor, Environmental Sustainability Club, various organized clean ups
    c. Peer Reviewer, Journal of Operations Management
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
    b. McAvoy, D., Duffy, S. F., Whiting, H. S., “Simulator Study of Precipitating Factors for Work Zone Crashes”, Transportation Research Board Annual Meeting, 2011
    c. Weckman, G. R., Paschold, H. W., Dowler, J. D., Whiting, H. S., Young, W. A., "Using Neural Networks with Limited Data to Estimate Manufacturing Cost", Volume 3, Number 4, Journal of Industrial and Systems Engineering, 2010
    d. McNutt, C. J., Vick, R., Whiting, H. S., Lyke, J., “Modular Nanosatellites-(Plug-and-Play) PnP CubeSat”, AIAA 7th Responsive Space Conference, 2009
10. Recent professional development activities
    a. Teaching Remedial Math Workshop, August 2015
    b. Applying for Federal Funding Workshop, July 2016
    c. Data Analysis on Navajo Nation, July 2016
    d. Presenter for Lean Production Workshop, August 2016
    e. ABET Symposium, April 2017
    f. ABET Basics of Assessment Workshop, April 2017

FACULTY VITAE

1. Name: Gholamreza Ehteshami, Ph.D.

2. Education

Degree	Discipline	Institution	Year
PhD	Chemical Engineering (Minor Analytical Chemistry)	University of Arizona, Tucson, AZ	
MS	Chemical Engineering (Minor in Applied Math & Statistic)	Oregon State University, Corvallis, OR	
BS	Petrochemical Engineering	Abadan Institute of Technology (AIT), Abadan, Iran	
BS	Chemistry	University of Tehran, Tehran, Iran	

3. Academic experience

Institution	Rank	Title	Dates Held	FT/PT
Navajo Technical University	Assistant Professor	Department Head of Engineering, Math, and Science	August 2013 - Present	FT
University of Arizona	Assistant Professor	Lecturer	1989-2000	FT
University of Arizona	Assistant Professor	Assistant Professor	2000-2013	FT
Oregon State University	Assistant Professor	Assistant Professor	1986-1989	FT

4. Non-academic experience:

Organization	Title	Duties	Dates	FT/PT
Restorative Biosciences Inc. Chandler Arizona	Vice President of R&D	Vice President of R&D	2009-2013	

Cynexus Corporations	Consultant/Vice president of R&D	Vice president of R&D	2005-2009	
Bio- interface Technologies	Consultant	Consultant	2004-2005	
National Petrochemical Co. Shiraz, Iran	Plant Manager	Managed a Styrene 1, 3-Butadiene Rubber (SBR) plant.	1981-1985	

5. Certifications or professional registrations:
    a. None
6. Membership in professional organizations
    a. American Institute of Chemical Engineers (AIChE), American Society (ACS)
    b. Society of Biomaterials (SFB), IEEE Engineering in Medicine and Biology Society (IEEE/EMBS)
7. Honors and awards
    g. Mining and Mineral Resources Research Institute (MMRRI) Awards, University of Arizona 1989-1995.
    h. Graduate College Scholarship Awards for outstanding teaching and research quality, University of Arizona 1994 – 1995.
    i. International Scholarship Awards for outstanding academic records, Oregon State University 1986 – 1988.
8. Service activities
    a. Graduate Students Research projects mentoring
        i. Trained and supervised over 40 technical staff and laboratory personnel including: post docs, graduate and undergraduate students in experimental research projects setups, instrumentation and research methods, etc.
9. Publications and presentations from past five years
    a. None
10. Recent professional development activities
    a. **Department of Bio, Chemical & Material Engineering. Arizona State University,** Tempe, AZ, (2000-2013)

FACULTY VITAE

1. Name: Casmir I. Agbaraji, Ph.D.

2. Education

Degree	Discipline	Institution	Year
PhD	Industrial Engineering	University of Oklahoma, Norman, OK	December 2008
MS	Industrial Engineering	University of Oklahoma, Norman Ok	July 2004
MS	Petroleum Engineering	Goethe-Institute Iserlohn, Germany, German	February 1993
Graduate Diploma	Petroleum Engineering	University of Ibadan, Nigeria	October 1991
BS	Industrial Chemistry	Imo State University, Nigeria	September 1986

3. Academic experience

Institution	Rank	Title	Dates Held	FT/PT
Navajo Technical University	Assistant Professor	Dean of Undergraduate Studies	June 2012 - Present	FT
Navajo Technical College	Assistant Professor	Director of Engineering Programs	April 2011 – May 2012	FT
Lone Star College	Adjunct Professor		August – December 2010	FT
University of Oklahoma	Graduate Assistant		January 2005 – December 2008	PT
University of Alaska	Graduate Assistant		August 1998 – December 1999	PT

4. Non-academic experience:

Organization	Title	Duties	Dates	FT/PT
Higher Learning Commission (HLC), Chicago, IL	Peer Reviewer		November 2012 – Present	PT

American Indian Research and Education Initiative (AIREI) Grant	Principal Investigator (PI)		June 2012 – May 2012	PT
Alcatel Optronics, Dallas, TX.	Chemical Lab Technician	Assembled optical connectors, cleaved, spliced, and soldered telecommunication components.	January 2001 – August 2001	

5. Certifications or professional registrations:
    a. N/A
6. Membership in professional organizations
    a. Society of Manufacturing Engineers, 2005 - Present
7. Honors and awards
    a. Served as a Faculty Advisor for Industrial Engineering Program, Navajo Technical University, 2011-2013
    b. Served as a Faculty Advisor for Navajo Technical University Engineering Club, 2011-2013
    c. Outstanding Graduate Assistant Award, School of Industrial Engineering, OU, Norman, OK, 2006
8. Service activities
    a. Volunteer: Sooner Elementary, Engineering and Science Club, OU, Norman, OK, 2005 – 2008.
        i. Taught science and engineering concepts to elementary school students in the Norman, OK, area.
9. Publications and presentations from past five years
    a. **Agbaraji, C.I.,** et al. (2012). "Heterogeneous Femur Model Reconstruction for Improved FEA Analysis." International Review of Mechanical Engineering (I.RE.M.E.), Vol. xx, n. x.
    b. **Agbaraji, C.I.** , and Raman, S. (2009). "Basic Observations in the Flat Lapping of Aluminum and Steels Using Standard Abrasives." International Journal of Advanced Manufacturing Technology, DOI: 10.1007/s00170-008-1827-4, Vol. 44, No. 3-4, pp. 293-305.
10. Recent professional development activities
    a. Society of Manufacturing Engineers, 2005 - Present

FACULTY VITAE

1. Name: Vincent J. Vohnout, P.E., Ph.D.

2. Education

Degree	Discipline	Institution	Year
PhD	Industrial Engineering	Ohio State University, Columbus, OH	1998
MS	Mechanical Engineering	Ohio State University, Columbus, OH	1982
BS	Mechanical Engineering	Cleveland State University, OH	1979

3. Academic experience

Institution	Rank	Title	Dates Held	FT/PT
Navajo Technical University, Crownpoint, NM	Associate Professor, Engineering, Math, and Technology Department	Teaches Structures and Properties of Materials, Advanced manufacturing Technology Program Coordinator	August 2015 - Present	FT
Bemidji State University, Bemidji, MN	Associate Professor	Engineering Technology program Coordinator Member: Advisory Board of the Minnesota State Center of Excellence for manufacturing and Engineering	2006 – December 2011	FT
ITESM, Leon Mexico campus	Visiting Professor, Engineering Department	Lecturer in Manufacturing Processes	June –Aug. 1999	FT
Ohio State University, Columbus, OH	Post-Doctoral Research Associate, Department Material Science and Engineering		1998-1999	FT

Ohio State University, Columbus, OH	Graduate Research Assistant, Department Industrial, Welding & Systems Engineering	Research and development of a new method of forming large automotive type parts from aluminum alloy sheet using, very high power, localized, electromagnetic pulses.	1996-1998	PT
Ohio State University, Columbus, OH	Research Fellow, Center for Net Shape Manufacturing	Investigation into alternative methods of forming sheet metal parts	1993-1996	FT

4. Non-academic experience:

Organization	Title	Duties	Dates	FT/PT
Bertec Corp., Columbus, Ohio	Mechanical and Manufacturing Engineer	New product development and manufacturing in bio-mechanics of gait and balance for research, rehabilitation and sports training	Jan. 2012- July 2015	FT
Simuletics Inc. Columbus, OH	President	Manufacture and marketing of computer assisted athletic training systems for serious competitive athletes	1989-1993	PT
Adaptive Machine Technologies Inc., Columbus, OH	Vice President of Mechanical Systems and Corporate President		1985-1993	FT

5. Certifications or professional registrations:
    a. Professional Engineer, State of Ohio, Reg. No. E-52984, issued May, 1988
    b. Journeyman Tool & Die Maker, 1974, Ohio Dept. of Commerce; Apprenticeships
6. Membership in professional organizations
    a. American Society of Mechanical Engineers (ASME)
7. Honors and awards
    a. None
8. Service activities
    a. None

9. Publications and presentations from past five years
    a. "An Excellent Adventure", Adv. In Mech.,Rob., Des.Educ & Res. MMS 14 pp 35-47 Springer International Publishing, Switzerland, 2013.
10. Recent professional development activities
    a. Licensed Consulting Engineer, Columbus Ohio (1993 – present)
        i. Machine design, manufacturing systems, industrial development, product design and litigation for a variety of corporate and entrepreneurial clients.
    b. Director of Product Development and Sales, Geo-Core, Columbus Ohio (1993 – present)
        i. Manufacturer of specialized sediment coring systems for paleoclimatology and archeology research

FACULTY VITAE

1. Name: Harold S. Halliday
2. Education

Degree	Discipline	Institution	Year
AAS	General Studies	UNM Gallup	2000
	Mech Engineering Tech	University of Maine	1981-85
	Mech Engineering Tech	Rochester Institute of Technology	2003-2006

3. Academic Experience

Institution	Rank	Title	Dates Held	FT/PT
Crownpoint Institute of Technology	Instructor		2003-2010	FT
Crownpoint Technical College	Instructor		2010-2014	FT
Navajo Technical University	Instructor		2014	FT
Navajo Technical University		Director, Center for Digital Technologies	2014-present	FT

4. Non-Academic Experience

Organization	Title	Duties	Dates	FT/PT
NASA	Summer Faculty Research	3D Modeling/Data Capturing	Summer 2006	FT
NASA	Summer Faculty Research	3D Modeling/Data Capturing	Summer 2007	FT
NASA	Summer Faculty Research	3D Modeling/Data Capturing/Metrology	Summer 2008	FT
NASA	Summer Faculty Research	3D Modeling/Data Capturing/Metrology	Summer 2009	FT
NASA	Summer Faculty Research	3D Modeling/Data Capturing/Metrology	Summer 2010	FT
NASA	Summer Faculty Research	3D Modeling/Data Capturing/Metrology	Summer 2011	FT

NASA	Summer Faculty Research	3D Modeling/Data Capturing/Metrology	Summer 2012	FT

5. Certifications or Professional Registrations: None
6. Membership in professional organizations
    a. Member, American Society for Manufacturing Engineers (SME)
    b. Member, American Society for Quality (ASQ)
7. Service activities
    a. Chair, Business and Computer Technology/Engineering Math and Technology 2009-2013
    b. Chair, Assessment Committee 2006-2010
    c. Chair, Curriculum Development Committee 2006-2010
8. Grants and Awards
    a. NASA MUREP - $985,000 – Develop Digital Manufacturing Program 2009-2011
    b. NASA CIPAIR - $448,000 – Strengthening Digital Manufacturing 2012-2014
    c. NSF ATE - $895,000 – Dimensional Metrology Certification Project 2015-2017
    d. NSF TCUP Small Grants for Research - $290,000 – Lattice structure Research 2016-2017
    e. NSF TSIP - $488,000 – Developing an Engineering Technology Program 2016-2018
    f. NASA CAN – $178,000 – LENO Biofuel and Rocket Engine Testing 2016-2017
    g. AIHEC/DOE - $150,000 – TCU Advanced Manufacturing Initiative 2015
    h. AIHEC/DOE - $477,000 – TCU Advanced Manufacturing Initiative Phase II 2016-2018
9. Recent Professional Development Activities
    a. Training Certifications
        i. Faro Laser Tracker/CAM2
        ii. PC-DMIS software Programmer
        iii. Motoman Robot Programmer Intermediate
    b. Training courses
        i. GDT course – AGI and Tec-Ease
        ii. Fanuc Milling Center

APPENDIX C – EQUIPMENT

Please list the major pieces of equipment used by the program in support of instruction.

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 Mark 2	Nylon with imbedded fibers - Carbon Fiber/Kevlar/Fiberglass	10.5 x 5 x 6	FDM – Nylon 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

Metrology Equipment:

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

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 lab:

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

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.

Harry S. Whiting II, PE, Assistant Professor of Industrial Engineering

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

Higher Learning Commission - accredited the Industrial Engineering program; February 21, 2012. They will visit in the Fall of 2017 to renew accreditation.

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

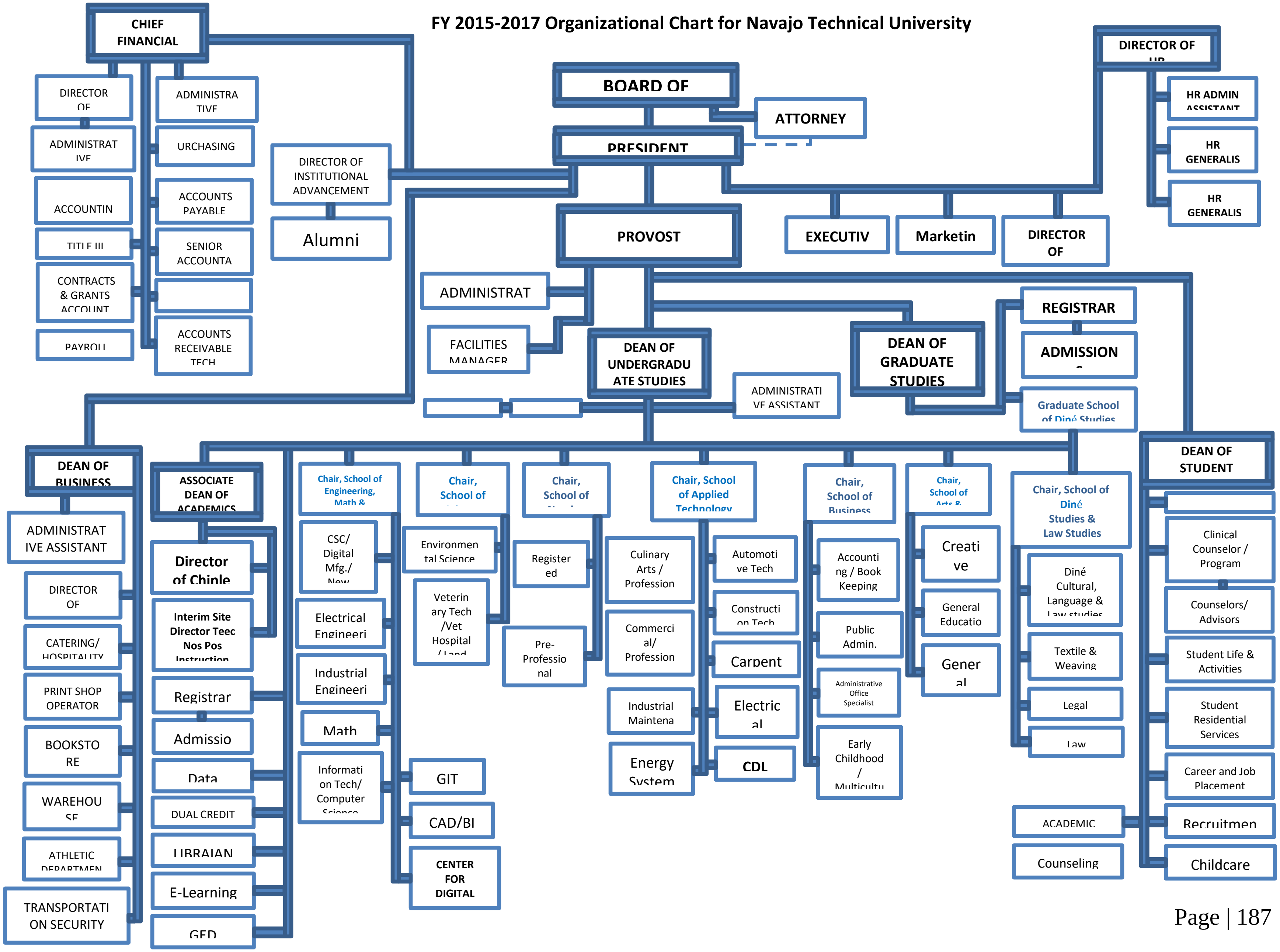
NTU is a public institution owned by the Navajo Nation. It has a Board of Regents appointed by the President of the Navajo Nation with the President of the University being the executive head of the school.

3. Educational Unit

Describe the educational unit in which the program is located including the administrative chain of responsibility from the individual responsible for the program to the chief executive officer of the institution. Include names and titles. An organization chart may be included.

Harry S. Whiting II 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 University



4. Academic Support Units

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. Casmir Agbaraji, Dean of (typically one class per semester)
- Dr. Gholam Resa Ehteshami, Associate Professor of Chemical Engineering (two or three overlapping classes per semester)
- Dr. Frank Stomp, Associate Professor of Information Technology (Computer Science) (teaches one class for Industrial Engineering)
- Harry S. Whiting II, PE, Assistant Professor of Industrial Engineering
- Harold Halliday, Director Center for Digital Technology (one class per semester, supplemental work as Project Coordinator)
- Dr. Vincent Vohnout, Assistant Professor of Advanced Manufacturing Technology
- Elisha Wortham, Assistant Professor of Building Information Modelling

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:

- 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
- Lemanuel Loley, Head of Job 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

Industrial 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						16		0	0	0	0
		PT						3					
1	2015/ 2016	FT						22		0	2	0	0
		PT											
2	2014/ 2015	FT						24		0	0	0	0
		PT											
3	2013/ 2014	FT						29		0	0	0	0
		PT											
4	2012/ 2013	FT						20		0	0	0	0
		PT											

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

Table D-2. Personnel

Industrial 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	5	3.5
Student Teaching Assistants[4]	0	2	1
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.

Signature Attesting to Compliance

By signing below, I attest to the following:

That __**Industrial 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**