BOARD OF TRUSTEES MEETING

March 7, 2024
Roaden University Center, Room 282
1:30 p.m.

AGENDA

I. Call to Order and Roll Call

II. Introduction of new Board of Trustee

III. Recognition of Students

IV. Approval of Minutes of November 30, 2023

V. Student Trustee Report

VI. President's Report

VII. Academic & Student Affairs Recommendations

  A. Policy 261 (Academic Credit from Other Institutions)

  B. Expedited New Academic Program Proposal (ENAPP) for the Bachelor of Science (BS) in Nuclear Engineering

VIII. Audit & Business Committee Recommendations

  A. Compensation Study Results

  B. Compensation Plan

  C. Non-Mandatory Fees

  D. Disclosed Project Modification

  E. Naming Opportunity

IX. Board Secretary Report

X. Other Business

XI. Adjournment

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Introduction of New Board of Trustee

☐ **Review** ☐ **Action** ☒ **No action required**

PRESENTER(S): Chair Harper

PURPOSE & KEY POINTS: Introduction of newly Governor appointed Trustee Camron Rudd. Trustee Rudd is a graduate of Tennessee Tech with a B.S. in Mechanical Engineering and a B.A. in German. Rudd is the Chief Operating Officer for Hörmann and resides in Cookeville, Tennessee with his wife Miranda, and they have two teenage children.

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Recognition of Students

☐ **Review** ☐ **Action** ☒ **No action required**

PRESENTERS: Chair Harper

PURPOSE & KEY POINTS:

Tennessee Tech Engineering for Kids (TEK) program designs equipment for children with special needs. The program matches a child with a specific need to a team of Tech engineering students in Stephen Canfield's kinematics and dynamics of machinery course for mechanical engineering.

The class was borne out of a partnership among Tech's colleges of Engineering and Education and the Tennessee Early Interventions System, a partnership which still exists.

Other project partners include Cumberland, Putnam and White County school systems, Cookeville Regional Medical Center, and regional therapy providers. Supporters include Cookeville Bicycles, NAPA Auto Parts of Cookeville and Cookeville Junior Women's Club.

Joining us today is **Dr. Stephen Canfield**, Professor, Mechanical Engineering, who will be introducing the below students:

Jakob Coats, *student who worked on a modified bicycle for children who struggle with pedal bikes*

Lacy Grinder, *student who worked on a pump caddy for a child with short gut syndrome*

Ian Sweetin, *student who helped construct an adjustable chair for a preschooler with special needs in Tech's Child Development Lab*

BOARD OF TRUSTEES

November 30, 2023

Roaden University Center, Room 282

MINUTES

Meeting streamed live via link found on this web page:

https://www.tntech.edu/board/board-and-board-committee-meetings.php

AGENDA ITEM I – CALL TO ORDER

The Tennessee Tech Board of Trustees met on Thursday, November 30, 2023, in Roaden University Center, Room 282. Chair Trudy Harper called the meeting to order at 1:31 p.m.

Chair Harper asked Mr. Lee Wray, Secretary, to call the roll. The following members were present:

- Addison Dorris
- Fred Lowery
- Tom Jones
- Jeannette Luna
- Thomas Lynn
- Rhedona Rose
- Johnny Stites
- Barry Wilmore
- Trudy Harper

A quorum was physically present. Tennessee Tech faculty, staff and members of the public were also in attendance.

AGENDA ITEM II – RECOGNITION OF STUDENTS

Chair Harper stated that student guests were computer science major students with concentrations in cybersecurity and represented Tennessee Tech's Cybersecurity Education Research and Outreach Center (CEROC). The group recently took first place in the annual Capture the Flag (CTF) cybersecurity competition at the 2023 InfoSec Nashville Conference. A total of ten teams competed in the event, representing a mixture of industry leaders and colleagues.

Chair Harper asked the students to explain the meaning of Capture the Flag and was told that ten or twenty different challenges that involved different areas of cybersecurity were provided for their review. Some of the challenges were offensive security where trying to hack into something, and others were defensive security. The goal was to look at the concern, solve it, find a flag, and submit it; if correct, points were given. The exercise provided a good way to practice one's expertise in different fields of cybersecurity in a gamified way. Some competitions were graded on time and others were graded on accuracy. Easy challenges resulted in fewer points earned.

Landon Crabtree stated he was a Junior from Manchester, Tennessee and involved on campus with various cybersecurity clubs. He stated he had a particular interest in offensive security, pen testing, WebEx exploitation, etc.

Micah Jones stated he was a Junior from Bristol, Tennessee and he came to Tennessee Tech as a freshman, not knowing what he wanted to do. Initially, he was a mechanical engineering student but was attracted into the cybersecurity bubble. He stated he was part of the defensive cybersecurity group. The four students present plus Anna Timmcke made up the winning group in its entirety.

Nate Dunlap stated he would be a senior next academic term and had interned at Cisco. He stated he has known about the program for less than two years but was brought to it by his robotic coach in high school and once he touched it, he was addicted to it. He stated they try to teach students about defensive cybersecurity, and hope to eventually acquire internships and full-time positions. The experiences were referred to as purple teaming (intersection between offensive and defensive cybersecurity): how to think like an attacker and use that to the best of their ability to better defend a system.

Landon Byrge stated he was from Cookeville. He stated he started in cybersecurity in middle and high school with the Air Force Association CyberPatriot Program. He competed in that program for five years, ended up placing well and was awarded an internship that progressed his cybersecurity interest further. He stated that typically, he was involved on the defensive security side but was invited to try out the CTF team and did quite well.

Chair Harper asked the students if cybersecurity was a good fit for them. Landon Crabtree stated Tech and CEROC had been pivotal to ensure they have the resources to grow in the field. Cybersecurity was one of the fields that required hands-on experience to further one's self and CEROC had done an excellent job providing students those opportunities like InfoSec or other competitions in which to participate. These types of opportunities helped students acquire hands-on experiences and grow their skills.

Mr. Lynn asked if there was a professor they particularly appreciated and when they graduated, where do they hope to go. Landon Crabtree stated that Eric Brown, Associate Director of CEROC, was the professor that pushes everything through CEROC and makes certain that students have the opportunities needed. He stated he had an internship with Microsoft, and he would be returning to Microsoft again this year. He stated he hoped to return to Microsoft full time hacking (legally) and helping them secure products.

Micah Jones stated that he was an undergraduate researcher and planned to pursue his master's degree. He stated he was leaving the area open but hoped to secure a hands-on internship this summer.

Nate Dunlap stated he learned a lot when he interned at Cisco. He stated cybersecurity was a broad area with many different fields and has near zero percent unemployment. An individual can choose almost anywhere and be hired, especially those who have competed and have good experience. He stated he would love to go to Cisco and do research, where a person might be given a product, provided a specific amount of time to identify as many vulnerabilities as possible, document those vulnerabilities, and then give customers due notice.

Landon Byrge stated that for the remainder of his college career, he hoped to continue his internship that allowed him to give back to middle and high school students with the competition. After graduation, he hoped to participate in a contracting incident response role or system administration role.

Chair Harper stated she had read about the computer science program having houses like Harry Potter. She inquired if students lived in the same house or in different houses and asked the students to explain about the house system and identify which house they resided in. Micah Jones stated that six houses were formed over the past year, and he and Nate lived in the same house. Dr. Jerry Gannod formed the houses and they were a way for computer science students to get out of their dorms or apartments and meet up for parties and events. He stated the Halloween party last year was the highlight of his semester because the party provided opportunities for him to talk with people in the department whom he would not have otherwise met. He stated the house system provided strong networking opportunities. At the actual meetings and at events like the Halloween party, there were games to play to earn points and compete against each other. It provided a fun, light-hearted way to get to know people that a student would not otherwise know. He stated that no other Tennessee Tech department offered anything like the computer science housing system.

Chair Harper stated that per President Oldham, computer science was now the largest department on campus.

Chair Harper reminded Trustees that if they had not yet signed and submitted their Code of Ethics and Conduct and Conflict of Interest Policy Acknowledgement and Attestation form, they should do so and submit to Diane Smith prior to the end of the meeting.

Chair Harper also stated that Ms. Rose was about to retire from a distinguished career with Farm Bureau Insurance. She congratulated Ms. Rose and thanked her, not only for what she has done for Tennessee Tech, but also for what Ms. Rose has done for the State of Tennessee. Ms. Rose thanked Chair Harper, stated that none of it would have been possible if not for Tennessee Tech, and stated that she hoped the students realized how valuable a Tennessee Tech education was.

AGENDA ITEM III – APPROVAL OF MINUTES

Chair Harper asked for approval of the minutes of the September 28, 2023, Board of Trustees meeting. Chair Harper asked if there were questions or comments regarding the minutes. There being none, Mr. Jones moved to recommend approval of the September 28, 2023, Board of Trustees minutes. Mr. Stites seconded the motion. There being no discussion, Chair Harper called a voice vote. The motion carried unanimously.

Chair Harper also stated that at the September 28, 2023, meeting, it was not possible to livestream the meeting so that was fully documented in the minutes for full disclosure. It was a requirement that we live stream but due to technical difficulties, it was not possible so we hope the detailed documentation in the minutes will be adequate.

AGENDA ITEM IV – STUDENT TRUSTEE REPORT

Chair Harper asked Ms. Dorris to provide her student trustee report. A few weeks ago, Tennessee Tech's campus was filled with spirit during homecoming week. The theme for this year's homecoming was *Once Upon a Homecoming.* Students had opportunities to participate in many competitive events, including a banner painting competition, lip sync night, field games, homecoming parade and homecoming football game. The Student Activities team did a phenomenal job planning a week to bring students, alumni and community to share in the pride of Tennessee Tech campus. The winners of the festivities were Alpha Delta Pi and Phi Gamma Delta in the gold division, Ellington and Warf Halls in the residence hall division and the Wesley Foundation in the purple division. The 2023 Mr. Tennessee Tech was Zack Henson who represented Sigma Phi Epsilon and the 2023 Ms. Tennessee Tech was Leela Gracey who represented Women in Cybersecurity Club. Perhaps one of the greatest highlights was Tennessee Tech's homecoming crowd funding drive, which this year raised $42,326 for Children's Miracle Network in Monroe Carell, Jr. Children's Hospital at Vanderbilt. In addition, each Mr. and Ms. Tennessee Tech candidate hosted canned food drives and candidates donated more than 2,000 high-need food items for the campus food pantry, so a lot of good was accomplished during this homecoming season.

Ms. Dorris stated that in regard to student concerns on campus, as mentioned in her last report, construction was still posing an issue to class commutes; however, as the pedestrian walkway and Ashraf Islam engineering building projects continue, students were thrilled to see the progress and excited for completion of campus improvements. Besides construction, the other most prevalent student concern was the loss of Tennessee Tech's ASPIRES program. ASPIRES is a federally funded grant program that addresses sexual assault on campus. The program provides forensic exams by specially trained registered nurses and advocacy services by trained victim advocates. ASPIRES has been an incredible resource for many years and the program ended due to the grant expiring at the end of the semester. Students are rallying around the program, creating petitions and spreading awareness, trying to make these resources a permanent part of the Tennessee Tech community.

Outside of homecoming festivals, Tennessee Tech has produced impactful leaders across industries, athletics and beyond and will continue to prepare students to be bold, fearless, confident, and kind leaders. One of the efforts included the recent creation of a leadership program committee. This committee, comprised of faculty and staff from different areas of campus, is focused on providing comprehensive programs in which students take part. Many campuses have this program and it is in early stages at Tennessee Tech but will be a game changer to produce a robust pool of leaders. A chapter of Omicron Delta Kappa (ODK) , a nationally recognized student leadership honor society that encourages collaboration among members across the five pillars of leadership, which include academics and research, athletics, service to campus and community, communications, and creative and performing arts, was founded. ODK will not only recognize student leaders on campus but also allow student leaders to create events and other students to further all Tennessee Tech students' leadership capabilities. Tennessee Tech cultivates well-rounded students who impact the community as golden eagles.

Mr. Wilmore asked if the student body was aware of the campus master renovation plan. He also asked if students were aware that not everything can be accomplished at once. Funds, timing and a lot of planning all play into renovations. He asked if the campus realized the significance of what had taken place in the past and what the plans were for the future.

Ms. Dorris stated that a great job was done in developing student awareness if students want to be aware. Sessions regarding the master plan have been offered, and she stated that she attended a session where all students were able to discuss the buildings being built and the new parking lot. She also stated that sessions were offered to Student Government Association (SGA) members and other student organizations having interest in those projects. She stated that students were going to complain one way or another, but all resources were available to them if they want detailed information.

Mr. Wilmore asked if master plan information was provided at SOAR, so participants could understand the transformation taking place regarding upgrading facilities and bringing things up to state-of-the-art. He stated that if SOAR participants were made aware, then that word would travel beyond them, and he stated he believed it was important to get the information out there as much as possible and keep pushing to make people aware.

President Oldham stated that in his comments to incoming students, he talked about ongoing renovations and the master plan. He stated it was difficult to provide in-depth information at SOAR sessions because the bandwidth available at those sessions was limited. He stated that information was made available and meetings were periodically scheduled with SGA to provide updates about the master plan. Information has been posted on the website and administration members make themselves available when students express an interest in knowing more.

Secretary Wray stated that an Oracle reporter recently interviewed the President regarding the master plan, but Secretary Wray had not yet seen the story – not every story makes it to print – but the Oracle reporter was very supportive of the plan.

President Oldham stated that the comment was a great one and no matter how much was communicated, a better job can always be done. He also stated that when prospective students visit, drawings of buildings coming to campus and drawings of the master plan were shown to them.

AGENDA ITEM V – PRESIDENT'S REPORT

President Oldham stated he was constantly in awe of what goes on around campus. He also voiced his appreciation to the Trustees for their time, talent, and passion for Tennessee Tech and for all they do as a Board.

He stated that his past reports were mostly focused on specific items (e.g., enrollment and recruiting, campus life, student success, academic programs, campus master plan, athletics or finance and planning.) However, he would like to pivot from that in this report.

Because it was Vice President for Research and Economic Development, Dr. John Liu's first meeting, he stated he wanted to recognize Dr. Liu for making a tremendous impact on campus. He stated that he was pleased Trustees were able to see what Dr. Liu was currently bringing to campus.

He stated that another area mentioned earlier was Tennessee Tech's accreditation, with the Southern Association of Colleges and Schools Commission on Colleges. Tennessee Tech's accreditation was a ten-year cycle of reaffirmation, and the cycle will come up again in 2026. He stated that planning was already underway, preparing for the rigorous and daunting 2026 reaffirmation process. Tennessee Tech last went through the process in 2016 – just prior to the Board being installed -- and it was a great experience. The process resulted in zero recommendations for Tennessee Tech. The accreditation process includes many moving parts and required about two years of preparation. Only five percent of the schools going through the process emerge unscathed as we did but we were able to do that because the institution was sound. He stated we also had excellent people led by Dr. Sharon Huo, who were able to put the process together and the process for the 2026 reaffirmation has already begun. A large group will be going to Orlando next week for the meeting to launch the process. He stated an entire group of standards exists and the reaffirmation process was a fundamental part of ensuring the institution stays in good shape and ensures that we are appropriately directed. Trustees have already heard that we have been approved for a differentiated review process; we will be required to respond (directly) to only about half the usual number of standards. The Board will be part of this process and Trustees will be interviewed when the site review team comes to campus.

President Oldham stated that a portion of the reaffirmation process was called the Quality Enhancement Plan (QEP) and, along with reviewing everything on campus, the teams also challenge the campus to say "What is your plan to create something different at Tennessee Tech? What is unique about Tennessee Tech? What can you do better than what you have done in the past?" It provides us an opportunity to look at those circumstances to see how we can better serve students over the next five to ten years and put together a rigorous plan. We already have groups of faculty beginning to discuss "What will be our next QEP?"

The last QEP completed in 2016 was "enhanced discovery through guided discovery", called *Edge*. It was tremendously successful and had a lot of undergraduate research components to it, as well as many other creative inquiry aspects.

President Oldham then stated that he was going to pivot away from the fundamentals to more of the "why" questions, "Why do what we do here at Tennessee Tech? Why are we in this?"

He stated that a couple weeks ago, he was asked to represent the presidents of the locally governed institutions (LGIs) at the Governor's budget hearing. One of the things he was asked to address was the big-picture item of higher education and the impact being seen a little over a year after the state increased the Hope Scholarship level in Tennessee. The Hope Scholarship was increased for students at four-year campuses, with freshmen and others at one level, and as an incentive, a higher level for juniors and seniors. The scholarship for juniors was increased to $4,500 and for seniors, the scholarship was increased to $5,700. So, the question was "What is the state's return on that added investment?" For public institutions in Tennessee, the Hope Scholarship increased from covering 35% to 45% of average tuition and fees during the first two years. And for juniors and seniors, the scholarship increased from 45% to 57% on average. These figures were before any institutional scholarships were provided. Tennessee students benefit from the ability to attend a quality institution like Tennessee Tech for an affordable price.

President Oldham asked, "What is the return to the state for the additional Hope Scholarship dollars?" He stated that, although we have only been in the increased scholarship amounts for slightly over a year, early signs were larger enrollments at the four-year campuses – including on Tennessee Tech campus. Generally, increased enrollments and higher first-year retention rates have also been seen on other four-year campuses. There seems to be, at least an early correlation, between student retention and the increased Hope Scholarship amount. Anecdotally, what was reported among most of the campuses was about a twenty percent increase in Hope Scholarship awards to freshmen, which means more freshmen attending four-year campuses. This was somewhat contrary to media attention around the value of a college degree. Some companies say, "It does not matter if you have a college degree or not; we will hire you." Some policymakers say, "Not everyone needs to go to college." However, the four-year public universities in the state created a consortium and said, "We need to publicize information about the increased enrollments and higher first-year retention rates."

President Oldham stated that it was definitely true that not everyone will go to college, and it can be argued that not everyone necessarily needs to go to college but compelling evidence exists that it is beneficial to have a college degree. So, the Tennessee public universities have bonded together and contracted with a marketing firm. A website, *Four the Future,* has been created and provides the state's perspective: What is good for Tennessee about a four-year college degree and what is good for individual students with a four-year college degree? Fundamentally, individuals secure better careers, more flexible careers, and have more choices available to them with a four-year college degree. All of this was evident in the data. Individuals were more resilient to economic downturns, so unemployment rates are half for college graduates than for noncollege graduates. Degree earners have increased financial benefits and job security benefits, but degrees also lead, of course, to greater career earnings of about $1.5 million to $2 million earnings more for a college graduate than for a noncollege graduate.

He stated that other, less obvious results, are that four-year degree earners were healthier. A *New York Times* article a few weeks ago presented that college graduates on average lived eight years longer than a noncollege graduate, they were healthier, seem to be better connected and tended to have a happier, more flexible lifestyle, so there were results other than money in the pocket that helped drive this. The key was to increase the number of individuals earning four-year degrees without those individuals absorbing a huge amount of student loans or student debt. Tennessee Tech was the means for students to earn a high-quality education at an affordable cost and enjoy these benefits without the negative baggage of student loan debt.

President Oldham stated that students learned they could accomplish something beyond themselves or beyond what they thought they could do otherwise while earning their degrees. He stated that he talks to students about the fact that when they are in school, they are measured by what they know and graded by what they can demonstrate on a test or the paper they can write. Once they get out of school, it was not what they know, it was what they can do, what they can produce, what they can generate, and the value they bring to whatever organization they were a part of. And this is what we do a great job of here at Tennessee Tech, giving students an opportunity to develop those skills so that they are able to produce desired results. They are smart and know a lot of things, but ultimately, it is about what they can do, and Trustees have seen that demonstrated. The students learn to believe in themselves and the world unwrapped to them. There may be things students have never dreamed of doing before, but now they understand are possible; there is no limit to that, other than their persistence and tenacity. They learn how to pick themselves up when they get knocked down. College presents challenges and the students learn how to overcome those challenges. Tennessee Tech students are making positive differences and they will make more positive differences when they finish here.

President Oldham stated that he certainly believed, and he knows the Trustees also believe, having a four-year college degree makes a difference and is an enabler. He stated that Tennessee Tech is the best for doing it more than any place he knows. He stated that he has been proud and continues to be proud of Tennessee Tech and what is being accomplished at Tennessee Tech. He stated that in future meetings, he hopes to be able to begin to think about, along with Trustees, where do we go next, what are the next steps for Tennessee Tech with the SACSCOC reaffirmation kicking up and we are toward the end of our last *Tech Tomorrow* strategic plan. We have accomplished 80-90 percent of what we set out to do in that plan. We are beginning to think "What do we need to do next? Where do we go from here?" He stated that he really wants to engage the Board, along with everyone on campus, in that process. What do we need to dream about? What is that vision?", but also keep in mind "Why are we doing it?" It is because of these students and what they can be capable of, with the assistance that we can provide. Again, thank you for everything you do for Tennessee Tech.

Mr. Wilmore stated that he has a question that he knew would put the President on the spot. Mr. Wilmore stated that he knows President Oldham deals with so much on a daily basis. The Board understands that and that is why they appreciate him. Mr. Wilmore asked "What is the biggest challenge you have that will help the Board understand a little more about what all goes on in your day-to-day activities?"

President Oldham stated that was a good question. He stated that the challenges vary from day to day and even hour to hour but he likes the variety and every hour is different. He stated that there were many days when he was playing whack-a-mole and fighting a fire here and a fire there. He stated those days happen and they can be challenging but the things that excited him the most were the things he had talked about today: "How can we become a particularly outstanding destination for students looking for an advantage in life? How can we be that enabler and how can we try to think outside the box?" He stated it is not necessary to do things like we have always done them or like anyone else has done them. "Is there a smarter, better way to accomplish something and what does that need to look like?" He stated that those things excite him the most and they were probably the most challenging, because change was hard on most of us, but these were also the things that were most rewarding.

Mr. Wilmore stated that President Oldham's response was intriguing, and he appreciated the answer. He stated that what President Oldham was saying was that he must deal with the day-to-day – that is very important – but there was also a vision with rather high priority and he believed that the Board was in line with that, as well.

Mr. Lowery stated that he was going to ask a similar but somewhat different question. He stated that there were so many things going well and it was incredibly rewarding for Trustees to hear those things. He asked "As a Board, and as we think about what is next for Tennessee Tech and focus on students' success, what is not going as well as you want it to go? The answers to this question will help us as a Board to think about what is next."

President Oldham stated that no matter how well we do things, it was never quite good enough. There were some areas where we need to do better, and he knows that Mr. Lowery has a love for the area he was about to mention, as he (President Oldham) does. Athletics is already a big part of and a very valuable part of this institution. There are so many great things about athletics here at Tennessee Tech for us to be proud of, but we need to create more championship-level programs in athletics. Athletics can be a tremendous advantage to the institution beyond the confines of the campus. It can be an attractor of students. It can be an enable of students in terms of their attitudes and outlook on life.

He stated that an example was back in 2018 when the baseball team won the regional and NCAA at Ole Miss and went to Texas to play in the super regionals. There was a significant bump in attitude and culture on campus. We were able to rally around it because we got to know the student athletes personally. They were an extension of who we were, and they were competing at the highest level that athletes can compete in the country, and it made us proud to see them do that. He stated that he believed it also taught the campus that others can achieve this level of accomplishment, too. Cybersecurity team members can compete at the national level. We can be as good as anyone anywhere and that is what athletics can help do for Tennessee Tech. He stated that was the only piece missing in terms of athletics, and he believed that was what we need to strive for. We must help athletics achieve that. Athletics wants to achieve that level of winning, they are capable of achieving that level, and we need to help them get there because it helps Tennessee Tech. Athletics is the front porch to the university, and that is one area where we could do better.

President Oldham stated that research is another area where we need to continue to excel and we have talked about it a lot. He stated he believed we are making good progress, but we need to secure it. We need to make certain that is a stronger part of the culture of the campus because of what it enables for the entire campus.

He stated that other than athletics and research, things never go as well as he would like because it takes so much time. It is never possible to get things done quickly enough. There are always delays, cost overruns, there is life and it never happens as quickly as we would like, but he stated that athletics and research are the things he was leaning into now.

Dr. Luna stated that she wanted to go back to Trustee Wilmore's question. She stated that she had served on Faculty Senate for six years, where President Oldham was regularly asked about many challenges and she wanted to commend him for always showing up. She stated that faculty can be rather direct but when he was asked a question, he would always answer the question. If there was a meeting that could not happen, it would be rescheduled. She stated that President Oldham always showed up and stayed until the questions were answered and she appreciated that because challenges arise frequently, but those challenges were always addressed along the way. She stated that she just wanted to thank President Oldham for that.

President Oldham thanked Dr. Luna and stated that not any of it was easy, but the reason it was not easy was because we were doing things that were important and the easy stuff would already have been completed. He stated that Mr. Wilmore is trying to go to space on an all new platform that has never been done before. That is not easy, and so the things we are doing here are primarily things we have to create, improve on and work on. That can be difficult and frustrating and we do not always agree on the best ways to go about that but by doing it together and leaning into it as a community, we get there and we do it better than we would have individually, and he appreciated that.

AGENDA ITEM VI – CONSENT AGENDA – A. POLICY 224 (ACADEMIC ACTIONS NOTIFICATION) B. POLICY 225 (NEW ACADEMIC PROGRAMS) C. POLICY 226 (ACADEMIC PROGRAM MODIFICATIONS) D. POLICY 227 (NEW ACADEMIC UNITS)

Chair Harper stated that the consent agenda included four policies which were discussed and considered during the morning Academic and Student Affairs Committee meeting and she asked for approval of the consent agenda. Mr. Jones moved to recommend approval of the consent agenda. Mr. Lowery seconded the motion. There being no discussion, Mr. Wray called a roll call vote. The motion carried unanimously.

AGENDA ITEM VII.A. - AUDIT AND BUSINESS COMMITTEE RECOMMENDATIONS – FY2023-24 REVISED BUDGET/ORGANIZATIONAL CHART

Upon the recommendation of the committee, Mr. Sites moved that the Board approve the fiscal year 2023-24 revised budget and organizational chart. Chair Harper stated that because the item came from committee, a second was not needed. There being no additional discussion, Mr. Wray called a roll call vote. The motion carried unanimously.

AGENDA ITEM VII.B. – AUDIT AND BUSINESS COMMITTEE RECOMMENDATIONS – TUITION TRANSPARENCY ACT REPORT T.C.A. § 49-7-1604

Mr. Stites stated that by February 1 of each year, the Board is required to provide a report to the General Assembly with information regarding expenditures of revenues derived from any tuition and fees increase in the previous full academic year. The report must include how revenues were used, the effect on student financial aid, and the effect on the average total cost of attendance.

Upon the committee's recommendation, Mr. Stites moved the Board approve the Tuition Transparency Act Report. Chair Harper stated that because the item came from committee, a second was not needed. There being no additional discussion, Mr. Wray called a roll call vote. The motion carried unanimously.

AGENDA ITEM VIII – BOARD SECRETARY REPORT

Mr. Wray stated that as follow-up to the Board self-evaluation review, if Trustees have thoughts on areas of governance that they would like him to research, email those ideas to him. He stated that he would be doing research as requested by the chair to see if governance videos are available from the Association of Governing Boards (AGB), instead of having a verbal report at the meeting. He also thanked Trustees for their service to Tennessee Tech.

Chair Harper stated that they had a really great conversation during the morning Academic and Student Affairs Committee meeting with Dr. Mick, Counseling Center Director. She stated that the Counseling Center does great work and we were very thankful for what they were doing.

AGENDA ITEM IX – OTHER BUSINESS

There was no other business.

AGENDA ITEM X – ADJOURNMENT

There being no further business, the Tennessee Tech Board of Trustees meeting adjourned at 2:40 p.m.

Approved,

Lee Wray, Secretary

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Student Trustee Report

☐ **Review** ☐ **Action** ☒ **No action required**

PRESENTER(S): Addison Dorris

PURPOSE & KEY POINTS: Student Trustee Addison Dorris will report on student life from the perspective of the student body.

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Policy 261 (Academic Credit from Other Institutions)

☐ **Review** ☒ **Action** ☐ **No action required**

PRESENTER(S): Provost Lori Bruce

PURPOSE & KEY POINTS: The main purpose of revising Policy 261 is to align it with the recent change in the TTU Organizational Chart, where the Office of the Registrar was transferred to Academic Affairs. In addition, the revised policy references the Office of the Registrar instead of an out-of-date Director of Academic Services.

Tennessee Technological University
Policy No. 261

Academic Credit from Other Institutions

Effective Date: July 1, 2015

Date(s) Revised: January 1, 2024

Policy No.: 261
Policy Name: Academic Credit from Other Institutions

I. Purpose

The purpose of this policy is to create uniform standards in awarding academic credits for undergraduate degrees from other institution.

II. Review

This policy will be reviewed every four years or whenever circumstances require review, whichever is earlier, by the Associate Provost, with recommendations for revision presented to the Academic Council, University Assembly, and the Board of Trustees.

III. Policy

A. An applicant or student must submit to Tennessee Tech an official transcript showing all post-secondary coursework taken at any institution of higher education. Failure to submit official transcripts of all previous work, as well as any falsification of the records, may result in the denial / revocation of admission and dismissal of the student.

B. Tennessee Tech will determine, in its sole discretion, which credits it will accept.

C. Coursework accepted for credit toward an undergraduate degree must represent collegiate coursework relevant to the degree, with course content and level of instruction resulting in student competencies at least equivalent to those enrolled in Tennessee Tech's undergraduate degree programs.

D. A transfer student whose transcript(s) indicate satisfactory completion of the General Education program established in Tennessee Transfer Pathway shall be exempted from taking additional courses that normally are a part of the general education requirements of Tennessee Tech, except where teacher certification regulations, major field requirements, or professional accreditation agencies require the inclusion of such courses in the program of studies.

E. Matters regarding Advanced Placement (AP) credit

1. Tennessee Tech will accept the advanced placement credit awarded by Tennessee Board of Regents (TBR) community college.

2. A student who has earned advanced placement credit at an institution that uses a lesser score to award such credit may still have that credit transferred to Tennessee Tech, provided the student has completed the next successive course in the sequence with a grade of C or better.

F. Tennessee Tech fully supports the Tennessee Transfer Pathway (TTP) program coordinated by the Tennessee Board of Regents. A student who completes all the courses listed on a particular Transfer Pathway and earns an Associate of Arts or an Associate of Science degree from a TBR community college will have those courses accepted for credit and count toward the completion of the baccalaureate degree in the particular major.

G. In addition to the requirements of Tennessee Tech Policy 260 (Requirements for a Baccalaureate Degree and Graduation), a student transferring credit from a two-year institution must complete a minimum of 50 semester hours at a four-year institution provided that the student earns at least the minimum number of credits that must be taken at Tech, as specified in Policy 260.

H. Tennessee Tech reserves the right to limit transfer credit in religious studies to a maximum of 12 semester hours.

I. Matters regarding transfer credit from institutions abroad.

1. With the exception of a student enrolled in the Tennessee Tech Study Abroad Program, an undergraduate student (domestic, permanent resident or international) who completes coursework abroad shall refer to Policy 243 (IV.B) regarding the evaluation and transfer of coursework from international institutions to Tennessee Tech.

2. Tennessee Tech will post credits and grades from institutions abroad only in accordance with the evaluation received from the National Association of Credential Evaluation Services (NACES) member organization.

3. A student must submit transcripts to the Undergraduate Admissions Office or to the Office of International Education, as appropriate. The Undergraduate Admissions Office can answer questions related to this requirement.

4. A student must submit to Tennessee Tech an official transcript showing all post-secondary coursework taken at any foreign institution of higher education.

J. Matters regarding credit by professional certificate or non-credit courses.

1. Academic credit may, in Tennessee Tech's sole discretion, be awarded for professional certification or non-credit courses.

2. Requests for the award of such credit must be submitted to the departmental chairperson of the department in which credit is being sought. As the executor of departmental policy, he/she will evaluate the requests and submit

a recommendation to accept or reject them to the college dean and to the Office of the Registrar for final approval.

K. Matters regarding the establishment of credit by special examination.

1. A student who has had sufficient training or experience in a subject to merit the establishment of credit by comprehensive examination but who has not enrolled in the same, comparable, or higher-level course at the college level may request the privilege of taking a special examination prepared by the department involved.

2. A student must submit a completed Application for Credit by Special Examination form with the receipt of payment to the Office of the Registrar.

3. Tennessee Tech will award credit based on the satisfactory results of such special examinations to a student's permanent record.

4. Only grades of A, B, C, D, or F will be assigned to such special examination courses.

5. A student must be enrolled at Tennessee Tech in order to take a special examination.

6. No more than 33 total semester hours of credit earned by correspondence and/or special examinations may be counted toward graduation.

L. Matters related to students wishing to take courses at other institutions.

1. Except in cases where Tennessee Tech has already developed a course-by-course articulation, as displayed on the Tennessee Tech Transfer website, a Tennessee Tech student who wishes to take courses at another institution with the intention of transferring this credit to Tennessee Tech should have prior written approval from the dean of the school or college in which the student proposes to graduate. The student should submit to the Office of the Registrar a completed Request to Study at Another Institution Form.

2. A student who takes courses without such prior approval must present the coursework to the Office of the Registrar for evaluation and approval or denial.

3. The student must immediately furnish official transcripts upon completion of such coursework.

4. Tennessee Tech will not award credit for correspondence courses in English Composition or in courses that include laboratory work.

M. Exceptions or Appeals

1. A student wishing to request an exception to any portion of this policy may complete the Request for Exception Form and submit it to the Office of Academic Services.

2. The Office of the Registrar will notify the student of approval or denial of his/her request within 14 calendar days of receipt of the request.

3. A student may appeal the decision of the Office of the Registrar by submitting a written appeal letter to the Office of the Provost no later than 14 calendar days after notification of the decision of the Office of the Registrar. At this time, the student may supply any additional or supplemental information he/she believes is pertinent to the request.

4. The Provost or his/her designee will request the Admissions and Credits Committee to convene a sub-committee and review the student's appeal.

5. The Provost or his/her designee on behalf of the sub-committee will notify the student in writing of its decision no later than 14 calendar days after receipt of the appeal and all supporting information.

6. The decision of the sub-committee of the Admissions and Credits Committee is final.

IV. Interpretation

The Provost or his/her designee has the final authority to interpret the terms of this policy.

V. Citation of Authority for Policy

T.C.A. § 49-8-203; T.C.A. § 49-7-202

Approved by:

Academic Council: 2015-04-15; 2019-01-23; 2023-10-04

University Assembly: 2015-04-22; 2019-04-17; 2023-11-16

Board of Trustees: 2019-03-21; xxxx-xx-xx

Tennessee Technological University
Policy No. 261

Academic Credit from Other Institutions

Effective Date: July 1, 2015

Policy No.: 261
Policy Name: Academic Credit from Other Institutions
Date Revised: January 1, 2024

I. Purpose

The purpose of this policy is to create uniform standards in awarding academic credits for undergraduate degrees from other institution.

II. Review

This policy will be reviewed every four years or whenever circumstances require review, whichever is earlier, by the Associate Provost, with recommendations for revision presented to the Academic Council, University Assembly, and the Board of Trustees.

III. Policy

A. An applicant or student must submit to Tennessee Tech an official transcript showing all post-secondary coursework taken at any institution of higher education. Failure to submit ~~any~~ official transcripts of all previous work, as well as any ~~will be considered as~~ falsification of the records, ~~and~~ may result in the denial / revocation of admission and dismissal of the student.

B. Tennessee Tech will determine, in its sole discretion, which credits it will accept.

C. Coursework accepted for credit toward an undergraduate degree must represent collegiate coursework relevant to the degree, with course content and level of instruction resulting in student competencies at least equivalent to those enrolled in Tennessee Tech's undergraduate degree programs.

D. A transfer student whose transcript(s) indicate satisfactory completion of the General Education program established in Tennessee Transfer Pathway shall be exempted from taking additional courses that normally are a part of the general education requirements of Tennessee Tech, except where teacher certification regulations, major field requirements, or professional accreditation agencies require the inclusion of such courses in the program of studies.

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F. Tennessee Tech fully supports the Tennessee Transfer Pathway (TTP) program coordinated by the Tennessee Board of Regents. A student who completes all the courses listed on a particular Transfer Pathway and earns an Associate of Arts or an Associate of Science degree from a TBR community college will have those courses accepted for credit and count toward the completion of the baccalaureate degree in the particular major.

G. In addition to the requirements of Tennessee Tech Policy 260 (Requirements for a Baccalaureate Degree and Graduation), a student transferring credit from a two-year institution must complete a minimum of 50 semester hours at a four-year institution provided that the student earns at least the minimum number of credits that must be taken at Tech, as specified in Policy 260.

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2. Tennessee Tech will post credits and grades from institutions abroad only in accordance with the evaluation received from the National Association of Credential Evaluation Services (NACES) member organization.

3. A student must submit transcripts to the Undergraduate Admissions Office or to the Office of International Education, as appropriate. The Undergraduate Admissions Office can answer questions related to this requirement.

4. A student must submit to Tennessee Tech an official transcript showing all post-secondary coursework taken at any foreign institution of higher education.

J. Matters regarding credit by professional certificate or non-credit courses.

1. Academic credit may, in Tennessee Tech's sole discretion, be awarded for professional certification or non-credit courses.

2. Requests for the award of such credit must be submitted to the departmental chairperson of the department in which credit is being sought. As the executor of departmental policy, he/she will evaluate the requests and submit

a recommendation to accept or reject them to the college dean and to the Office of ~~Academic Services~~the Registrar for final approval.

K. Matters regarding the establishment of credit by special examination.

1. A student who has had sufficient training or experience in a subject to merit the establishment of credit by comprehensive examination but who has not enrolled in the same, comparable, or higher-level course at the college level may request the privilege of taking a special examination prepared by the department involved.

2. A student must submit a completed ~~request~~Application for Credit by Special Examination form ~~for special examination~~with the receipt of payment to the Office of ~~Academic Services~~ the Registrar. ~~Additionally, a student must submit the fee payment of $20.00 per semester hour to the Business Office.~~

3. Tennessee Tech will award credit based on the satisfactory results of such special examinations to a student's permanent record.

4. Only grades of A, B, C, D, or F will be assigned to such special examination courses.

5. A student must be enrolled at Tennessee Tech in order to take a special examination.

6. No more than 33 total semester hours of credit earned by correspondence and/or special examinations may be counted toward graduation.

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1. Except in cases where Tennessee Tech has already developed a course-by-course articulation, as displayed on the Tennessee Tech Transfer website, a Tennessee Tech student who wishes to take courses at another institution with the intention of transferring this credit to Tennessee Tech should have prior written approval from the dean of the school or college in which the student proposes to graduate. The student should submit to the Office of ~~Academic Services~~ the Registrar a completed Request to Study at Another Institution Form.

2. A student who takes courses without such prior approval must present the coursework to the Office of ~~Academic Services~~ the Registrar for evaluation and approval or denial.

3. The student must immediately furnish official transcripts upon completion of such coursework.

3

4. Tennessee Tech will not award credit for correspondence courses in English Composition or in courses that include laboratory work.

M. Exceptions or Appeals

1. A student wishing to request an exception to any portion of this policy may complete the Request for Exception Form and submit it to the Office of Academic Services.

2. The ~~Director of Academic Services~~Office of the Registrar will notify the student of approval or denial of his/her request within 14 calendar days of receipt of the request.

3. A student may appeal the decision of the ~~Director of Academic Services~~Office of the Registrar by submitting a written appeal letter to the ~~Vice President for Enrollment Management and Career Placement~~Office of the Provost no later than 14 calendar days after notification of the decision of the ~~Director of Academic Services~~Office of the Registrar. At this time, the student may supply any additional or supplemental information he/she believes is pertinent to the request.

4. ~~The Vice President for Enrollment Management and Career Placement~~The Provost~~, in consultation with the Provost~~ or his/her designee~~,~~ will ~~convene~~ request ~~a sub- committee of the~~ the Admissions and Credits Committee to convene a sub-~~-~~committee and ~~to~~ ~~hear~~ review the student's appeal.

5. ~~The Vice President for Enrollment Management and Career Placement~~The Provost or~~and~~ his/her designee on behalf of the sub-committee will notify the student in writing of its decision no later than 14 calendar days after receipt of the appeal and all supporting information.

6. The decision of the sub-committee of the Admissions and Credits Committee is final.

IV. Interpretation

The Provost or his/her designee has the final authority to interpret the terms of this policy.

V. Citation of Authority for Policy

T.C.A. § 49-8-203; T.C.A. § 49-7-202

Approved by:

Academic Council: 2015-04-15; 2019-01-23; 2023-10-04

University Assembly: 2015-04-22; 2019-04-17; 2023-11-16

4

Board of Trustees: 2019-03-21; xxxx-xx-xx

5

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Expedited New Academic Program Proposal (ENAPP) for Bachelor of Science (BS) in Nuclear Engineering

☐ **Review** ☒ **Action** ☐ **No action required**

PRESENTER(S): Provost Lori Bruce

PURPOSE & KEY POINTS:

The new degree program for which approval is sought is a Bachelor of Science (BS) degree in Nuclear Engineering proposed by the Department of Mechanical Engineering in the College of Engineering. An Expedited Letter of Notification (ELON) for the program was presented to the Board as an information item on March 9, 2023. If approved by the Board of Trustees, this Expedited New Academic Program Proposal, ENAPP will be presented to the THEC Commission for final approval.

The proposed program in nuclear engineering aims to meet the current demand for nuclear engineers trained at the baccalaureate level, as well as to address emerging needs as Tennessee grows a nuclear development and manufacturing ecosystem. The program will require 128 credit hours, including a minimum of 32 credits of math and basic science courses as required by the Accreditation Board for Engineering and Technology (ABET) and satisfy the minimum 41 credits of General Education requirements stipulated by the university. The program's enrollment is projected to gradually increase from 10 students in Year 1 (Fall 2024) to 47 students in Year 5, with an estimated graduation of 10 students per year after five years.

Tennessee Tech has well established engineering programs with associated infrastructure. Thus, the estimated cost to support the proposed nuclear engineering program are predominantly tied to recruiting new faculty and establishing appropriate laboratories. These costs include significant purchases of new equipment, for which the university has secured $3 million in federal funding.

Tennessee TECH

Expedited New Academic Program Proposal (ENAPP) for

Bachelor of Science in Nuclear Engineering

Tennessee Technological University

Slide courtesy of East Tennessee Economic Council (ETEC)

Table of Contents

Appendices:

Expedited Letter of Notification

For the

Bachelor of Science

in

Nuclear Engineering Program

March 2023

Submitted by

Tennessee Tech University

OVERVIEW

INSTITUTION NAME:	Tennessee Technological University
PROPOSED ACADEMIC PROGRAM:	Bachelor of Science in Nuclear Engineering
DEGREE DESIGNATION:	BSNE
CIP CODES:	14.2301
CIP CODE TITLES:	Nuclear Engineering
ACADEMIC PROGRAM LIAISON:	Dr. Joseph C. Slater, Dean College of Engineering 931-372-3172 jslater@tntech.edu
IMPLEMENTATION TIMELINE:	
▪ **Estimated date of submission of ENAPP**	September 2023
▪ **Proposed date for the external site visit:**	November 2023
▪ **Estimated date of submission of the external review report to THEC:**	November 2023
▪ **Estimated date of institution's response to external review:**	January 2024
▪ **Proposed date of the institutional governing board's meeting to consider the proposed academic program for approval:**	March 2024
▪ **Proposed date of the THEC meeting to consider the proposed academic program for approval:**	May 2024
▪ **Proposed implementation date when students will enroll in the proposed academic program:**	August 2024
▪ **Estimated timeline for proposed programs that will seek programmatic accreditation:**	Fall 2028

Background

- Provide a short narrative describing the circumstances that initiated the need and development of the proposed academic program.

The current production status of nuclear engineers in the United States is slow to meet the future workforce needs. In 2021 ASEE reports only 384 students graduated across the country in Nuclear Engineering[1]. Many Nuclear Engineering programs graduate in the single digits per year. So, while the U.S. produces a minimal number of nuclear engineers each year, a shortage is looming to address the future workforce needs. Per the Bureau of Labor Statistics, 13,900 nuclear engineers are employed in the country[2]. According to the Nuclear Energy Institute, approximately 38% (5,282) of nuclear energy industry workers are expected to retire in the next few years[3]. In addition, BLS projected in 2021 that the job outlook will decline by 11% (1,529). This shows that there will be alteast 3,753 new jobs till 2031, which can be addressed by the college graduates. The graduates will meet the current need and maintain status-quo.

Further, indications are that nuclear energy is on the cusp of another heyday, contrary to public sentiment. The landscape in power and energy sector workforce is changing rapidly, projecting a large unmet workforce need into the future. The former president of Green Peace, Patrick Moore, has stated that using nuclear power is critical to addressing fossil fuel dependence driving greenhouse gasses and climate change. He said: "I see it as a long-term technology that will continue to be perfected."[4] Governor Lee has stated in his 2023 State of the State Address[5], "No other state in the country comes close to Tennessee's legacy, resources, and potential to be a leader in nuclear energy. And there is no long-term national strategy that doesn't include nuclear energy. That's why, tonight, I'm proposing $50 million in a Nuclear Fast Track fund to recruit companies to our state that will specifically establish a nuclear development and manufacturing ecosystem built for the future of Tennessee. We cannot not pass up this opportunity. Tennessee can and should be the leader in nuclear energy for America." This shows the priority and efforts by the Tennessee state government to expand the nuclear engineering ecosystem, as more training for nuclear engineers would be needed, demonstrating a future unmet need for Nuclear Engineering workforce in the state of Tennessee.

- Provide a general overview of the program, including a description of the academic program, total credit hours, target audience, purpose, program outcomes, delivery method (on-ground, online, hybrid, etc.), and any other pertinent information.

Tennessee Tech University proposes to initiate a Bachelor of Science in Nuclear Engineering (BSNE) program. The purpose of this program is to address the future unmet need for a Nuclear Engineering workforce in the State of Tennessee. Students in this program will apply the principles of physics, chemistry, and mathematics to study engineering topics, including statics, materials mechanics, machines, thermodynamics, and metallurgy. The knowledge gained in these areas is applied to understanding nuclear engineering topics, including reactor fluid

[1] https://ira.asee.org/wp-content/uploads/2022/11/Engineering-and-Engineering-Technology-by-the-Numbers-2021.pdf
[2] https://www.bls.gov/ooh/architecture-and-engineering/nuclear-engineers.htm#tab-1
[3] https://www.power-eng.com/nuclear/addressing-the-age-gap-in-nuclear-power-generation/
[4] https://www.wired.com/2007/11/co-founder-of-greenpeace-envisions-a-nuclear-future/
[5] https://www.tn.gov/governor/sots/2023-state-of-the-state-address.html

mechanics and heat transfer, reactor physics, nuclear radiation measurement, radioactive waste management, and nuclear systems design. A B.S. in Nuclear Engineering will provide students with the foundational knowledge necessary to contribute to the nation's workforce.

The target audience for this program include primarily traditional high school students from within Tennessee and current TTU students enrolled in other majors. It is also expected that the program will attract transfer students from regional community colleges and adult learners who are interested in becoming nuclear engineers.

In total, the BSNE program will consist of 128 credit hours of coursework and will be offered on-ground. Of these, 41 credit hours are assigned to general education, 21 credit hours are assigned to math and science, and the remaining 66 credit hours are assigned to programming core and electives.

Program Educational Objectives:

Graduates of the BSNE program will …

- excel in diverse career paths, using their engineering knowledge and professional skills to address complex problems and make positive impacts on society.
- serve their profession and the public as ethical team members and leaders with awareness of modern issues, commitment to inclusive collaboration, and effective communication.
- practice adaptive learning, expanding and enhancing their knowledge, creativity, and skills through professional development, continuing education, and/or earning advanced degrees.

Student Learning Outcomes:

Students are expected to have the following skills upon completing the undergraduate degree program.

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

Justification for Consideration of Expedited Policy

- Provide clear evidence that the proposed program is in high demand in the region and in the state.

The proposed nuclear engineering, BS is high need in both the region and the state. Evidence follows that demonstrates that the program will contribute to both 1) the current need/demand for nuclear engineers trained at the baccalaureate level, and 2) an emerging need for nuclear engineers as TN builds a nuclear development and manufacturing ecosystem that meets several evolving needs and reflects changes to the nuclear industry.

Current needs

One of the goals of the THEC's State Master Plan is to "increase enrollment in majors leading to high-demand jobs." The proposed BSNE program supports this goal in several ways. There is a workforce shortage in Nuclear Engineering. Currently, 92 nuclear reactors in the United States power tens of millions of homes and anchor local communities, including the four in Tennessee[6]. This demonstrates that Tennessee is a leader in nuclear energy production. In 2022, the primary source of electricity in Tennessee at 43.4% was nuclear[7]. The students from the proposed program will be qualified to work in the current workforce and meet the current needs of the nuclear engineering workforce.

In 2020, the U.S. Department of Energy presented a strategy to assure U.S. National Security, and stated that "Nuclear power is intrinsically tied to National Security."[8] Per information stated in the Background section of this document, the demand for new nuclear engineers is 3,753 between 2021 and 2031, and the graduates from existing programs will meet the current workforce need and maintain status-quo.

Future Needs

In 2021, The Center for Energy Workforce Development projected that by 2026, there will be 15,000 potential replacements in Nuclear Engineering, demonstrating a significant employee demand[9]. In Tennessee, only 35 new nuclear engineering graduates entered the workforce in 2022[10]. The average age of nuclear reactor engineers in the workforce is just over 50 years[11]. This could signal a potential shift in developing and integrating next-generation power plants in the U.S.

The U.S. Nuclear Regulatory Commission recently announced its approval of the designs for a first-of-its-kind small modular reactor (SMR)[12]. As the new technology such as small nuclear reactors in nuclear engineering is emerging, federal investment is coming, there will be future need for nuclear engineering workforce.

The U.S. Energy Department has provided more than $600 million since 2014 to support the design,

[6] https://www.nei.org/resources/us-nuclear-plants
[7] https://www.nei.org/CorporateSite/media/filefolder/resources/fact-sheets/state-fact-sheets/Tennessee-State-Fact-Sheet.pdf
[8] https://www.energy.gov/articles/restoring-americas-competitive-nuclear-energy-advantage
[9] https://cewd.org/wp-content/uploads/2022/02/Gaps-In-Energy-Careers-Report-2022_Final-pages.pdf
[10] https://registrar.utk.edu/commencement-overview/spring-2022-confirmed-degrees/tickle-college-of-engineering-2022-spring/
[11] https://nuclear.mst.edu/media/academic/nuclear/documents/Nuclear%20Engineering-Undergrad%20SS2021.pdf
[12] https://www.energy.gov/ne/articles/nrc-certifies-first-us-small-modular-reactor-design

licensing and siting of NuScale's small modular reactor power plant and other domestic small reactor concepts [13]. Roughly 40 serious concepts are in development for the next generation of advanced nuclear reactors worldwide[14]. With Tennessee's aspiration to become a nation's leader in developing next generation of nuclear power, these new small reactor concepts and governor's investment would potentially create employment opportunities for nuclear engineers in the state. The proposed BSNE program will be designed with an emphasis on latest technology, policies and regulations, minimizing dependence on fossil fuels, and addressing the employment workforce needs of the future. The first group of graduates from this program will enter the workforce around 2028, meet the needs of future nuclear technology development and operation, and contribute to the state and beyond.

In the 2023 State of the State Address, Governor Lee stated, "No other state in the country comes close to Tennessee's legacy, resources, and potential to be a leader in nuclear energy. And there is no long-term national strategy that doesn't include nuclear energy."[15] Addressing this limitation, the Governor is investing $50 million in establishing a nuclear development and manufacturing ecosystem built for the future of Tennessee. This endorsement from the Governor demonstrates that we need to develop new programs to facilitate future workforce development in Nuclear Engineering.

Nuclear engineers serve in a broad range of sectors including government, industry, and manufacturing. A quick search for "Nuclear Engineering" and "Nuclear Engineer" jobs on a couple of websites showed that several hundred jobs are available across the country, of which majority (over 89%) require only a Bachelor's degree[16]. Some of the job titles for these positions include: Nuclear Engineers; Nuclear Materials Accountability Engineer; Chemical Nuclear Engineer; Nuclear Engineer/Physicist; Radiological Engineer; Nuclear Safety Analysis Structural Engineer; Nuclear Criticality Safety Engineer; Hoisting and Rigging Engineer; Nuclear Auxiliary Operator; Chief Engineering Manager; System Engineering Manager; Instrumentation and Control Engineer, etc. The new emerging technologies in energy system are going to result in more demand in nuclear engineer, and this proposed BSNE program will serve the future workforce needs in those broad range of sectors.

Existing Programs of Study at the Institution

[13] https://www.energy.gov/ne/articles/nrc-certifies-first-us-small-modular-reactor-design

[14] https://apnews.com/article/us-nuclear-regulatory-commission-oregon-climate-and-environment-business-design-e5c54435f973ca32759afe5904bf96ac

[15] https://www.tn.gov/governor/sots/2023-state-of-the-state-address.html

[16] https://www.indeed.com/jobs?q=Nuclear+Engineering&from=mobRdr&utm_source=%2Fm%2F&utm_medium=redir&utm_campaign=dt&vjk=496702788bc1b762 ; & https://www.google.com/search?rlz=1C1GCEB_enUS953US953&q=nuclear+engineer+jobs+in+Tennessee&spell=1&sa=X&biw=1920&bih=937&dpr=1&ibp=htl;jobs&ved=2ahUKEwiFyOKhlqX-AhXknGoFHeAlBG0Qkd0GegQIGxAB#fpstate=tldetail&htivrt=jobs&htidocid=3E0L2gZsO0oAAAAAAAAAAA%3D%3D

- If the proposed program is emerging from an existing minor or certificate program, provide the previous three years of enrollment and graduation data for the existing program.

Currently, the Tennessee Tech University College of Engineering offers eight programs with curricula leading to Bachelor of Science degrees in Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, General Engineering, Mechanical Engineering, Computer Science, and Engineering Technology. The undergraduate programs in Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, and Mechanical Engineering are accredited by the ABET Engineering Accreditation Commission. The Computer Science program is accredited by the ABET Computing Accreditation Commission. The Engineering Technology program is accredited by the ABET Engineering Technology Accreditation Commission. 2449 undergraduate students are currently in these programs across the college.

There are no existing minor or certificate programs in Nuclear Engineering at Tennessee Tech University. The only programs related to this area are B.S. in Chemical Engineering and B.S. in Mechanical Engineering, with a steady annual enrollment of approximately 200 and 700, respectively.

There was a nuclear engineering concentration within the Electrical and Computer Engineering Department at TTU that started in 1995 was discontinued in 2001 primarily due to budgetary constraints, declining enrollment, and shifting industry demands. Specifically, the concentration faced challenges due to reduced funding and increased safety concerns with nuclear reactors that resulted in notable decrease in student interest and enrollment in the program. Also, changes in university priorities, and faculty retirements combined to create an environment where it was not feasible to continue offering the program at the standards, we aspire to at TTU. During this period, the nuclear power industry experienced a downturn and stagnation, further contributing to the program's discontinuation[17].

Since the closure of the previous program, there have been significant changes that justify the re-establishment of a nuclear engineering program. Nuclear energy seems poised for another heyday, as it is becoming a critical resource for addressing fossil fuel dependence, resulting in a coming shift in the power and energy workforce. According to the Nuclear Energy Institute, approximately 38% (5,282) of nuclear energy industry workers are expected to retire in the next few years. Governor Lee's 2023 State of the State Address includes creating an ecosystem for the development and manufacturing ecosystem. This shows the priority and efforts by the Tennessee State government to expand the nuclear engineering ecosystem, as more training for nuclear engineers would be needed, demonstrating a significant future unmet need for Nuclear Engineering workforce in the State of Tennessee.

Student Interest: Student interest and feedback were solicited about the proposed program from all undergraduate engineering students in the College of Engineering in the form of a survey in February & March 2023. An overwhelming response was received from 265 students with strong support for this program. 28% of respondents indicated that they were extremely likely to have considered majoring in nuclear engineering if it

[17] https://world-nuclear.org/information-library/current-and-future-generation/outline-history-of-nuclear-energy.aspx

was available when they started at TTU, and 44% indicated that they would consider nuclear engineering as a major, if it is available now. The lessons learned from the previous program's closure have informed the planning and development of the proposed program. This includes a complete degree beyond a concentration in nuclear engineering, robust financial planning, curriculum updates, and enhanced industry partnerships.

In conclusion, while the closure of the previous program was a result of multiple factors, TTU has since taken significant steps to address these challenges. We are confident that the re-establishment of a nuclear engineering program now aligns with both industry needs and the strategic goals of the university.

Community and Industry Partnerships

- Provide a minimum of two letters of support from regional, community, and/or workforce partners in the ELON appendix. Letters should be dated and appear on letterhead.

Five letters of support from the industry are submitted in the Appendix of this letter of notification. These letters show support for the degree program from the regional workforce partners in Tennessee and beyond.

- Spectra Tech Inc, Oak Ridge, TN
- Teledyne Brown Engineering, Huntsville, AL
- EchoWolf Solutions, Park City, UT
- Alex A. Beehler & Co., LLC, Bethesda, MC
- General Atomics Electromagnetic Systems, San Diego, CA

Accreditation

- If the proposed program has a programmatic accrediting agency, please describe plans, timeline, and associated costs to obtain accreditation.

The primary accrediting agency for all engineering programs is ABET. All undergraduate engineering, engineering technology, and computer science programs offered at Tennessee Tech University are accredited by ABET. This B.S. in Nuclear Engineering program will seek ABET accreditation in alignment with these programs.

Quality Assurance of the Proposed BSNE Program:

The proposed BS in Nuclear Engineering program will achieve and maintain quality and rigor through continuous assessment, evaluation, and maintaining ABET Accreditation, consistent with all other engineering programs at Tennessee Tech University.

To receive ABET accreditation, a program must initially describe its Program Educational Objectives (the career and professional accomplishments that the program is preparing graduates to achieve), and its Student Outcomes (what students are expected to know or be able to do by the time of graduation from the program).

Furthermore, the BSNE program must demonstrate that they satisfy both "General Criteria for Baccalaureate Level Programs" and "Program Criteria" that is specific for Nuclear Engineering[18].

The General Criteria for Baccalaureate Level Programs includes several components, including but not limited to: Criterion 1. Students; Criterion 2 Program Educational Objectives; Criterion 3. Student Outcomes; Criterion 4. Continuous Improvement; Criterion 5. Curriculum; Criterion 6. Faculty; Criterion 7. Facilities; Criterion 8. Institutional Support. Detailed information on this criterion is not listed to maintain brevity, but is available on the ABET website[5].

The Program Criteria specific to Nuclear Engineering has two subcomponents including:

> *Curriculum:* The program must include the following curricular topics in sufficient depth for engineering practice:
> (a) mathematics, to support analyses of complex nuclear or radiological problems,
> (b) atomic and nuclear physics,
> (c) transport and interaction of radiation with matter,
> (d) nuclear or radiological systems and processes,
> (e) nuclear fuel cycles,
> (f) nuclear radiation detection and measurement,
> (g) nuclear or radiological system design.
>
> *Faculty:* The program must demonstrate that faculty members primarily committed to the program have current knowledge of nuclear or radiological engineering by education or experience.

The program leadership has already drafted the Program Educational Objectives and Student Outcomes as listed above, and anticipate drafting the curriculum and a plan to meet all ABET criterion before submitting the full program proposal (ENAPP) later this year.

Per ABET guidelines, the university must graduate at least one cohort from the program before seeking accreditation[19]. Considering that THEC approves the starting of this program in January 2024, a first-year class will be accepted in fall 2024, with anticipated graduation in spring 2028. An ABET Readiness Review document will be submitted in October 2028, following a self-study report in June 2029 and an on-site visit in September 2029. The current fee for initial program accreditation is $8,000[20].

Administrative Structure

- Provide an organizational chart that includes the college, department, administrative unit, and program director for the proposed academic program.

[18] https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2022-2023
[19] https://www.abet.org/accreditation/get-accredited/
[20] https://www.abet.org/accreditation/cost-of-accreditation/

The proposed B.S. in Nuclear Engineering program is intended to be housed in the Department of Mechanical Engineering within the College of Engineering, as presented in Figure 1. The administrative structure within the college is as follows: The Dean for the College of Engineering administers activities within the college, and the Chair of the Department of Mechanical Engineering administers activities within the department. The Department Chair will report to the College Dean. To aid in administrating the B.S. in Nuclear Engineering program, the Department of Mechanical Engineering will appoint a faculty member as a coordinator and allow release time from teaching to compensate for those responsibilities.

- If a new academic department will be required for the proposed program, the THEC Academic Policy A1.3: New Academic Units must be followed and should be noted in this section. The request for a New Academic Unit must be submitted concurrently with the Expedited Letter of Notification.

A new academic department is not required to establish the B.S. in Nuclear Engineering. This program is intended to be housed in the existing Department of Mechanical Engineering within the College of Engineering at Tennessee Tech University.

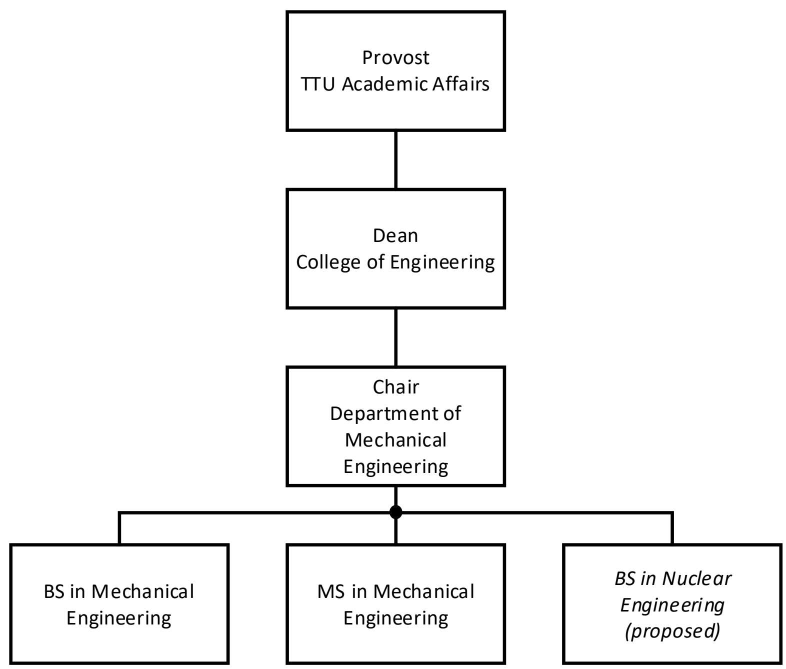

Figure 1: Administrative structure for the Nuclear Engineering program

Enrollment and Graduation Projections

- Provide initial projections for the first five years of enrollment and graduates. Enrollment projections should be realistic and based on demonstrable student demand. Attrition calculations should be based on the average rates of similar programs or overall institutional attrition rates.

Before determining the projections required, the enrollment and graduation rates of similar programs, such as the B.S. in Mechanical Engineering, B.S. in Electrical Engineering, and B.S. in Chemical Engineering at Tennessee Tech University, were examined. The projected enrollment and graduation rates are presented in Table 1.

Table 1: Projected Enrollment and Graduation Rates

Year	Academic Year	Projected Total Enrollment in Fall Semester	Projected New Freshman	Projected Attrition	Projected Graduates
1	2024-25	10	10	2	-
2	2025-26	18	10	3	-
3	2026-27	27	12	3	-
4	2027-28	38	14	3	6
5	2028-29	47	18	4	10

Institutional Alignment and Demand

Alignment with State Master Plan and Institutional Mission

- Explain how the proposed program aligns with the THEC Master Plan and Institutional Mission State or Profile.

The program will address the following strategic initiatives:

- T.N. Reconnect – Drive to 55
- 2023 State of the State Address – Governor Lee
- Tennessee Technological University Institutional Mission

Support Drive to 55 Goals. A 2017 T.N. Reconnect report indicated that over 900,000 Tennesseans have some college credit but no college degree. For the state of Tennessee to meet the Drive to 55 initiative, we must take every reasonable step to keep students progressing toward the degree. The BSNE Program will provide new program options for students while embracing TTU's Strategic Plan to be responsive to the needs of stakeholders.

This program will provide Tennessee with a skilled workforce that is prepared to meet the growing demand for nuclear engineers. Additionally, the program will support Drive to 55 by increasing the number of Tennesseans who have completed a postsecondary credential. Currently, only 38% of Tennesseans have an Associate or higher degree, falling short of the state's goal of 55%. By offering a degree program in nuclear engineering, TTU will help Tennessee move closer to achieving this goal. Moreover, the program will also create opportunities for Tennesseans to obtain high-paying jobs and contribute to the state's economy.

In the 2023 State of the State Address, Governor Lee stated, "No other state in the country comes close to Tennessee's legacy, resources, and potential to be a leader in nuclear energy. And there is no long-term national strategy that doesn't include nuclear energy." Addressing this limitation, Governor Lee is investing extensively in establishing a nuclear development and manufacturing ecosystem built for the future of Tennessee. This endorsement from the Governor demonstrates that we need to develop new programs to facilitate workforce development in Nuclear Engineering. The BSNE program will address workforce initiatives by creating partnerships that engage industry leaders, workplace managers, and business executives. These partnerships will identify gaps in the workforce and shape the BSNE curriculum to provide innovative solutions to address the shortcomings.

Potential Partnerships. TTU personnel have engaged in extensive discussions with representatives from the Nuclear Engineering industry, congressmen, workplace managers, and business executives. This includes the Congressional Nuclear Caucus meeting held at the Rayburn House Office Building in Washington, DC. The representatives met and interacted with include individuals from organizations such as Spectratech, ORNL, UltraSafe Nuclear, GE Hitachi Nuclear, TVA, Curio, DOE, General Atomics, ARPA-EA, Echowolf Solutions, Centrus Energy, The Atlantic Council, and Teledyne Brown. The potential partnerships with these organizations include:

- Internships: Partnering with nuclear industry firms to establish internships for students, allowing them to gain hands-on experience and exposure to the industry.
- Guest Lectures: Inviting industry professionals to give guest lectures, sharing their knowledge and expertise with students and providing networking opportunities.
- Research Collaborations: Collaborating with industry on research projects, providing students with valuable experience and potential career opportunities.
- Equipment and Technology: Partnering with nuclear industry firms to provide the latest equipment and technology for the university's nuclear engineering program.
- Scholarship Opportunities: Partnering with industry to establish scholarships and other financial assistance programs for students studying nuclear engineering.

Tennessee Tech University intends to collaborate with academic institutions such as UTK and government labs such as ORNL in the state while designing and offering this BSNE program. This collaboration could include curriculum design and offering, faculty expertise, resource sharing, assessment and evaluation metrics, activities to meet workforce demands, etc. Preliminary discussions on these potential partnerships have taken place in Fall 2022 and early spring 2023. The University is also interested in developing other collaborations to meet specific regional and national needs.

Alignment with Tennessee Tech's Institutional Mission**.** The proposed BSNE program strongly supports Tennessee Tech University's mission: "Tennessee's technological university creates, advances, and applies knowledge to expand opportunity and economic competitiveness. As a STEM-infused, comprehensive institution, Tennessee Tech delivers enduring education, impactful research, and collaborative service." Aligning with the mission, the BSNE is a STEM degree with strength in nuclear and reactor physics, nuclear fuel cycles, nuclear system design, which supports Tennessee Tech's mission "as a STEM-infused" institution and a technological university. This BS in Nuclear Engineering program aligns with TTU's mission in several ways, including:

- Strengthening Research: The program will provide opportunities for faculty and students to conduct cutting-edge research in nuclear engineering and related fields, aligning with TTU's strategic plan to increase research efforts and enhance the university's research infrastructure.
- Advancing Workforce Development: The program will help meet the growing demand for nuclear engineers and technicians in the region, supporting TTU's goal of advancing workforce development and economic growth in Tennessee.
- Enhancing Student Success: The program will provide a rigorous and specialized curriculum that prepares students for successful careers in the nuclear industry, aligning with TTU's mission to provide transformative educational experiences that empower students to reach their full potential.
- Fostering Community Engagement: The program will provide opportunities for collaboration between the university and the nuclear industry, promoting community engagement and supporting TTU's strategic plan to enhance partnerships with industry and other stakeholders.
- Promoting Sustainability: The program will contribute to the development of safe and sustainable nuclear energy solutions, aligning with TTU's mission to promote responsible stewardship of natural resources and support environmental sustainability.

Student Interest

- Provide compelling evidence of student interest in the proposed program. Types of evidence vary and may include enrollment in related concentrations or minors; representative student and alumni surveys; and national, statewide, and professional employment forecasts and surveys.

Student Interest: Student interest and feedback were solicited from all undergraduate engineering students in the College of Engineering in the form of a survey in February & March 2023. An overwhelming response was received from 265 students with strong support for this program. The survey included vital questions to ascertain if they would enroll in this program if offered and the significance of providing it at Tennessee Tech University.

1. If Nuclear Engineering had been available as a major when you started at TTU, how likely is it you would have considered it as a major?
   Extremely Likely: 74 (28%)
   Very Likely: 97 (37%)
   Somewhat Unlikely: 62 (23%)
   Extremely Unlikely: 32 (12%)

2. If Nuclear Engineering is available as a major now, how likely is it you would have considered it as a major?
   Extremely Likely: 44 (17%)
   Very Likely: 88 (33%)
   Somewhat Unlikely: 76 (29%)
   Extremely Unlikely: 57 (21%)

3. Considering that the majority of electricity generated in T.N. is from Nuclear sources, and there is only one undergraduate Nuclear Engineering program in the state, how important is it to have a B.S. degree in Nuclear Engineering at TTU?
   Extremely Important: 147 (56%)
   Very Important: 78 (29%)
   Moderately Important: 32 (12%)
   Slightly Important: 6 (2%)
   Not Important: 2 (1%)

4. Please include any feedback you like to provide on this program. *(only a few responses were included for brevity).*
   - I'd love to see this program!
   - I think this is an excellent idea. As the world is coming to terms with the costs of continuing to use massive amounts of fossil fuels, we are feverishly trying to find new ways to satisfy our energy demands. One of the best ways is nuclear. We need more people with the knowledge to design and create new and better reactors.
   - Coming from the Oak Ridge area, Nuclear Engineering would be sought after by many places out that way.
   - Always been my dream! Add this!!

Existing Programs Offered at Public and Private Tennessee Universities

- List all academic programs with the same or similar CIP code offered at public and private universities in Tennessee along with the number of degrees awarded for the last three years of available data.

Per THEC Academic Program Inventory[21], only the University of Tennessee Knoxville (UTK) offers a B.S. in Nuclear Engineering program. The enrollment and degrees awarded for the last three years are presented in Table 2. Tennessee Tech University intends to collaborate with academic institutions such as UTK and government labs such as ORNL in the state while designing and offering this BSNE program. This collaboration could include curriculum design and offering, faculty expertise, resource sharing, assessment and evaluation metrics, activities to meet workforce demands, etc. The University is also interested in developing other collaborations to meet specific regional and national needs.

Table 2: Enrollment and Graduation Rates at other Universities

CIP Code	Degree	Major	University	2018-2019	2019-20	2020-21	2021-22
14.2301	B.S.	Nuclear Engineering	UTK				
Enrollment				205	194	195	198
Degrees Awarded				38	43	32	42

[21] https://thec.ppr.tn.gov/THECSIS/Research/Research.aspx

- If there are current programs in Tennessee, provide a short narrative on how the proposed program will substantially differ from existing programs.

The proposed B.S. in Nuclear Engineering degree program at Tennessee Tech University will be housed and supported by the excellent faculty in the Department of Mechanical Engineering and the Center of Excellence in Energy Systems Research. The degree program will stress engineering science fundamentals and mathematics. The core curriculum will cover the basic principles of nuclear energy production, reactor systems design, and management of radioactive materials. Elective courses will be developed to permit students to broaden their education as desired.

All students in this program will be required to participate in appropriate experiential learning activities. These activities require students to go beyond mastering basic skills and knowledge in applying that material to problem-solving challenges. These activities involve collaboration and reflective learning and allow students to learn in an environment that aligns with their aptitudes. Examples of these activities that fulfill experiential learning include, but are not limited to, co-ops or internships, undergraduate research or design projects, participation in a design competition, study abroad programs, service learning projects, etc. Some of curriculum contents and experiential learning approaches could potentially distinguish the TTU Nuclear Engineering Program from the UTK Nuclear Engineering Program, such as inclusion of knowledge and skills on cybersecurity, emerging energy technology, and environment and sustainability. Further, the course delivery will be accomplished through active learning strategies that lead to higher student engagement and promote better knowledge retention.

We highlight the integration of practical, hands-on experiences that complement our theoretical curriculum. Key elements include extensive laboratory work in two specific lab courses, providing students with direct experience in nuclear radiation detection techniques and reactor physics technologies. We also emphasize industry partnerships that facilitate co-op education and internships, offering real-world experience under professional guidance. Additionally, our program includes capstone projects in the final year, where students apply their learning to solve nuclear industry-relevant problems, often in collaboration with our industry partners.

Furthermore, the program enriches learning through field trips to nuclear facilities (ORNL, Y-12, TVA, UCOR, etc.), participation in faculty-led research projects, and the use of advanced simulation technologies. These components are complemented by professional development workshops and seminars, ensuring that our graduates are well-prepared for the challenges and opportunities in the field of nuclear engineering. By weaving these experiential learning opportunities throughout the curriculum, we aim to equip our students with both the theoretical knowledge and practical skills necessary for a successful career in nuclear engineering.

While we are excited about the potential growth in the field of Nuclear Engineering, we recognize that this is a highly regulated area and requires significant attention to detail and safety. As a university, we strive to be forward-thinking and responsive to the evolving workforce needs of Tennessee and the nation. We will contribute to the education and training of professionals in this field.

Articulation and Transfer

- For proposed bachelor's programs, indicate all Tennessee Transfer Pathways (TTP) that may be acceptable for entry into the proposed program.

One primary Tennessee Transfer Pathway currently exist that would align with the proposed B.S. in Nuclear Engineering: A.S. in Mechanical Engineering

The A.S. in Mechanical Engineering is available at the following community colleges:

- Chattanooga State Community College
- Cleveland State Community College
- Columbia State Community College
- Jackson State Community College
- Motlow State Community College
- Nashville State Community College
- Northeast State Community College
- Roane State Community College
- Volunteer State Community College
- Walters State Community College

- Indicate any additional community college or technical college programs that may be articulated for transfer into the proposed bachelor's program.

Tennessee Tech University does not anticipate articulating other transfer programs into the proposed bachelor's program. As the program grows, it would be an interest to explore furth

Support Letters

Spectra Tech Inc.

Engineering, Environmental & Nuclear Services

April 26, 2022

To Whom It May Concern:

This letter is being written in support of the establishment of a nuclear engineering program at Tennessee Technological University (Tennessee Tech). The resurgence and current interest in nuclear power and technology, coupled with the wave of retirements from the industry, has resulted in a dire need for well-trained nuclear engineers. Nuclear engineers work in a myriad of areas such as nuclear power, environmental cleanup, national security (weapons programs), engineering and design companies, equipment vendors, radiation sterilization, regulatory agencies, universities, research laboratories, and nuclear medicine. There is a shortage of nuclear engineers in every one of these areas, as evidenced by the many job openings and high salaries.

Tennessee Tech has a reputation for graduating engineers who are ready to go to work. The university provides their graduates with not only a strong academic foundation, but also practical training and a "can-do" attitude. No doubt they put out a great product!

As the President and owner of an engineering and environmental company that focuses on nuclear work, I believe that a nuclear engineering program at Tennessee Tech would be a great resource to our state and nation. I heartily support the effort to establish the nuclear engineering program and look forward to hiring some of the graduates.

Sincerely,

Loong Yong, Ph.D. (Nuclear Engineering)
President
Spectra Tech, Inc.
Oak Ridge, TN 37830

132 Jefferson Court • Oak Ridge, Tennessee 37830
Phone (865) 483-7210 • Fax (865) 483-7262
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Huntsville, Alabama 35807-7007
256.726.1000

April 26, 2022

Dr. Terry Saltsman
Tennessee Tech
1 William L Jones Dr
Cookeville, TN 38505

Dear Dr. Terry Saltsman:

As a member of the Tennessee Valley Corridor Leadership Council, we have discussed the increasing need for educational opportunities in nuclear engineering.

Establishment of a nuclear engineering program at Tennessee Tech is consistent with that need and very timely for our region as numerous opportunities in new nuclear reactor development and deployment exist. TVA has recently announced its support of new nuclear development as well as other reactor developers connected with the Tennessee Valley Corridor. Especially with these opportunities growing related to the need for carbon free power, increasing numbers of new nuclear engineers will continue to be in demand for the foreseeable future.

Best wishes to Tennessee Tech in establishment of the nuclear engineering program.

Sincerely,

Gard Clark
Senior Vice President
Energy and Environment
Teledyne Brown Engineering, Inc.

echo wolf solutions

March 25, 2023

Dr. Robert Smith
Interim Executive Director
Tennessee Higher Education Commission
312 Rosa Parks Ave.,
9th Floor Nashville, TN 37243

Dear Dr. Smith,

I am writing to express my support for Tennessee Technological University's (TTU) efforts to reopen its Nuclear Engineering program.

Since founding EchoWolf Solutions, a business strategy and market intelligence agency, I have been invited to collaborate and consult with nuclear industry and utility executives, U.S. Department of Energy, U.S. Department of Defense, government contractors, private sector leaders, nonprofit foundations, Universities, and industry groups. In working with industry leaders and their teams for over a decade, I see the pressing need for skilled nuclear engineers in the workforce.

The nuclear energy industry is undergoing a period of innovation and growth, with the development of new and advanced technologies and approaches essential to meeting the world's increasing energy needs. The field of nuclear engineering is critical to this effort, providing the knowledge and technical expertise necessary to design, build, and operate nuclear power plants and other facilities.

Unfortunately, there is a significant shortage of trained nuclear engineers in the United States, and this deficit is only expected to grow in the coming years. As existing nuclear facilities reach the end of their lifetimes, new facilities and advanced reactors are built, the demand for skilled nuclear engineers will only increase.

TTU's new Nuclear Engineering program would provide a valuable resource for the state of Tennessee and the nuclear energy industry as a whole. The program's focus on practical, hands-on training and close collaboration with industry partners would give students a unique and valuable educational experience, preparing them to excel in their careers and contribute to the growth and development of the industry.

As someone who has worked closely with the U.S. nuclear energy industry and participated as a University of Utah Nuclear Engineering Education Board Member, I have seen firsthand the critical importance of skilled nuclear engineers. While one or two universities in each state will not currently provide the needed graduates to fill available positions, the reopening of TTU's Nuclear Engineering program is a significant step forward in meeting this need and helping to ensure the future of the industry providing safe, reliable power.

Thank you for your consideration of this important matter.

Sincerely,

Sally N. White
CEO and Founder

ALEX A. BEEHLER & CO., LLC

Alex A. Beehler | 5310 Wriley Road | Bethseda, MC 20816 | alex.beehler@gmail.com | 301-832-5463

Dr. Robert Smith
Interim Executive Director
Tennessee Higher Education
Commission 312 Rosa
Parks Ave., 9th Floor
Nashville, TN 37243

Dear Dr. Smith,

I am writing to express my support for Tennessee Technological University's (TTU) efforts to restart its Nuclear Engineering program. As the former Assistant Secretary of the Army for Installations, Energy and Environment, and the former Acting Deputy Undersecretary of Defense for Installations and Environment, I have had the opportunity to work closely with the nuclear energy industry and to witness firsthand the importance of developing a strong and capable nuclear engineering workforce.

Over my 20 years of experience working either in the Pentagon or with the Department of Defense, I have witnessed an increasingly pressing need for newly minted engineers, especially in the field of nuclear engineering. This demand is only expected to grow as the "new nuclear" focus on innovation recharges the nuclear field.

As the pilot projects currently underway at the Department of Defense and Department of Energy are successfully tested and completed, they will pave the way for widespread commercialization of nuclear energy. This will, in turn, drive the demand for young nuclear engineers with specific training at the university level.

It is clear that there is a critical need to develop and train the next generation of nuclear engineers to meet the challenges of the future. The reopening of Tennessee Technological University's Nuclear Engineering program would provide a much-needed resource to address this need and prepare the workforce of tomorrow. The need for qualified nuclear engineers has only grown more critical in recent years, as our nation faces a growing demand for clean, reliable energy sources. Nuclear energy is one of the most efficient and cost-effective sources of electricity available, and it has the added benefit of producing no greenhouse gas emissions. However, the industry is currently facing a shortage of skilled workers, particularly in the area of nuclear engineering.

Tennessee has a rich history in the field of nuclear energy. Restarting the program would not only help to address the shortage of qualified nuclear engineers but also provide Tennessee with a valuable economic asset.

In addition, the program would offer students the opportunity to gain hands-on experience through partnerships with nuclear energy companies and national laboratories. This type of experiential learning is essential to preparing students for careers in the nuclear industry, and it would help to ensure that the next generation of nuclear engineers is equipped with the skills and knowledge needed to meet the challenges of the future.

I strongly believe that the reopening of the Nuclear Engineering program at TTU would be a positive development for both the university and the state of Tennessee. I urge you to support TTU's efforts to reestablish this important program.

Thank you for your attention to this matter.

Sincerely,
The Honorable Alex A. Beehler

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March 27, 2023

Dr. Robert Smith
Interim Executive Director
Tennessee Higher Education Commission
312 Rosa Parks Ave., 9th Floor
Nashville, TN 37243

Dear Dr. Smith:

I am writing this letter in strong support of reopening a new nuclear engineering department at the Tennessee Technological University (TTU). I cannot emphasize enough the need we have in the U.S. for additional capacity to educate and train the current and next generations of nuclear engineers and scientists. Workforce shortages in all skill categories are substantially hindering the further development and deployment of new nuclear capacity in our country (and, indeed, across the world). The deployment of advanced, safe, nearly zero Green House Gas-emitting, and economically viable nuclear reactors is seen as essential to achieving our clean energy deployment goals, as also described in an excellent recent report from the U.S. Department of Energy.[1]

The U.S. is indeed falling behind our competitors abroad in deploying the safest and most economical next generation of nuclear reactors. Compounding the domestic workforce shortages are the aging of, and retirements across, the current workforce. This means that the demand for nuclear engineers far exceeds the current availability of new well-educated and trained workers. With nuclear power-related jobs one of the best paying jobs in the U.S.[2], job opportunities are very much abound (including those in my own company!)

Addressing the growing demand for nuclear engineers and scientists necessitates increasing the availability and capacity of nuclear engineering and other nuclear science related academic and vocational options throughout our country—and fast. TTU, with its long-standing tradition of excellence in education, is uniquely positioned to hosting one of these highly needed new nuclear engineering departments. Its Southeast location readily facilitates the hiring of fresh graduates into the locally growing nuclear power sector, with nuclear power plants like Vogtle, those of the Tennessee Valley Authority, in addition to new demonstration projects planned at Oak

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[1] https://liftoff.energy.gov/wp-content/uploads/2023/03/20230320-Liftoff-Advanced-Nuclear-vPUB.pdf
[2] https://www.nei.org/corporatesite/media/filefolder/resources/fact-sheets/state-fact-sheets/illinois-state-fact-sheet.pdf

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16530 VIA ESPRILLO, SAN DIEGO, CA 92127   PO BOX 85608 92186-5608   (858) 676-7100

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Ridge and across the region and the rest of the nation. The reopening of the Nuclear Engineering Department at TTU would surely help meet this growing demand by graduating well-qualified nuclear engineers with the cutting-edge knowledge skills required to be successfully employed and/or pursue their academic careers in order to continuously replenish the pipeline of nuclear engineering and science educators of the future.

Sincerely,

Dr. Ron S. Faibish
Senior Director
Strategic Development
Nuclear Technologies and Materials
General Atomics Electromagnetic Systems
(202) 713-8333 (cell)
Ron.faibish@ga.com

Tennessee Higher Education Commission Expedited Letter of Notification Evaluation

March 8, 2023

The evaluation of the Expedited Letter of Notification (ELON) is in accordance with the *THEC Policy A1.6 Expedited Academic Programs: Approval Process.* The evaluation is conducted by interested parties and THEC staff. The ELON is posted on the THEC website for a 10-day period of comment by interested parties. Based on the internal and external evaluation, THEC will make a determination to support, not to support, or defer a decision based on a revised ELON.

Institution: Tennessee Technological University	**LON Submission Date**: February 22, 2023
Academic Program, Degree Designation: Nuclear Engineering, BSNE	
Proposed CIP Code: 14.2301 (Nuclear Engineering)	
Proposed Implementation Date: August 2024	
Time Period Posted on Website for Public Comment: February 22 – March 4, 2023	
Program Liaison: Joseph Slater; Dean, College of Engineering; jslater@tntech.edu; 931-372-3172	

Note: Comments in italics within this document should be addressed in a revised ELON.

Criteria	Comments
Letter of support from President/Chancellor	▪ A letter of support from President Philip Oldham, dated February 17, 2023, points to the workforce shortage in Nuclear Engineering, the need for the program in Tennessee, support from Governor Lee, and $3 Million in already secured federal funding for the proposed program.
Implementation timeline	▪ The Proposed timeline includes: o Site visit – April 2023 o ENAPP submission – August 2023 o TTU Governing board approval – December 2023 o THEC Governing board approval – January 2024 ▪ ***The external site visit should follow the submission of the ENAPP. Please revise the timeline.*** **TTU Response:** The program timeline has been revised on page 2 of the revised ELON.

Background narrative	▪ Several factors point to the need for a Bachelor program in Nuclear Engineering including insufficient current production of Nuclear Engineering graduates. ▪ According to the American Society for Engineering Education (ASEE), 384 students graduated in Nuclear Engineering in the U.S. in 2021 and many programs graduate only a few graduates per year. ▪ A shortage of Nuclear Engineers is looming – with approximately 38 percent of employees in the nuclear energy industry expected to retire in the next few years (U.S. Nuclear Engineering Institute). ▪ Nuclear energy seems poised for another heyday, as it is becoming a critical resource for addressing fossil fuel dependence. ▪ The proposed 128 credit Nuclear Engineering, Bachelor of Science will provide students with the foundational knowledge to contribute to the nuclear energy industry. ▪ The 128 credits will include 41 general education credits, 21 hours of math and science, and 66 hours of programming core and electives. ▪ ***Please include information about the target audience, purpose, and delivery method.*** **TTU Response:** This information about the target audience, purpose, and delivery method has been included on pages 3-4 of the revised ELON.
Justification for consideration of expedited policy	▪ There are 92 nuclear reactors in the U.S., including four in Tennessee. Only 35 nuclear engineering graduates entered the Tennessee workforce in 2022. The average age of nuclear reactor engineers is just over 50 years. ***Please add information here about the number of employees in nuclear engineering (either in the nation or State) to further justify the claim of an employee shortage.*** **TTU Response:** This section of the ELON has been extensively revised by demonstrating the current and future needs in nuclear engineering workforce. Extensive statistics supported with citations have been included in pages 5-6 of the revised ELON. ▪ Small modular reactors have been recently approved by the U.S. Nuclear Regulatory Commission, which could signal a potential shift in developing and integrating next-generation power plants in the U.S. ***Please provide more information about the timeline anticipated for this shift, and the workforce implications of the shift, were it to happen.*** **TTU Response:**

	A new section on *future needs* is added into the proposal. This explain the justification for the projected future need, along with timeline anticipated for this shift, and the workforce implications of the shift, were it to happen. This information can be found in pages 5-6 of the revised ELON. ▪ In Tennessee, Governor Lee is establishing a nuclear development and manufacturing ecosystem. ***Please explain how the proposed program intersects with the ecosystem being developed in Tennessee.*** **TTU Response:** More information has been provided about the proposed program addressing Tennessee's growth and the future needs in nuclear engineering. The projected growth aligns with Governor Lee's vision for Tennessee to be a leader in nuclear energy, as he stated in his 2023 State of the State Address. This information has been included on pagee 5-6 of the revised ELON.
Existing programs of study at the institution	▪ No existing minor or certificate programs in Nuclear Engineering exist at TTU.
Community and industry partnerships	▪ Letters of support are included from SpectraTech Inc, and Teledyne Brown Engineering. The letters point to the shortage of nuclear engineers, the reputation of TTU for graduating engineers who are ready to work, and TVA's recent support of new nuclear reactor development. **TTU Response:** A few additional letters of support have been obtained since we submitted the initial ELON. These letters are included in the revised ELON.
Accreditation	▪ The proposed Nuclear Engineering, BSNE will be accredited by ABET. TTU's current engineering programs are already ABET Accredited. ▪ To qualify for ABET Accreditation, at least one cohort must graduate. An ABET readiness review will be submitted in October 2028, followed by a self-study report in June 2029 and a site visit in September 2029.
Administrative structure	▪ The proposed program will be housed in the Department of Mechanical Engineering, in the College of Engineering.
Enrollment and graduation projections	▪ The program anticipates enrolling 10-15 new students a year, and graduating 6-8 students annually, beginning in year 4. Projections are as

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follows:

Year1:10enrolled,2attrition,0graduates
Year2:18enrolled,3attrition,0graduates

Year3:27enrolled,3attrition,0graduates
Year4:36enrolled,3attrition,6graduates
Year5:47enrolled,4attrition,8graduates
Only five years of projections are required for bachelor's degrees. Please revise.

TTU Response:
The five years of projections are presented in page 10 of the revised ELON.

Please list the total number of students you anticipate being enrolled in the Fall semester (beginning of the academic year) for each year. Currently, the continuing students seems to be the number who remain at the completion of the academic year.

TTU Response:
This information of total enrollment, new freshmen, attrition, and graduation each year is presented on page 8 of the revised ELON.
<table>
<tr><th>Year</th><th>Academic Year</th><th>Projected Total Enrollment in Fall Semester</th><th>Projected New Freshman</th><th>Projected Attrition</th><th>Projected Graduates</th></tr>
<tr><td>1</td><td>2024-25</td><td>10</td><td>10</td><td>2</td><td>-</td></tr>
<tr><td>2</td><td>2025-26</td><td>18</td><td>10</td><td>3</td><td>-</td></tr>
<tr><td>3</td><td>2026-27</td><td>27</td><td>12</td><td>3</td><td>-</td></tr>
<tr><td>4</td><td>2027-28</td><td>38</td><td>14</td><td>3</td><td>6</td></tr>
<tr><td>5</td><td>2028-29</td><td>47</td><td>18</td><td>4</td><td>10</td></tr>
</table>
</td>
</tr>
<tr>
<td>Alignment with State Master Plan and institutional mission profile</td>
<td>
Please be more specific about the ways that this program will support drive to 55 goals.

TTU Response:
Support Drive to 55 Goals:
The BSNE Program will provide new program options for students while embracing TTU's Strategic Plan to be responsive to the needs of stakeholders. This program will provide Tennessee with a skilled workforce that is prepared to meet the growing demand for nuclear engineers. Extensive information in this area is presented on page 10 of the revised ELON.

GovernorLee's2023StateoftheStateAddressincludes extensive investmentincreatinganucleardevelopmentandmanufacturing ecosystem. The proposed Nuclear Engineering, BSNE will create

</td>
</tr>
</table>

	partnerships that engage industry leaders, workplace managers, and business executives, working to identify gaps in the workforce and shape the curriculum. ***Please provide more information about these potential partnerships.*** **TTU Response:** Information on additional potential industry partnerships has been included on page 11 in the revised ELON. ▪ ***Please point to specific ways that the program aligns with TTU's mission.*** **TTU Response:** More information has been included about the alignment between the proposed program and TTU's mission on page 12 of the revised ELON.
Student interest	▪ 250 students enrolled in TTU college of engineering programs responded to a surveyed about their interest in the program. ***When was the survey conducted?*** **TTU Response:** This student interest survey was conducted in Feb and March 2023. ▪ Twenty-nine percent of respondents indicated that they were extremely likely to have considered majoring in Nuclear Engineering if it was available when they started at TTU, and 43 percent indicated that they would consider Nuclear Engineering as a major now. ***Response numbers for individual questions do not always add up to the number of survey participants reported in this section, please clarify the number of respondents to each question on the survey.*** **TTU Response:** As of March 27, 2023, 265 TTU College of Engineering undergraduate students have completed the survey. The summary of these responses includes: If Nuclear Engineering had been available as a major when you started at TTU, how likely is it you would have considered it as a major? Extremely Likely: 74 (28%) Very Likely: 97 (37%) Somewhat Unlikely: 62 (23%) Extremely Unlikely: 32 (12%) If Nuclear Engineering is available as a major now, how likely is it you would have considered it as a major?

	Extremely Likely: 44 (17%) Very Likely: 88 (33%) Somewhat Unlikely: 76 (29%) Extremely Unlikely: 57 (21%) Considering that the majority of electricity generated in T.N. is from Nuclear sources, and there is only one undergraduate Nuclear Engineering program in the State, how important is it to have a B.S. degree in Nuclear Engineering at TTU? Extremely Important: 147 (56%) Very Important: 78 (29%) Moderately Important: 32 (12%) Slightly Important: 6 (2%) Not Important: 2 (1%) This information has been updated on pages 12-13 of the revised ELON.
Existing programs offered at public and private Tennessee universities	▪ The only Nuclear Engineering, BSNE offered at a public university in Tennessee is UTK's program (CIP 14.2301). That program has an average enrollment of 198 students/year over the past four years. An average of 38 students graduate from the program per year. ▪ The proposed program will be different from UTK's program through its core curriculum that is focused on basic principles of nuclear energy production, reactor systems design, and management of radioactive materials, and its experiential learning focus, which will allow students to learn through co-ops, internships, undergraduate projects, study abroad programs, and service-learning projects. ***Please provide more information about how the experiential opportunities in the proposed program differ from those in the current UTK program and elaborate on any partnership agreements that have been developed with companies willing to participate.*** **TTU Response:** More information about how the experiential opportunities in the proposed program is presented on page 14 of the revised ELON.

Articulation and transfer	▪ The TTP in AS Mechanical Engineering would align to the program. ***Have those students been surveyed related to their interest in the proposed program?*** ▪ Articulation agreements are not anticipated. **TTU Response:** It is anticipated that most students in this program will be traditional high school graduates and current TTU undergraduate students. Transfer students can use Tennessee Transfer Pathways (TTP) – Mechanical Engineering to transition from regional community colleges to Tennessee Tech University to pursue the BS in Nuclear Engineering degree.
Public comments	▪ Public comments were received from UTK, which are included in the Appendix. ***Please address each concern raised in this letter.*** **TTU Response:** While we are excited about the potential growth in the field of Nuclear Engineering, we recognize that this is a highly regulated area and requires significant attention to detail and safety. As such, Tennessee Tech University intends to collaborate with academic institutions such as UTK and government labs such as ORNL in the state while designing and offering this BSNE program. This collaboration could include curriculum design and offering, faculty expertise, resource sharing, assessment and evaluation metrics, activities to meet workforce demands, etc. Preliminary discussions on these potential partnerships have taken place in Fall 2022 and early spring 2023. As a university, we strive to be forward-thinking and responsive to these evolving workforce needs of Tennessee and the nation. We will contribute to the education and training of professionals in this field. Please see the updates made on pages-2, 3, 7, 8, 9, and 10 of the revised ELON.

THEC TSAC

ROBERT M. SMITH
INTERIM EXECUTIVE DIRECTOR

STATE OF TENNESSEE
HIGHER EDUCATION COMMISSION
STUDENT ASSISTANCE CORPORATION
312 ROSA L. PARKS AVE., 9TH FLOOR
NASHVILLE, TN 37243
(615) 741-3605

BILL LEE
GOVERNOR

Memorandum

TO: Lori Bruce, Provost and Vice President for Academic Affairs
Tennessee Technological University

FROM: Julie A. Roberts, Chief Academic Officer
Tennessee Higher Education Commission

Digitally signed by Julie A. Roberts
Date: 2023.04.27
11:41:17 -05'00'

SUBJECT: Tennessee Technological University
Expedited Letter of Notification: Nuclear Engineering, Bachelor of Science (BSNE)

DATE: April 27, 2023

Thank you for the submission of the Expedited Letter of Notification (ELON) for the Nuclear Engineering, Bachelor of Science (BSNE) program. Per THEC Policy A1.6 – Expedited Academic Programs: Approval Process, the ELON is evaluated on the following criteria: alignment with workforce, economic, or other state needs while still assuring quality, student demand, uniqueness, and institutional capacity to deliver the proposed program.

After reviewing the ELON, I approve Tennessee Technological University's (TTU) plan to develop the Expedited New Academic Program Proposal (ENAPP) for the Nuclear Engineering, BSNE program. The proposed program will need to be developed in accordance with the mission of TTU and meet the Master Plan for Tennessee Postsecondary Education 2015-2025 degree completion and workforce development objectives.

Attachment

cc: Philip Oldham, TTU, President
Robert Smith, THEC, Interim Executive Director
Sharon Huo, TTU, Associate Provost for Academic Affairs
Joseph Slater, TTU, Dean – College of Engineering
Ryan Korstange, THEC, Director of Academic Affairs

Section II: Curriculum

Provide an adequately structured curriculum that (a) meets the stated objectives of the academic program, and (b) reflects breadth, depth, theory, and practice appropriate to the discipline and the level of the degree. The curriculum should be compatible with disciplinary accreditation and meet the criteria for the general education core, as well as articulation and transfer, where applicable.

Catalog description

The Bachelor of Science in Nuclear Engineering (BSNE) program, housed in the Department of Mechanical Engineering (ME), aims to educate and prepare individuals for careers in nuclear engineering. The BSNE curriculum is broad in scope and strongly based in the fundamentals essential for professional practice, life-long learning, and advanced study at the graduate level. It focuses on nuclear science and technologies, such as nuclear reactor design, operation, simulation, and maintenance, as well as nuclear energy production, radiation detection, and computational methods. The program also covers topics related to nuclear materials, security, and policies. Design being a unique element of the engineering profession, students' design experience is developed and integrated throughout the degree program. By graduation, students are equipped for various job opportunities in industry, national laboratories, and graduate studies. The program emphasizes the highest standards of professional and ethical conduct and prepares students to tackle the complex challenges associated with the next generation of nuclear science and engineering. The curriculum is developed to meet the criteria for the institutional generation education core, ABET accreditation, and existing articulation and transfer pathways.

Program learning outcomes

- Provide the program learning outcomes for the proposed program. Outcomes should reflect the specific knowledge and skills expected for students to acquire as part of their educational experience in the proposed program.

The following Program Learning Outcomes (PLOs) are proposed as the expected accomplishments of students in the first few years following graduation. The graduate of the Nuclear Engineering program will

- excel in diverse career paths using their engineering knowledge and professional skills to address complex problems and make positive impacts on society.
- serve their profession and the public as ethical team members and leaders with awareness of modern issues, commitment to inclusive collaboration, and effective communication.
- practice adaptive learning, expanding and enhancing their knowledge, creativity, and skills through professional development, continuing education, and/or earning advanced degrees.

It is anticipated that these PLOs will be reviewed and revised as needed at the Fall 2023 meeting of the ME Department's External Advisory Board (ME EAB).
Specifically, the PLOs are linked to the mission of the University as follows:

The first BSNE PLO indicates that our graduates "excel in diverse career paths using their engineering knowledge and professional skills to address complex problems and make positive impacts on society." This is consistent with the mission of the ME Department, which is to "… prepare its students for productive careers in a competitive, dynamic, technologically-based society (in a global and regional context); will advance the knowledge of engineering principles and applications; and will serve the public." Likewise, the second and third PLOs "our graduates serve their profession and the public as ethical team members and leaders with awareness of contemporary issues, commitment to inclusive collaboration, and effective communication" and "our graduates practice adaptive learning, expanding and enhancing their knowledge, creativity, and skills through professional development, continuing education, and/or earning advanced degrees" are also consistent with the mission statement of the ME Department, as well as the College of Engineering mission "to prepare career-ready engineering, computing, and technology professionals" and Tennessee Tech's mission of expanding opportunities and delivering enduring education as a STEM-focused university.

Student learning outcomes

- Outline the student learning outcomes for the proposed program. Outcomes should clearly state the specific and measurable outcomes students will display to verify learning has occurred. Every student learning outcome must directly align with and/or relate to one or more program learning outcomes.

The Student Learning Outcomes (SLOs) for the proposed BSNE program are formulated to adhere to the ABET accreditation guidelines and best practices. It is expected that by the time of graduation, the Tech's NE students will have demonstrated:

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

The BSNE PLOs are rather broad in nature relating to the career and professional accomplishments of the program's graduates. As such, achievement of SLOs (1) through (7) is a necessary part of achieving the overall outcomes. More specific linkages of PLOs and SLOs are indicated in Table 3 below:

Table 3 Mapping of Program and Student Learning Outcomes	
Program Learning Outcomes	**Student Learning Outcomes**
Our graduates excel in diverse career paths using their engineering knowledge and professional skills to address complex problems and make positive impacts on society.	1, 2, 4, 6, 7
Our graduates serve their profession and the public as ethical team members and leaders with awareness of modern issues, commitment to inclusive collaboration, and effective communication.	3, 4, 5
Our graduates practice adaptive learning, expanding and enhancing their knowledge, creativity, and skills through professional development, continuing education, and/or earning advanced degrees.	1, 5, 6, 7

Academic program requirements

- Include the required number of semester credit hours (SCH), courses, (course prefix and number, title, SCH) and any special requirements including thesis, internships, practicum, etc.

The BSNE program will require 128 credit hours, including a minimum 32 credits of math and basic science courses as required by ABET Criteria for Accrediting Engineering Programs, and satisfy the minimum 41 credits of General Education requirements stipulated by the State of Tennessee. While some overlap exists with current ME courses, several new courses are being developed in consultation with an external subject matter expert. The flow chart of the proposed program showing all courses taken sequentially from the first semester is shown in Figure 2. The curriculum is developed with an intent to educate a holistic nuclear engineering graduate. The following is a breakdown of the curriculum credit hours in different categories:

- ***English***- 9 credits (English I, II, Communications)
- ***Physics***- 11 credits (Physics I, II with labs and Modern Physics)
- ***Mathematics***- 18 credits (Calculus I, II and II, Diff. Equations, and Prob. and Statistics)
- ***Chemistry***- 4 credits (Chemistry I with a lab)
- ***Humanities and Fine Arts***- 6 credits (from the approved list)
- ***Social and Behavioral Sciences*** – 6 credits (from the approved list)
- ***Engineering*** Courses- 71 credits
    - ***New Nuclear Engineering Courses***- 38 credits

The catalogue description, number of credits of these courses are explained in the following sections. Internships/ co-op are optional, every student must complete a two-semester senior capstone design course sequence as part of the degree requirement. A formal approval by curriculum committees is being undertaken as a parallel effort to the implementation portfolio of the THEC application process.

Capstone Design Experience:
A two-semester course sequence (6 credit hours total) provide the capstone design experience for the proposed BSNE program. This two-semester sequence course is intended to provide a hands-on engineering design experience which both emphasizes customer satisfaction and includes realistic constraints. As the capstone design experience, the course projects bring together the knowledge, skills, and experience students have gained in their earlier coursework, as well as any additional professional and industrial experiences they may have had (co-op, participation in student organizations and/or competitive teams, etc.). In the capstone design courses, students work in teams (typically 4-6 students) on a year-long, hands-on design project. The emphasis in the course is not only on the design process, but also product realization that culminates in a functional prototype. The design projects contain a variety of realistic constraints, such as cost; time; manufacturability; health and safety; codes and standards; product footprint; environmental impact and sustainability, and social and ethical considerations. Although every project may not have specified needs related to all of the public health, safety, and welfare, global, cultural, social, environmental, and economic factors, each project team must consider each of those factors and the factor's importance and impact on the design. These projects will be tailored for the nuclear industry in the proposed NE capstone design courses.

Existing and new courses

- List existing and new courses for the proposed academic program including a catalog description and credit hours for each course.

The flowchart in Figure 2 shows all courses in various color-coded format. All new courses developed for the program start with prefix NE (orange colored) as shown. Existing Mechanical Engineering courses are shown in green color; Mathematics in pink, English in light blue, Physics in purple, Chemistry in Blue, etc. The following tables (Tables 4 through 6) lists all the existing and new courses respectively along with credit hours, catalogue descriptions are included in Appendix A-1 and A-2.

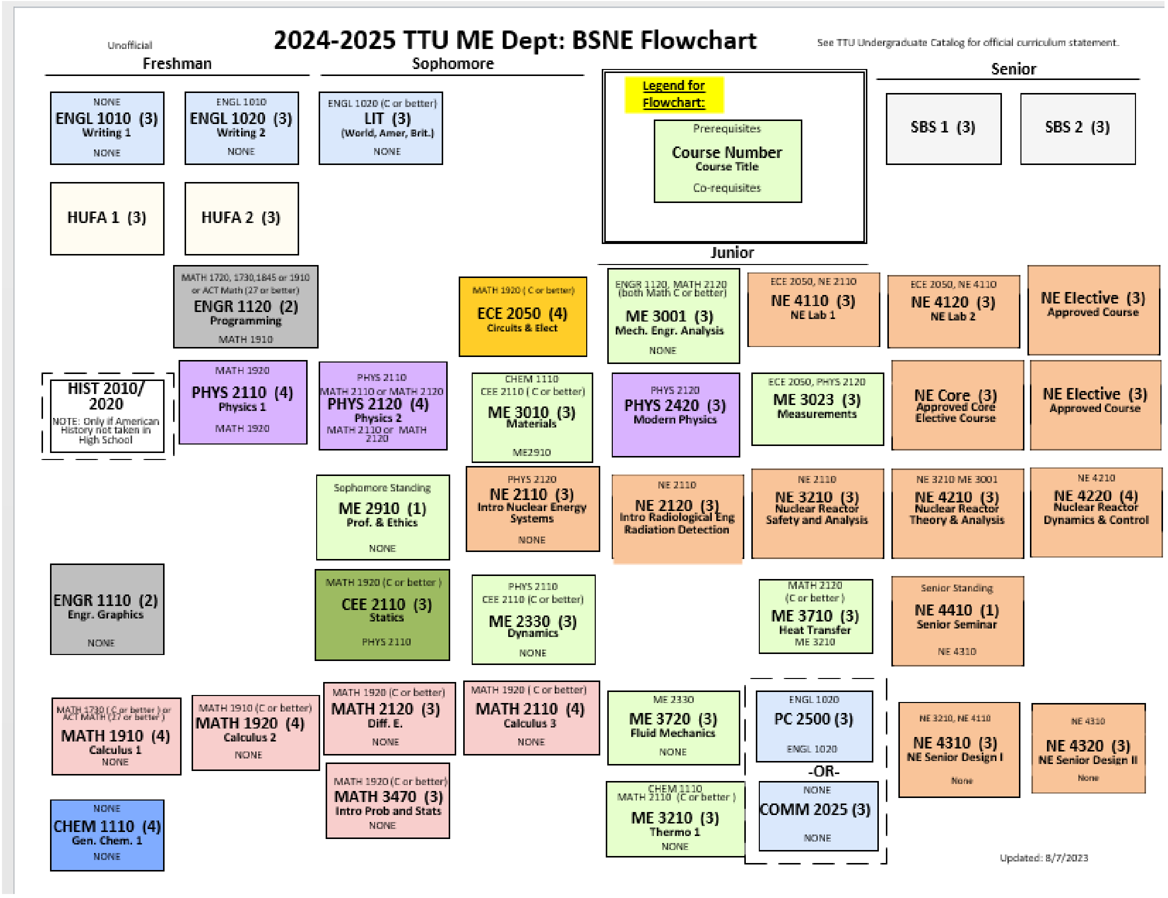

Figure 2. Flow Chart of the Proposed BSNE Curriculum.

Table 4. Nuclear Engineering Curriculum- Existing Courses

Course Name	No. of Credits
ENGL 1010 - English Composition I	3
ENGL 1020- English Composition II	3
PC 2500 - Communicating in the Profess OR COMM 2025 - Fundamentals of Communication	3
PHYS 2110 - Calc-based Phys I	4
PHYS 2120 - Calc-based Phys II	4
PHYS 2420 - Modern Physics	3
MATH 1910 - Calculus I	4
MATH 1920 - Calculus II	4
MATH 2110 - Calculus III	4
MATH 2120 - Differential Equations	3
MATH 3470 - Intro/Prob & Stats	3
CHEM 1110 - General Chemistry I	4
Humanities and Fine Arts -1*	3
Humanities and Fine Arts-2*	3
Social and Behavioral Sc -1*	3
Social and Behavioral Sc- 2*	3
ENGR 1110 - Engineering Graphics	2
ENGR 1120 - Programming for Engineers	2
ECE 2050 - Circuits and Electronics I	4
CEE 2110 - Statics	3
ME 2330 - Dynamics	3
ME 2910 - Professionalism and Ethics	1
ME 3001 - Mechanical Engr Analysis	3
ME 3010 - Materials & Processes in Mfg	3
ME 3023 - Measurements/Mech Sys	3
ME 3210 - Thermodynamics I	3
ME 3710 - Heat Transfer	3
ME 3720 - Fluid Mechanics	3

*****from the approved list shown in Appendix A-1

Table 5. Nuclear Engineering Curriculum- New Courses

Nuclear Engineering Courses
NE *Courses (38 credits) --Detailed Course descriptions and ABET format Syllabi for these courses are included in Appendix A-2.*

Course No.	Course Name	Credits	Prerequisites
NE 2110	Intro to Nuclear Engineering	3	Physics II
NE 2120	Intro to Radiological Engg & Detection	3	NE 2110
NE 3210	Nuclear Reactor Safety & Analysis	3	NE 2110
NE 4110	Nuclear Engineering Lab I	3	NE2110, ECE 2050
NE 4120	Nuclear Engineering Lab II	3	NE4110, ECE2050
NE 4210	Nuclear Reactor Theory & Analysis	3	NE3210, ME 3001
NE 4220	Nuclear Reactor Dynamics & Control	4	NE4210
NE 4310	Senior Design I	3	NE3210, NE4110
NE 4320	Senior Design II	3	NE4310
NE 4410	Senior Seminar	1	Senior Standing
NE 4510 (Core Elective)	Introduction to Industrial Maintenance Tech	3	
NE 4520 (Core Elective)	Adv Reactors and Small Modular Reactors	3	
Technical Elective 1	Senior Elective	3	
Technical Elective 2	Senior Elective	3	
NE 4900	Special Topics in Nuclear Engineering	3	Senior Standing
NE xxxx (New Course)	Reactor Engineering	3	NE 2110

List of Suggested Technical Electives. These are all existing courses

Course No.	Course Name	No. of Credits
ME 4260	Energy Conversion/Conservation	3
ME 4720	Thermal Design	3
ME 4730	Numerical Heat Transfer	3
ME 4930	Noise Control	3
ME 4060	Mechanical Vibrations	3
ME 4380	Intro to Data Acq and Signal Proc	3
ME 4620	Turbomachinery	3
ME 4610	Steam Power Plants	3
Other upper division (3000 and 4000 level) engineering, technology, science or business courses may be used with prior approval of advisor, course instructor and the ME department.		3

Program of study

- Provide a sample program of study for students completing the program full-time. The sample program of study should include all courses by semester and term for students to complete the proposed program. --- Please see Table 6

Table 6. BSNE Curriculum

College of Engineering
TENNESSEE TECH

Degree Map

CATALOG YEAR: 2024-25 **Degree:** BSNE **MAJOR:** Nuclear Engineering

The major map illustrates one path to completing your major, based on faculty members' advice on course sequence and course schedule. This document provides general direction.

Course	Cr. Hrs.		Course	Cr. Hrs.
FIRST YEAR				
Semester: Fall — Total Credit Hours: 16			Semester: Spring — Total Credit Hours: 16	
ENGR 1110 Graphics	2		ENGL 1020 English Composition II	3
MATH 1910 Calculus 1	4		ENGR 1120 Programming	2
CHEM 1110 Gen Chemistry	4		MATH 1920 Calculus II	4
ENGL 1010 English Composition I	3		PHYS 2110 Physics I	4
Humanities/Fine Arts Elective	3		Humanities/Fine Arts Elective	3
Course	**Cr. Hrs.**		**Course**	**Cr. Hrs.**
SOPHOMORE YEAR				
Semester: Fall — Total Credit Hours: 17			Semester: Spring — Total Credit Hours: 17	
CEE 2110 Statics	3		ME 2330 Dynamics	3
MATH 2120 Diff. Equations	3		NE 2110 Intro to Nuclear Energy Systems	3
MATH 3470 Prob and Statistics	3		ME 3010 Materials	3
PHYS 2120 Physics	4		ECE 2050 Principles of Electric Circuits	4
ENGL 2130, 2230, or 2330 Lit.	3		MATH 2110 Calculus III	4
ME 2910 Professionalism and Ethics	1			
Course	**Cr. Hrs.**		**Course**	**Cr. Hrs.**
JUNIOR YEAR				
Semester: Fall — Total Credit Hours: 15			Semester: Spring — Total Credit Hours: 15	
ME 3001 ME Analysis	3		ME 3023 Measurements	3
PHYS 2420 Modern Physics	3		NE 3210 Nuclear Reactor Safety & Analysis	3
ME 3210 Thermo I	3		NE 4110 Nuclear Engineering Lab !	3
ME 3720 Fluid Mechanics	3		ME 3710 Heat TRansfer	3
NE 2120 Intro Radiological Engg and Detection	3		PC 2500 or COMM 2025 Communications	3
Course	**Cr. Hrs.**		**Course**	**Cr. Hrs.**
SENIOR YEAR				
Semester: Fall — Total Credit Hours: 16			Semester: Spring — Total Credit Hours: 16	
NE 4120 Nuclear Engineering Lab II	3		NE 4320 Senior Design II	3
NE 4210 Nuclear Rector Theory and Analysis	3		NE 4220 Nuclear Reactor Dynamics and Control	4
NE 4310 Senior Design I	3		NE Elective	3
NE Core Elective	3		NE Elective	3
Social Behavior Sc. Elective	3		Social Behavior Sc. Elective	3
NE 4410 Senior Seminar	1			

Assessment and evaluation

- Identify who will be responsible for conducting program assessments and evaluations.
- Provide the schedule for program assessments or evaluations including program evaluations associated with Quality Assurance Funding, institutional program review, student evaluations, faculty review, accreditation, and employer evaluation. Include copies of relevant documents, rubrics, or other materials in the appendices of the ENAPP.

The assessment instruments and corresponding data assessment processes to be used to evaluate the quality of the Bachelor of Science in Nuclear Engineering program will be consistent with instruments and practices already in place for the Mechanical Engineering (ME) program. These include both direct and indirect measures. The ME department's Goals and Assessment committee consisting of four faculty members will be responsible for this activity with input from all department faculty. Table 7 below shows the assessment instruments and schedule used in the Mechanical Engineering program, and a similar procedure will be developed for the BSNE program.

The expertise of the existing ME faculty and expected new faculty for the NE program covers the breadth, depth and the level of sophistication required for today's highly interdisciplinary engineering profession. All of the faculty qualifications and experience comply with SACSCOC (Commission on Colleges of the Southern Association of Colleges and Schools, which is the recognized regional accrediting body in the eleven U.S. Southern states for institutions of higher education that award associate, baccalaureate, master's or doctoral degrees) guidelines. Tennessee Tech University last went through a SACSCOC review in 2016 and, in December of that year, received "reaffirmation of accreditation by SACSCOC". The next reaffirmation will take place in 2026. Reaffirmation does confirm that the faculty credentials do comply fully with SACSCOC requirements.

Annual quantitative data in the form of Undergraduate Enrollment Numbers, Retention Rates, 6-Year Graduate Rates, Post-Graduation Employment Numbers, and Post-Graduation Employment Salaries will be collected to measure the BSNE program's effectiveness in increasing access to nuclear engineering education, student success, and career outcomes. The assessment instruments and corresponding data assessment processes to be used to evaluate the quality of the Bachelor of Science in Nuclear Engineering program for internal as well as external quality assurance funding, institutional review and external accreditation.

The continuous improvement process is guided by a six-year assessment/evaluation schedule, shown in Table 7. Ongoing actions include application of the assessment instruments, analysis of resulting data, discussion of findings, and bi-annual presentation of outcomes. The Mechanical Engineering Department's previous year's ABET Self-Study Report will serve as a good guide for the new program. These include documenting the changes that have occurred within the program over the six-year evaluation period such as: (1) changes due to events external to the College of Engineering; (2) changes due to issues or events internal to the College of Engineering; (3) changes to the continuous improvement processes; and (4) changes directly informed by assessment data and/or supporting evidence. Public access to accreditation, assessment, and program improvement data, including Program Educational Objectives (PEOs), will be provided on the Mechanical Engineering website at https://www.tntech.edu/engineering/programs/me/accreditation.php.

The outcome assessment instruments used for assessment are given below, sample rubrics included in Appendix B.

Assessment Instruments:

1. ***Alumni Survey (AS):*** Alumni surveys are sent to graduates of the program at one year and five years post- graduation. The fifteen questions on this survey occur in three sections. Section 1 (four questions) gathers data related to the Program Goals; Section 2 (seven questions) is used to assess alumni perception of ability with respect to ABET Student Outcomes; and Section 3 (four questions) requests text feedback on program strengths, weaknesses, suggested improvements, and open comments. The electronic Alumni Survey is issued annually in late fall via Machform and employs a 0-4 point scale in Sections 1 and 2, so there is no adjustment of scale prior to combining with other measures. Data from the Alumni Survey informs the evaluation of each Student Outcome (1-7).

2. ***Co-Op Employer Survey (CES):*** For students who participate in co-op appointments sponsored through Tennessee Tech University's Center for Career Development, the co-op employers are required to complete a formal evaluation of the performance of each student at the end of each term in the co-op program. For College of Engineering students, the Tech Co-op Employer Survey (CES) also includes program- and Student Outcome-related assessment questions. These co-op surveys are considered a valuable source of direct feedback from employers, providing insight into student performance in-process, i.e., before they graduate. The Co-Op Employer Survey employs a 5-point scale (1 to 5), which is then converted to the 0-4 point scale by subtracting 1 point. Data from the Co-op Employer Survey informs the evaluation of five of the Student Outcomes (1, 3, 4, 5, 7).

   Co-op is not mandatory in the proposed Bachelor of Science in Nuclear Engineering program, but strongly encouraged as a vital part of the student experience. The proposed program recognizes the immense value of co-op in bridging academic learning with practical industry experience, thereby enhancing both the educational journey and future career prospects of students. About 50% of enrolled Mechanical Engineering students currently pursue co-ops indicating its popularity among our students.

   To promote co-op participation, we have already established robust partnerships with leading industries in the engineering field, and additional industries in nuclear pertinent fields will be added over time. These partnerships not only provide diverse co-op opportunities but also serve as a platform for networking and potential career paths after graduation. We integrate these experiences into our curriculum by offering academic credit for relevant co-op placements, thus incentivizing students to engage in these practical learning opportunities. Additionally, our career services department plays a pivotal role in facilitating co-op placements, offering resources such as resume workshops, interview preparation, and career fairs to connect students with potential employers.

3. ***External Evaluation of Senior Design Projects (EESDP):*** The External Evaluation of Senior Design Projects (EESDP) is conducted by evaluators invited from the ME External Advisory Board and from industry partners. These assess the Senior Design Projects and Project Presentations. The EESDP instrument uses the 0-4 pt. level-of-attainment scale. This instrument form has undergone three significant revisions, described in a later section, as part of the program's continuous improvement process. Data from the External Evaluation of Senior Design Projects informs the evaluation of five of the Student Outcomes (2, 3, 4, 5, 7). This assessment method is currently under discussion by the ME department Goals and Assessment Committee for possible revision.

4. ***Instructional Outcomes Faculty Assessment (IOFA):*** The Instructional Outcomes Faculty Assessment (IOFA) instrument provides a direct assessment of the level-of attainment of the students

in a class with regards to the Course Instructional Outcomes. The Instructional Outcomes Faculty Assessment is surveyed for selected courses in the curriculum. The assessment, completed by the course instructor at the end of each semester, consists of a detailed analysis of the extent to which the Course Instructional Outcomes are achieved, as evidenced by student performance on specific test and homework problems, and other course assignments. The IOFA tool uses the 0-4 pt. level-of-attainment scale. Data from the Instructional Outcomes Faculty Assessment informs the evaluation of each of the Student Outcomes (1-7).

5. ***Instructional Outcomes Student Survey (IOSS):*** The Instructional Outcomes Student Survey (IOSS) is administered to students in selected courses in the BSNE curriculum, same as for the IOFA above. The IOSS tool provides a pre/post self-assessment of student progress in achieving the Instructional Outcomes of the course. This is based on the difference between a student's perception of their level of knowledge for each Course Instructional Outcome upon entering a course and upon leaving the course. The IOSS survey is considered an indirect data source for assessment of Student Outcomes, as it requires a conversion through detailed mapping of a Course Instructional Outcomes to the Student Outcomes. The Instructional Outcomes Student Survey tool uses the 0-4 pt. level-of-attainment scale. Data from the IOSS informs the evaluation of each of the Student Outcomes (1-7).

6. ***Senior Exit Interview Written Survey (SEIWS):*** The Senior Exit Interview Written Survey (SEIWS) is one part of the Senior Exit Interview process. Students graduating from the BSNE program provide self-assessment of their level of attainment of the ABET Student Outcomes, self-reporting of their engineering club and pre-professional activities while at Tennessee Tech, and text feedback regarding the BSME program and the Department. The Senior Exit Written Survey uses a quantitative 1-5 pt. "satisfaction" scale which is then converted to a 0-4 pt. scale for later combination with other assessment instruments results. The quantitative data is reviewed in conjunction with the Senior Exit Interview Oral Focus Groups, and the Goals and Assessment Committee summarize the qualitative comments. The data from the Senior Exit Interview Written Survey informs the evaluation of each of the Student Outcomes (1-7).

7. ***Senior Exit Interview Oral Focus Groups (supporting source of evidence):*** The Senior Exit Interview Oral Focus Groups (SEIOFG) process consists of an open discussion forum of graduating seniors with the ME chair and associate chair. The interview serves as a valuable source of suggestions for program improvement, as well as a source of supporting feedback on student performance. After receiving the feedback from the students, continuing concerns are compiled by the Goals and Assessment Committee and brought to the ME faculty for further discussion and possible action. Full records of student commentary are stored with all other assessment records.

8. ***ME External Advisory Board Feedback (supporting source of evidence):*** Feedback from the ME External Advisory Board is an important source of evidence for program improvement, guidance, and provides supporting evidence regarding the performance of students who are graduates of the BSME program. The External Advisory Board is composed of member representatives of several key constituency groups of the program, i.e., employers, alumni, and the professional community at large. Meeting minutes are kept with the other assessment data.

Expected Level of Attainment of the Student Outcomes

The expected level of attainment of Student Outcomes is scored with a 0-4 point level-of- attainment scale where each level is defined as 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Low, and 0 = Negligible. Data from the assessment instruments are combined according to the evaluation plan to determine the final scored value each year for each Student Outcome.

A score of 3-to-4 is the desired level-of-attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Beginning Fall 2021 the ME department adopted a new plan for an overall change in process for assessment, evaluation, and change (AEC Plan). The two-year implementation cycle of the new AEC Plan, data collection and tracking and reporting on outcomes is currently underway. Observational analysis from existing data collection instruments used before are being made by the members of the Goals and Assessment Committee as we consider modifications to current instruments into the new AEC Plan. The objective is to improve assessment tools and analysis procedure to collect data that are effective in the continuous improvement of the curriculum to attain student outcomes.

Table 7. Schedule for Administration of Assessment Instruments and Review of Assessment Data for Accreditation and Continuous Improvement.

Assessment Instrument	**Administration Schedule** By Semester	**Review Schedule**
Alumni Survey (AS)	Fall	Spring
Co-Op Employer Survey (CES)	Fall, Spring, Summer	Yearly
External Evaluation of Senior Design Projects (EESDP)	Fall, Spring	Yearly
Grades Received in STEM, General Education, Writing, and Speech Courses	N/A	Mid-cycle review
Instructional Outcomes Student Survey (IOSS)	Fall, Spring	Yearly
Instructional Outcomes Faculty Assessment (IOFA)	Fall, Spring	Yearly
Senior Exit Interview Written Survey (SEIWS)	Fall, Spring	Yearly
Senior Exit Interview Oral Focus Groups (SEIOFG)	Fall, Spring	Yearly
External Advisory Board Feedback (EABF)	Fall, Spring	Yearly

Tennessee Tech will apply for ABET accreditation of the proposed BSNE degree. The ABET Engineering Accreditation Commission (EAC) guidelines can be found at https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2023-2024/

The program is being developed with courses that meet the accreditation criteria requirements. In addition to curricular requirements, ABET accreditation requires the creation and participation of Institutional Review Boards (IRB) and meeting industry specific guidelines which are allied with ABET guidelines for particular areas.

The process of ABET accreditation is very rigorous. It involves continuous data collection for assessing student outcomes every year to show compliance with the accreditation criteria. For a new program such as this BSNE, an internal review needs to be conducted at three years into the program to provide feedback for the program and to prepare for the writing of program's self-study report. The time line of the process spans five years. At the end of the fourth year (when the program has graduates), a self-study report is developed and submitted with a request for a general review. This occurs in the fifth year. Students who have graduated in the fourth year could be grandfathered into the accreditation period. After the initial accreditation, following reviews are conducted every six years. The following diagram depicts our proposed plan for ABET accreditation of the BSNE program.

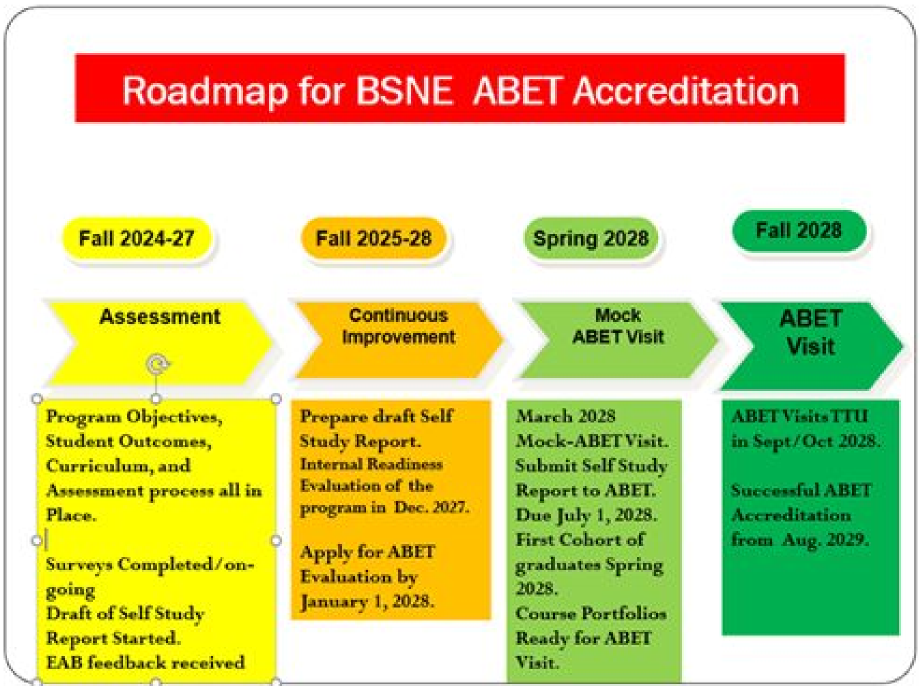

Figure 3. Proposed Plan for ABET Accreditation of the BSNE Program.

Section III: Students

Academic standards

- Clearly state the admission, retention, and graduation standards, which should align with institutional or governing board policy.

At Tennessee Tech, admission requirements for new students vary based on whether the new student is a freshman, transfer, or international student. The following sections describe the requirements for each category.

Admission Requirements for Freshmen Students

Freshmen students under the age of 21 are evaluated using the following criteria for the College of Engineering programs:

- 3.0 high school GPA and
- 20 ACT Composite[22] and
- ≥22 ACT Math sub-score[23] and
- completion of a college-preparatory high school curriculum.

Admission Requirements for Transfer Students

In addition to meeting the requirements for admission to the University, transfer students seeking admission to any College of Engineering major must have the following:

- a cumulative higher education quality point average of at least 2.0 (excluding credit for remedial and developmental courses) and
- a grade of "C" or higher in a pre-calculus mathematics course that includes a study of the trigonometric identities.

These requirements also apply to current Tech students desiring to change their major from a non-engineering program such as General Curriculum to a major in the College of Engineering.

Admission Requirements for International Students

Because international students do not generally take the ACT or SAT exam, and those whose native language is not English must demonstrate proficiency, the admission process is somewhat different, as follows:

- Students who can provide an ACT/SAT score follow the admission process and admission standards for domestic students.
- International undergraduate applicants who have graduated from a secondary school must show proof of such with diploma and support documentation showing all years of high school course work. World Education Services provides information on these courses.

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[22] *The 20 ACT Composite is equivalent to an SAT score of 1040.*

[23] *Exception to this sub-score requirement may be allowed for students scoring sufficiently on the ACCUPLACER exam.*

- In addition, all international students whose native language is not English must have an official Test of English as a Foreign Language (TOEFL) score or its equivalent (whether another English based test or Certificate from an accredited Intensive English language Program). The minimum score on the TOEFL is 490 for the paper-based test, 163 for the computer-based test, or 57 for the internet-based test.

For general admission into the university, a GPA of 2.5 out of 4.0 is required for international students, but the College of Engineering requires international applicants to have a 3.0 out of 4.0 GPA for admission into any of its programs.

Admission Process

Applicants graduating from high school must have completed 22 credits of college preparatory courses that include, among other requirements, four credits of English, four credits of mathematics, and three units of science including laboratory science. Applicants for admission to freshman standing who have been enrolled at another college or university must submit official transcripts from each institution attended. A transfer student who has completed less than twenty-four transferable semester hours of degree credit (college-level courses) is evaluated using a combination of the admission requirements for freshmen and transfer applicants.

Applications to Tennessee Tech by new students are typically evaluated within 1-2 business days by Admissions personnel. Decisions are based on the following procedures.

- If an applicant requests a major within the College of Engineering and meets the College of Engineering admission requirements, the applicant is automatically placed in the program requested.
- An applicant requesting a major in the College of Engineering who does not meet the College of Engineering admission requirements, but who meets the Tennessee Tech general admission requirements, is admitted into the General Curriculum program and placed in a General Curriculum major with a concentration in the program requested. A student will remain in General Curriculum until the requirements for transfer into the College of Engineering are met.
- If an applicant does not meet the general admission requirements for the University, the applicant may request that his or her application be evaluated using a holistic approach that considers personal factors other than GPA and test scores. Applications undergoing a holistic review are evaluated by a subcommittee of the Admissions and Credits Committee. The College of Engineering's associate dean for academic affairs is a member of the review committee, which meets monthly or as often as needed to consider such applications.
- Holistic admissions are rare but are granted when there is evidence that the applicant has the motivation, maturity, and background to succeed, despite not satisfying all general admissions criteria. An example might be a student who does not meet the admissions criteria because of a single ACT sub-score, but who has a well-articulated plan to seek tutoring or other help needed to be successful. Students admitted by holistic evaluation who request a major in a College of Engineering program are admitted to the General Curriculum program and placed in a General Curriculum major with a concentration in the program requested.

Quality Point Average
Tennessee Technological University expects all students to strive for the highest academic achievement of which they are capable. Knowing that grades, once obtained, become a permanent record, the University is desirous that grades truly represent student accomplishment. A quality point average (QPA) of 2.00 is required to be eligible for the baccalaureate degree. This means that a 2.00 QPA is required over all college work taken, for all courses taken at Tennessee Tech, and for all courses taken in the major field.

Process for Evaluating Student Performance

Course instructors evaluate student performance on homework, exams, projects, or other assessment opportunities and assign letter grades at the end of each term. Tennessee Tech uses a 4.0 quality point scale with a grade of A equal to 4 points and a grade of F equal to 0 points. Although Pass/Fail grading is an option, a course passed under the Pass/Fail system is not to be used for credit toward a degree except under extraordinary circumstances such as during the recent COVID-19 pandemic.

Processes for Monitoring Student Progress

- Student progress is monitored by both the university through the Office of Records and Registration and the academic program through the student’s academic advisor.

- Tennessee Tech’s Office of Records and Registration monitors student grades through the Banner student information system and enforces academic progress standards. When student grades are entered at the conclusion of each semester, the QPA is calculated and evaluated according to the academic retention standard.

- A student who fails to meet the minimum semester QPA is initially placed on academic warning. Failure to improve to meet the minimum and cumulative QPA standards leads to academic probation, followed by academic suspension if the student fails to meet standards in subsequent semesters.

- The University requires instructors to submit mid-term grade reports for courses in which freshman students are enrolled. These mid-term grades are available to students and their academic advisors for consideration during the designated advising week prior to registration for the next semester.

- Students and academic advisors use Degree Works, a comprehensive academic advising, transfer articulation, and degree audit tool, as well as the Eagle Online (Self-Service Banner) registration system, to determine and monitor the students’ academic progress.

- Students must meet with their advisors at least once each semester to determine their courses for the following term. Approval of coursework for the next semester is required before the student is given the PIN number required for online course registration. Students and advisors utilize the Degree Works degree audit tool to assist with determining remaining degree requirements.

As evidence that these processes are working, the one-year fall-to-fall retention rate for first-time freshmen starting in the College of Engineering was 79.4% for the 2018 cohort; for transfer students, the one-year fall-to-fall retention rate was 85.6%. For cohorts from 2014 through 2023, one-year fall-to-fall retention has improved by approximately 3% for first-time freshmen and more than 7% for transfer students in comparison to cohorts in the 2008-2023 timeframe. Two-year fall-to-fall retention has improved by more than 4% for first-time freshmen and almost 5% for transfer students for the same periods.

Course Prerequisite Enforcement

The enforcement of course prerequisites is important both to student success and to timely progression by the student through the curriculum. This enforcement is accomplished automatically through the University's course registration system (Banner™), which checks for required pre- and co-requisites before allowing a student to take a course. In special situations, pre- or co-requisite requirements may be waived for courses offered by the Department, or prerequisites may be allowed to be taken as co-requisites. Such exceptions can only be granted by the department chair or associate chair, in consultation with the student's advisor and/or the course instructor, as needed. The pre- and co-requisites for all courses are periodically reviewed by the faculty, both individually and as a whole, to ensure that they appropriately reflect the background needed for a particular course. Any changes to course pre- or co-requisites must be approved by the department Faculty, the College of Engineering Curriculum Committee, and the University Curriculum Committee before appearing in the University Undergraduate Catalog.

Tennessee Tech already has longstanding relationships with community colleges that have resulted in articulation agreements for transfer courses. With the increasing number and percentage of transfer students, a strategic goal of the College of Engineering for the next five years is to facilitate transfer student enrollment and success by developing specific 2+2 agreements with selected community colleges. Articulation agreements exist with public community colleges in Tennessee, as well as some four-year institutions who do not offer engineering and who have entered into 2+2 or 3+2 agreements with selected Tennessee Tech engineering programs. These agreements are reviewed annually and updated when courses or the curriculum changes. When a transfer student is admitted to Tennessee Tech, a graduation analyst in the Records Office evaluates the transcript from the previous institution and awards any credit known to be equivalent to Tennessee Tech courses by virtue of an existing articulation agreement or Transfer Pathway. For other courses where there is no apparent equivalent course here, the analyst may award elective credit in the discipline in which the course was taken in consultation with department chair and advisors.

The process for approving in-house course substitution requests is the same as the procedure for the granting of transfer credit. As with transfer courses, the department Chair serves as the primary judge for determining equivalencies in course substitutions, consulting with the Chairs of other departments as needed for courses outside of the Department. The admission process for international transfer students is similar to that previously described for new international students. International transfer students may be admitted directly into a degree-granting program if their background and ACT Compass placement scores are sufficient to warrant such admission.

Graduation Standards

A quality point average (QPA) of 2.00 is required to be eligible for the baccalaureate degree. This means that a 2.00 QPA is required (1) over all college work taken, (2) for all courses taken at Tennessee Tech, and (3) for all courses taken in the major field.

The Bachelor of Science in Nuclear Engineering requires the completion of a curriculum totaling 128 semester credit hours.
Graduation analysts in the Office of Records and Registration verify that the graduation requirements have been met by comparing each student's record with the curricular requirements of the student's catalog year and the QPA requirements of the University. The catalog year for a student is typically the year that the student entered the university, but a student may request to move to a newer catalog year.

All curricular requirements of the degree for the student's catalog year must be met. Degree Works allows students and advisors to be aware of progress toward degree completion and to identify any missing courses. In addition, students must apply for graduation early in their next-to-final semester. A graduation analyst will review a student's progress at that point and notify the student of remaining requirements.

Sometimes there may be valid reasons for a student to deviate from the program in the student's catalog year. Approval for deviations is generally required from the advisor, the department chair, and the associate dean of academic affairs using one of the following forms: Substitution, Request for Exception to University Policy, or Request to Study at Another Institution. The degree audit will note these substitutions, and the Banner student information system now retains an electronic copy of those approval forms.

Degree Name

The degree to be awarded is the Bachelor of Science in Nuclear Engineering.

Marketing and recruitment

- Provide a plan that outlines how the proposed program will market and recruit a diverse population of students including underserved and historically underrepresented students and is aligned with the proposed implementation timeline.

The plan for marketing and recruiting students to the BSNE program will follow the well-established current practice for recruiting students including minority students to other programs in the College of Engineering (CoE) at Tennessee Tech. These include several community outreach and high school outreach activities conducted throughout the year by the Office of Admissions, and Office of Diversity Affairs. The CoE Clay N. Hixson Student Success Center offers outreach opportunities to local high school students some of which are described at https://www.tntech.edu/engineering/pre-college-programs/index.php.

Although the Tennessee Tech admissions office handles all freshman admissions, the CoE will be proactive in recruiting students to the proposed BSNE program. We seek to recruit a diverse student body that reflects community diversity and addresses the state's need to increase access to higher education for historically underrepresented and economically disadvantaged students. The College of Engineering's explorations in engineering and computing summer camp https://www.tntech.edu/engineering/pre-college-programs/eec.php is a great opportunity to attract students from underrepresented ethnic and cultural groups and those that will be first-generation college students.

In addition, we will follow a multipronged approach in our recruiting some of which are:

- Develop brochures and a website for advertising the new program.
- Send emails and materials to students in local high school schools and colleges. Provide information that will help students in their decision-making process.
- Determine a "network" of connections within the local high schools and community colleges with particular emphasis on underrepresented populations.
- Identify students that are the best "fit' to this program and develop "pipelines" with colleagues at these institutions for new student referrals.
- Contact targeted students via telephone.
- Host an evening or weekend orientation for prospective students.
- Advertise the program during freshman orientation and Tennessee Tech's Preview Day in October, and Spring Showcase in March.
- Advertise the program during the homecoming football, sporting and other college fair events.
- Use Facebook and other social media to advertise the program.

Student support services

- Provide an overview of student support services that will be available to students in the proposed program (e.g., academic advising, tutoring, internship placement, career counseling, or others).
- Describe how the proposed program will ensure student success for all students, especially underserved and historically underrepresented students.

Since the BSNE program is proposed to be housed within the ME Department in the College of Engineering, the student advising procedure that is currently used in the University, College and ME Department will be followed.

Student advising is also a very important priority to the University for student success. Evidence of this commitment can be seen in the University's new "Launchpad," which sets out the institution's priorities and actions for the next few years. The Launchpad Student Success Center is the one-stop-shop for freshman and undeclared student advising, transition assistance, and academic and personal support at Tennessee Tech. The team is dedicated to helping new students adjust to college life, navigate their first year on campus, and supporting their transition into their academic program of study.

The advising of new freshman begins in the summer prior to the student's entrance term with participation in a SOAR session (Student Orientation, Advising, and Registration) conducted by the University Launchpad and the department. Offered multiple times during the summer, the SOAR sessions enable students and parents to come to campus for a day-and-a-half to meet with their advisors and register for classes, as well as a number of other related activities and events.

At the SOAR session, incoming students will be informed about the Reinforce Advanced Math Placement (RAMP) Program, an academic bridge program. This program includes structured math and engineering preparation activities combined with structured social and cultural events to help students gain the skills and confidence needed for success in college. It helps freshmen advance their math readiness prior to the Fall term and potentially test into a higher math course via the ACCUPLACER test, and graduate earlier than initially anticipated.

The advising at SOAR and throughout the rest of their freshmen year is done by dedicated advisors assigned at the college level by Launchpad who serve as Freshmen Advisors for all engineering majors. These advisors have in-depth knowledge of issues related to freshmen advising, including such things as General Education requirements, AP & ACT course credit, and mathematics course requirements. Upon reaching their sophomore year, each student is then assigned (based on the initial of their last name) a college academic advisor for their remaining years in the undergraduate program.

At the college level, student advising is seen as an important area to student retention and success, key elements of the College of Engineering's Strategic Plan. As part of the College's commitment in this area, the "Clay N. Hixon Student Success Center" was created in the 2012-2013 academic year. The Center currently has a full-time Director, several academic advisors provide academic advising, support, encouragement and resources to help our students as they work toward reaching milestones on the way to becoming professional engineers.

Students meet with their advisors at least once a semester, as advisors must approve courses that the students wish to take the next term. College staff members assist with the gathering of information and preparation of advising materials, the approval of course selection forms, substitution forms, course adds/drops, and senior electives requiring the signature of a faculty member. Further details on advising and academic resources for engineering students are available at
https://www.tntech.edu/ssc/advisingresources.php and
https://www.tntech.edu/ssc/engineering/resources.php.

Career advising and mentoring is done through several means. The individual faculty advisors counsel students about career paths, co-ops, and employment opportunities. In addition, faculty also discuss this in their lectures; and there is a dedicated lecture on career guidance, resume writing, and interview skills in the Professionalism and Ethics course. Tech's Center for Career Development also conducts regular seminars and workshops every semester as part of a professional development seminar series in cooperation with the College of Engineering.

A Peer Tutoring program is available by appointment and as a drop-in service, providing individual and small group tutoring to students offered by the CoE Clay N Hixon Student Success Center. Trained peer tutors assist students in improving academic achievement by meeting with them on a regular basis to clarify learning problems, work on study skills through coaching, and assist the student in becoming a successful, independent learner. Other assistance might include reviewing class material, discussing the text, predicting test questions, formulating ideas for papers, or working on solutions to problems. The Center for Career Development (https://www.tntech.edu/career/students/index.php)is the university's centralized career planning and development and student recruitment center. The center connects students and alumni with employers by offering Career Readiness Certificates, hosting workshops, conducting on-campus interviews, annual career fairs, and coordinating the cooperative (Co-op) education program, which provides students with real-world work experience in their chosen major. The center hosts a variety of programs to help students for career readiness. The workshops, career fairs, and employer engagement events conducted by the center provide students the opportunity to develop skills needed for a co-op, internship, part-time job, and first employment after graduation.

Tennessee Tech is committed to a supportive environment for all students, staff and faculty. As stated in the university's strategic plan, "Tech Tomorrow," we are dedicated to providing a welcoming community, as well as a campus size and atmosphere that fosters personal attention and fit. Students in the proposed BSNE program will have access to all of the resources, including but not limited to the student organization such as Society of Women Engineers, National Society of Black Engineers, Society of Hispanic Professional Engineers, All Ladies in Civil Engineering, Women in Computing, Women in CyberSecurity, Engineers Without Borders, University Intercultural Affairs etc.

The Intercultural Affairs Office promotes personal, cultural, social, and academic growth and development of students from underrepresented populations and encourages opportunities for all students to engage with others across differences by way of dialogues, informal interaction, and programs in alignment with the goals of the Student Affairs Division and the Tech Tomorrow Plan. The vision of the Intercultural Affairs Office is a campus where all students are able to perform, both in perception and reality, at their highest potential because of an atmosphere that invites and appreciates diversity of ethnicity. Empowering women and promoting underserved and historically underrepresented students at the university, the Women's Center provides leadership, support services and special events to educate and enlighten the campus community. The Women's Center houses a library of books and literature related to women's issues and hosts a regular book club meeting. Support groups and awareness events are held by the center throughout the year. Tech students make the world a better place through service learning projects in the campus community and beyond. Service-Learning is a resource for students interested in being involved in service projects and for connecting students with community partners. Tech students volunteer their time and efforts to support a wide range of causes and community events. In addition, the Tennessee Tech's Honors Program (https://www.tntech.edu/honors/) is available for intellectually ready, open-minded students who want to stretch their individual strengths, both within and beyond their academic field. The Honors Program offers a dynamic combination of research, leadership, civic engagement and service, communication, team-building, and committed cultural understanding within a community of learners.

Section IV: Instructional and Administrative Resources

Since Tennessee Tech already has well established engineering programs with associated infrastructure including classrooms and laboratories, new resources and student support services to support the proposed BSNE program are tied to recruiting new faculty and purchasing new equipment to support related laboratory courses.

Faculty resources

Current and anticipated faculty resources should ensure a program of high quality. The number and qualification of faculty should meet existing institutional standards and should be consistent with external standards.

Current faculty

- Using the *8. Current Faculty* Roster table, list the name, highest degree, rank, and primary department, full-time or part-time status, and percent of time to be devoted to the proposed program. If the proposed academic program is at the graduate level, designate graduate faculty status with an asterisk (*).
- Please identify the faculty member who will have direct administrative responsibilities for the proposed program as "PD" after the faculty member's name.

Currently, mechanical engineering has 17 faculty members. Out of these, four faculty having expertise in Energy, Thermal Science and Fluid Mechanics will contribute by teaching courses in the proposed program to the extent possible when students enroll in existing ME courses. Other faculty will also be available for advising students in the Capstone Senior Design projects as topical experts as needed. All of the ME faculty have adequate credentials including a terminal degree (Ph.D.) that meet SACSCOC and ABET requirements for faculty qualifications. We anticipate that four new faculty members and a lab engineer will join the department and play major roles for the proposed program. Therefore, the current and anticipated faculty will provide a sufficient number of faculty for the proposed program

Table 8. Current Faculty Roster in ME Department

Current Faculty Roster					
Faculty Name	**Highest Degree**	**Rank**	**Primary Department**	**Full-time or Part-time**	**% of Time Devoted to Program**
Ethan Languri	PhD	Assoc Prof	Mech Engg	FT	10
Andy Pardue	PhD	Senior Lecturer	Mech Engg	FT	10
Mohan Rao-PD*	PhD	Prof. and Chair	Mech Engg	FT	10
Ahmad Vaselbehagh	PhD	Assoc Prof	Mech Engg	FT	10
Penz Zhang	PhD	Assistant Prof	Mech Engg	FT	5

*Will serve as PD till the NE director is recruited

Anticipated faculty

- Using the *9. Anticipated Faculty and Instructional* Staff table, list the additional faculty likely needed during the next five years for successful implementation of the proposed program. For each proposed faculty hire, provide full-time or part-time status, anticipated salary (excluding benefits), anticipated start date, and any pertinent comments.

Table 9. Anticipated Faculty and Instructional Staff

Anticipated Faculty and Instructional Staff				
Faculty Rank or Job Title	**Full-time or Part-time**	**Anticipated Salary**	**Anticipated Start Date**	**Comments**
Director of Nuclear Engineering	FT	$150-160K	August 2024	Nationwide search for a founding director of NE will be conducted during 2023-24 academic year.
Assistant Professor	FT	$100-110K	August 2025	Nationwide search will be conducted during 2024-25 academic year.
Assistant Professor	FT	$110-120K	August 2026	Nationwide search will be conducted during 2025-26 academic year.
Lecturer of NE	FT	$90-110K	August 2025	Nationwide will be conducted during 2023-24 academic year.

Non-Instructional staff

- Using the *10. Anticipated Non-Instructional* Staff table, list the additional Non-Instructional Staff needed during the next five years for successful implementation of the proposed program.
  For each proposed non-instructional hire, provide full-time or part-time status, anticipated salary (excluding benefits), anticipated start date, and any pertinent comments.

Table 10. Anticipated Non-Instructional Staff

Anticipated Non-Instructional Staff				
Job Title	**Full-time or Part-time**	**Anticipated Salary**	**Anticipated Start Date**	**Comments**
Lab Engineer for NE	FT	$80-90K	August 2024	Nationwide will be conducted during 2023-24 academic year.

Section V: Institutional Capacity to Deliver Proposed Program

In assessing institutional capacity to deliver the proposed program, provide a narrative explanation of existing and needed resources. Additionally, provide the cost projections for one-time and recurring expenditures in the *Estimated Costs to Deliver the Proposed Program* table below. **Please note:** the narrative must align with the projected costs provided in the *Estimated Costs to Deliver the Proposed Program* table.

Accreditation

- Describe any costs associated with regional and/or programmatic accreditation during the planning and first five years for successful implementation of the academic program.

The BSNE program will seek ABET accreditation as soon as the transcripts of the first cohort of graduate are available, on or around May 2028. An on-site visit during Fall 2028 will allow the assigned accreditation review team to assess factors that have been adequately described in written form in the self-study report due July 1, 2028. On-site visits are conducted for an initial accreditation review, for a regularly scheduled comprehensive re-accreditation review, and for an interim visit review. The typical minimum review team size is three members; one team chair and two program evaluators (PEVs) for a single program visit. The base fee for a single program review is $3700 plus travel expenses for the visiting team (approx. $6000). The BSNE program will also be included in Tennessee Tech's next reaffirmation of its SACSCOC (Southern Association of Colleges and Schools Commission on Colleges) accreditation to award baccalaureate, master's, specialist, and doctoral degrees. This reaffirmation is scheduled for 2026. The annual Institutional Effectiveness (IE) reports (for AY 24-25 and 25-26) for the BSNE will support and facilitate planning and assessment at the departmental level. Campus Labs software is being used as a repository for student learning and program outcomes, assessment results, and modifications aimed at continuous improvement. There is no additional cost involved for the SACSCOC reaffirmation.

Consultants

- Provide a summary of anticipated consultant needs and associated costs during the planning and first five years for successful implementation of the academic program.

Dr. Belle Upadhyaya, a recently retired eminent professor of Nuclear Engineering from the University of Tennessee - Knoxville is being hired as an external consultant for the program development, including advising concerning the new curriculum, laboratory development and serving as a sounding board for advice for the future direction and trends for renewable energy in the country, including nuclear technology. The anticipated initial cost for this is $8k followed by annual retainer fee of $5k for the first five years.

Equipment

- Assess the adequacy of the existing equipment available for the proposed academic program. Include physical equipment, computer facilities, special classrooms, etc.
- Describe additional equipment needed during the planning and first five years for successful implementation of the academic program.

Tennessee Tech is pleased to announce that funding in the amount of $3,000,000 to purchase laboratory equipment, supplies, technology, and software licenses to establish its proposed Bachelor of Science in Nuclear Engineering (BSNE) program has been secured from the United

States Department of Education through Congressional appropriations. The equipment and technology purchased through this Congressionally directed funding will equip the necessary laboratories as the university launches the program, as well as support industry collaboration and innovation. The BSNE program curriculum and its supporting equipment and technology will also support the state's need for a vibrant nuclear and associated supplier industries economy while growing the renewable and sustainable energy and manufacturing sectors. It will support the growth requirements for Tennessee Valley Authority (TVA), Oak Ridge National Laboratory (ORNL), Consolidated Nuclear Security (CNS), Y-12 National Security Complex, and other agencies. Graduates of the program will benefit from the increased depth and breadth of the program made by possible by the availability of next-generation technology, as well as emerging areas in embedded security, end cycle nuclear reclamation and reprocessing, mathematical modeling, and electronic controls as the industry moves toward increased demand for safe nuclear energy.

The equipment and technology also create new opportunities for education and research collaboration with additional engineering and science programs with the university; sustains interdisciplinary projects among students in mechanical engineering, mechatronics, electrical and computer engineering, computer science and cybersecurity, and more; and facilitates research innovation with industry partners. These synergistic efforts will lead to national recognition for Tennessee Tech in many facets of nuclear engineering.

With the appropriate state-of-the-art equipment and lab facilities, students will be "learning by doing" from day one with hands-on experiences combined with practical skills so that they are career-ready by the time they graduate from the program. The requested funding for equipping nuclear engineering laboratories is critical to students' success and the program's viability and sustainability. The complete list of new equipment to be purchased is given in Appendix C-1. The required equipment and laboratories listed below will support the new nuclear engineering program:

Nuclear Radiation Measurements and Spectroscopy Laboratory. This laboratory is designed to have 15 experiment stations, each equipped with survey meters, alpha probes for alpha radiation detection, beta probes for beta radiation detection, gamma probes for gamma radiation detection, neutron search probes to detect the presence of gamma radiation, and neutron dose probes for neutron dose measurement. Instruction will include contemporary radiation detection theory and experiments with high-resolution gamma-ray spectroscopy, solid state detectors, neutron detection, and conventional gas filled detectors. In addition, the laboratory will be equipped with basic and advanced lab kits to support the experiments. These instruments will be purchased from Mirion Technologies (Canberra) Inc, or similar vendor.

Neutron Science Laboratory: This laboratory will support experiments that advance knowledge, understanding, and applications of neutron science, particularly in developing radiation detection materials, devices, and systems. The neutron generator in combination with heavy iron targets will be used to induce fission and mimic the reaction inside the fuel cell. The fission products and the effects of the fission can be studied using High Purity Germanium (HPGe) detectors. The Deuterium-Deuterium Neutron Generator and Pulsed Neutron Generator will be purchased from Adelphi Technology, or similar vendor.

Augmented Reality/Virtual Reality Laboratory: As AR/VR technology has increased in prevalence, the nuclear engineering program can offer unique and interdisciplinary learning opportunities in data visualization. Using head-mounted devices to display data as holographic impressions, students can visualize radiation fields and radioactive sources.

In addition to the new equipment, some existing equipment owned by the ME Department that is currently used in Fluid Mechanics, as well as in the Measurement and Instrumentation and Energy Systems Laboratories will also be available for use by the BSNE students. A complete list of currently available equipment is given in Appendix C-2.

Information Technology

- Describe current information technology resources available to support the program.
- Describe additional information technology acquisitions needed during the planning and first five years for successful implementation of the academic program.

The College of Engineering at Tennessee Tech has a variety of computing facilities available for the proposed BSNE program. Tennessee Tech offers numerous computer labs for use across campus for teaching and general student use, and faculty can reserve some of these laboratories for teaching classes. A list of campus computer labs is available at https://its.tntech.edu/display/MON/Computer+Labs. Labs such as the Library Learning Commons are open for general use during business hours and allow students to check out laptops and other items for temporary use. Some labs are restricted for the use of students within a particular college or discipline. For example, the computer lab in Brown Hall 207 is restricted to students in the College of Engineering. Two labs on campus are normally open for 24-hour access. The primary role of university laboratories maintained by Information Technology Services (ITS) is to provide fixed computing resources hosting software that is prohibitively expensive or difficult to configure for the end user.

The university's ITS provides and supports traditional desktop laboratories, but also a range of other opportunities for accessing software and storage space, along with technology assistance, as follows:

- TechAnywhere virtual desktops provide on- and off-campus access to a computer environment similar to those found in campus computer labs. This environment is divided in desktop pools. In addition to the Anywhere Computer Lab pool, a student's class enrollment may grant access to additional pools with specialized software.

- Tennessee Tech's secure wireless network for students, faculty, and staff is known as EagleNet. During the past six years, network access has been significantly enhanced in both bandwidth and reliability. During the COVID-19 campus closure, ITS increased outdoor wireless coverage for EagleNet for students who may not have had a good internet connection at home but could come to campus. This allowed students to remain in their cars or outdoors in a socially-distanced setting and still take advantage of campus wi-fi.

- LabDrive is a file storage space available for faculty, staff, and students using any computer lab on campus. This storage provides up to 5GB of space, and is available from any desktop, laptop, or virtual (VDI) lab computer. It provides temporary storage only.

- TECHcheck on the main floor of the Volpe Library offers a technology checkout service for currently-enrolled Tech students. Laptops, projectors, and other technologies are available for checkout at TECHcheck and may be used for the purposes of study, work, and research.

- The myTECH HelpDesk offers first-level (Tier 1) IT services to the Tennessee Tech community. These services include password resets for Banner SSB (Eagle Online), Banner INB, and e-mail accounts; network connectivity troubleshooting; general technology knowledge base; student PC Service, i.e., general assistance with computer-related issues for students currently enrolled at Tech; Scantron exam grading; and Tier 1 support for Tech-owned faculty and staff devices. Access is available by e-mail and telephone. A chat service is available during normal business hours.

- Lab Patrol is part of the Tier 1 services of ITS. Student Lab Patrol workers are tasked with maintaining the cleanliness and presentability of the university's computer labs. They monitor lab supplies such as printer toner, paper, and other consumables, as well as clean desks, sanitize computer peripherals, straighten chairs, and perform similar tasks.

- Tech provides a High-Performance Computing cluster and a staff member to support it. The staff member assists faculty and students on the use of the cluster, especially with ensuring that the cluster is used both efficiently and equitably across units that wish to use this resource. The staff member also provides short courses and other informal learning opportunities that assist with optimal use of the cluster.

- LinkedIn Learning is an online learning portal offering video courses in multiple fields. It is available for free to all Tennessee Tech faculty, staff, and students.

- Students can download a free copy of Microsoft Office as well as Windows 10. Faculty, staff, and students can also install Office 365 to work from home. Other software and hardware can be purchased at a discount.

The ME and Electrical and Computer Engineering Departments share Brown Hall 207, now equipped to support virtualized graphic intensive applications such as Hyperworks, Inventor, SolidWorks, and 10 CAD-ready workstations. In addition, other university facilities maintained by ITS such as the Cornerstone Labs (CLEM 303A, B, and C) in Clement Hall (each with an average of 30 PCs), and the Volpe Library with nearly 200 computers/laptops, provide computing resources to all campus students. The Volpe Library resources include an equipment-checkout option as described above.

The software available in the computing facilities varies depending on the discipline; but for computer facilities used by multiple disciplines, the standard deployment includes Abaqus, Absoft, Fortran, ANSYS, AutoDesk, COMSOL, Fluent, Hyperworks, Tohee, VMD, Gambit, LabVIEW, Maple, MathCAD, Matlab, MS Office, MS Project, MS Visio, MS Visual Studio, Minitab, ProEngineer, PuTTY, Python, Ruby, SAS, SPSS, TeX Live, and others.

The College of Engineering employs three technical specialist personnel with IT-related backgrounds who work with ITS, college faculty, graduate students, and R&D engineers in the College to provide computer/software support to the departments and programs in terms of computing needs and requirements.

Library resources

- Provide an overview of the current library resources available to support the proposed program. This might include a summary or listing of the appropriate monographs, serials, databases, and online resources that are held by the campus or college libraries to support the proposed program.
- Describe additional library acquisitions needed during the planning and first five years for successful implementation of the academic program.

The 105,000 square foot Angelo and Jennette Volpe Library at Tennessee Tech has a number of services to support academic programs. The Volpe Library is regularly open 98 hours per week and keeps extended hours during projects week and final examinations week each semester.

Volpe Library Organization

The main (second) floor of the library is the Learning Commons area, which has a café, computers, group study rooms, open study space, current periodicals, printing, scanning, classroom space, research help, circulation, and the ITS myTech Helpdesk. The first floor of the library houses Tech's Archives and Special Collections, additional classroom space, more group study rooms, and the TLC (Testing and Learning Center).

The third floor houses the majority of the library's print collection, and the electronic collection is available online from anywhere. Also available on the third floor is the Learning Support Program, which offers classroom support for students who need assistance in developing their skills in math, reading, and writing. Students who require learning support in two or more classes also take a Learning Strategies course in order to facilitate student success.

Finally, as mentioned above, the Volpe Library provides group study rooms. Currently, there are 15 rooms for student use, all of which can be reserved through Dibs, the online reservation system. Twelve are small rooms on the main floor that seat up to six people. All study rooms have whiteboards, and seven have monitors mounted on the wall that allow a laptop hookup. The other three study rooms, two on the first floor and one on the third floor, have tables, chairs, and whiteboards. One of the study rooms on the first floor is the size of a regular classroom, and the other is the size of a 15-seat conference room. The third-floor study room is the size of a 20-seat conference room.

Library Collections and Related Services

The Volpe Library offers access to approximately 276,000 physical book and 294,000 electronic book titles. The library also has over 88,000 print and electronic magazines, journals, and newspaper titles. As a selective depository for U.S. government publications, the library receives materials from various government agencies. There are over 35,000 bound volumes of government publications and approximately 4,000 maps. An increasing number of online databases offer on-campus and off-campus access to magazines, journals, and e-books, many with full text. Students needing help finding resources, print or electronic, can make appointments online to meet with a librarian.

Like most university libraries, the Volpe Library has transitioned from a focus on providing on-site resources to an approach of enabling access to online resources. Numerous online databases, along with e-journals and government publications, are available from the library's website. (Please see https://www.tntech.edu/library/databases.php.)

EagleSearch is the Volpe Library's one-stop search service for resources. Available from the library's homepage, it searches most of the Volpe Library databases for journal articles, books, and conference proceedings. Every Tech student has an account that allows searches and results to be saved, and the search capability is integrated with inter-library loan and RefWorks. Interlibrary loan is a free service for the Tech community to find and access full-text resources. Resources requested are delivered within two to three days, if digital, to the requestor's account and provide PDF file access. Through the inter-library loan program, students and faculty have easy access to the holdings of most of the libraries in the United States and Canada, as well as a few libraries in other countries.

RefWorks is an online citation management software system provided to Tennessee Tech students and faculty. These systems allow access to the library's holdings and electronic resources from on- and off-campus locations.

Tennessee Tech has partnered with several libraries that augment the library resources on campus. Students and faculty have access to the libraries of the University of Tennessee at Knoxville and a reciprocal borrowing program for faculty with Vanderbilt University, located in Nashville. Tech's faculty build most of the library's collection by making purchase requests to the library tailored to fit their instruction and research needs. Faculty may submit requests either directly to the library online, or through their departmental liaison. Final decisions on purchases are made by the Volpe Library staff. The funds available for this purpose are sufficient to cover all faculty requests of this type.

Testing and Learning Center (TLC)

The TLC area on the first floor of the Volpe Library is for examinees to take class exams, make-up exams, standardized tests, exit exams, major field tests, placement tests, and other proctored exams. Students schedule exams online, and all types of exams are administered simultaneously. The testing area facilitates both paper and computer-based exams.

The TLC also runs the university's tutoring program, which offers free, peer tutoring both in-person and online. Tutors help students understand course material, answer questions, and offer suggestions for studying and learning. Students can schedule tutoring appointments online for any class/subject, writing help, resumes, test preparation, and study skills.

Center for Innovation in Teaching and Learning (CITL)

The Volpe Library is also the home of the Center for Innovation in Teaching and Learning, which offers comprehensive support for the design and evaluation of courses. The CITL helps in four specific ways, as described below.

- **Teaching and Learning**
  Faculty can work with a trained teaching and learning expert to communicate learning outcomes, create instructional activities, and construct assessments in significant and transformative ways. Faculty can request to have the CITL conduct a Small Group

Instructional Diagnostic for their course, which is a well-established interview tool used to gather information from students about how they are learning. As part of this suite of services, faculty can also request guidance on developing and implementing a Scholarship of Teaching and Learning (SoTL) project for one or more courses. SoTL is a form of inquiry in which faculty closely and critically explore student learning in order to improve their courses and to share their insights more broadly.

- **Instructional design**
  The CITL also offers instructional design services specializing in online course and program development, design, and engagement. Services offered include coordination of new online course and/or program development and design; updating existing online offerings to increase engagement; recommendation or examination of Open Educational Resources (OERs) for use in online offerings; incorporating/increasing the use of iLearn into existing blended, hybrid, or in-person courses; and assistance with integration of supported technologies in collaboration with our technology specialists.

- **Instructional Technology**
  Instructional Technology services support and train faculty in using software and equipment in the classroom from development to teaching and managing a class. They also offer individual consultation and assistance on supported software.

- **TN eCampus Support**
  CITL also supports students in TN eCampus courses in areas such as answering general information inquiries, issuing permits, proctoring exams, and providing assistance with course-related issues. More information about TN eCampus courses and student resources is available at https://tnecampus.info/.

myTech Helpdesk and TECHcheck
As previously noted, the myTech Helpdesk is the first level of ITS support for students, faculty, and staff. It is located in the east wing of the Volpe Library's main floor and is staffed by a manager and three Tier 1 support agents. Located with the helpdesk is the TECHcheck technology checkout service.

Other Resources in the Volpe Library
In addition to all of the resources previously discussed, other resources located in the Volpe Library are available for students and faculty.

- **iCUBE**
  Tennessee Tech's iCube is a place where students and faculty "imagine, inspire, and innovate" (i3). The goal is to provide creative solutions to traditional problems through marketing, training, website and app development, public policy campaigns, and the application of emerging technologies, such as virtual reality.

- **iMakerSpace**
  The iMakerSpace is a university-wide, student-centered space under the leadership of the Colleges of Engineering and Business. The iMakerSpace serves as a focal point on campus to provide training, service, partnership, research, and evaluation in innovation and entrepreneurship to all disciplines. The iMakerSpace encourages interdisciplinary

teams and provides support and training to extend innovation and entrepreneurship activities into research and the classroom.

Marketing

- Outline any anticipated costs associated with the marketing for the proposed program during the planning and first five years.

It is anticipated that the proposed new BSNE program will be marketed by Tenness Tech's Office of Undergraduate Admissions with dedicated staff and the Office of Communications & Marketing (OCM). The OCM consists of a variety of teams and individuals that are available for help. The OCM reports to the Division of Enrollment & Communication and supports the communication and marketing needs for campus and community. There may be some minimal cost (approx. $10k over first 5 years) associated with print material (brochures and flyers) for the program that can be covered by the College of Engineering and ME Department operating budget.

Facilities

- Describe facilities that will support of the proposed program. For existing space and facilities, briefly describe the type(s) of space and facilities (e.g., a listing of the number and types of classrooms or labs, student offices or spaces, etc.).
- For new or renovated facilities, clearly outline them and include the amount and type of space, costs identified, and source(s) of funds to cover costs.

The Mechanical Engineering Department is located in Brown Hall where the majority of faculty offices for the department are also located. A total of five classroom spaces are directly controlled by the ME Department for instructional purposes, with class size dictated by fire code limits. Each classroom space is multimedia-equipped with a computer, projection equipment, and DVD player. In addition, the University purchased classroom-scheduling software called "EMS" (Event Management Software) is available to assist in finding and scheduling available classrooms on a campus-wide basis. Overall, classroom space and quality are more than adequate for the proposed new program

Table 11. Brown Hall Classroom Space

Room	Description	Seating Capacity	Sq. Ft.
BRWN 236	Classroom	40	802
BRWN 237	Classroom	52	909
BRWN 241	Classroom	36	754
BRWN 307	Classroom	36	774
BRWN 315	Classroom	40	1160
Total:			**4399**

The BSNE labs will be located in the Lab Science building (LSC). The following rooms have been assigned for this program.

- NE Labs – LSC Room 2306, 2307, 2308, 3111 (Total: 1649 SFT)
- NE Faculty Offices – LSC Room 2302, 3315, 3318 (Total: 384 SFT)

The need for more classroom space will be much better met in the near future with the addition of modern classrooms and learning studios in the new engineering building slated to open in August 2024.

Tennessee Technological University is building a new 60,000 net-assignable square foot (NASF) building for the College of Engineering, with the anticipated occupation data set for August 2024. This new building is a student-centered, interdisciplinary space used by all departments in the College of Engineering, comprising more than one-quarter of students at Tennessee Tech. This Ashraf Islam Engineering Building is being programmed around the concept of intelligent infrastructure, along with open, flexible, and reconfigurable spaces to promote multi-purpose use and collaborative learning. The building will include large-capacity classrooms to foster efficient use of resources and facilitate students' timely completion of degrees. The building will be designed to facilitate hands-on learning through maker-spaces and industry-linked design project spaces. The "smart building" will itself serve as both an instructional and a research laboratory with sensors embedded to collect information from all building systems. The additional space, in combination with the intelligent building design, will facilitate growth in research and instruction in engineering fields related to smart technologies, especially artificial intelligence, autonomy, nuclear and security – topics that will be critical to industry and government for decades to come, as smart technologies change the way humans live, work, and interact with devices, infrastructures, and vehicles. These areas build on Tennessee Tech's existing strengths in engineering and cybersecurity, as well as ME's new Nuclear Engineering, Vehicle Engineering concentration and curricula, and research related to smart technologies. The Smart Engineering Building will facilitate increases in engineering enrollment and degree attainment, enhance research and workforce development, and serve the educational and workforce needs of Tennessee.

Mechanical Research Engineering Labs: The ME Department has nine research labs, where student-learning teams can conduct work related to their Learning Challenges.

- Acoustics and Vibration Laboratory
- Fluid Mechanics Laboratory
- Computer-Aided Engineering (CAE) Laboratory
- Fuel Cell Laboratory
- Geometric Design and Manufacturing Integration Laboratory
- Mechatronics and Intelligent Machines Laboratory (MIML)
- Microstructural Analysis Laboratory
- Senior Design Project Laboratory
- Measurements and Instrumentation Laboratory
- Dynamic and Smart Materials Laboratory

Travel

- Provide a summary of anticipated travel expenses during the planning and first five years.

The travel budget is estimated to be approximately $5,000 for Year 1 and Year 2, and around $2,500 for Year 3.

The Program Director, faculty members, and/or graduate student may need to visit several nuclear-related equipment companies/organizations (ORNL, Y-12, CNS), etc. for potential interactions/discussions. The faculty and/or students will attend a technical conference related to processing and characterization of nuclear fuels to learn the latest in the field once each year. Travel costs are set by Tennessee Tech policy with in-state travel having a special set of limits. At present mileage is reimbursed at the rate of $0.47/mile. Out of-state travel limits are set by CONUS rates on the government website. Travel costs may include ground transportation, air fare, baggage fees, lodging, per diem, parking and registration.

Other resources

- Describe other support resources available to support the program.
- Describe additional support resources that may be needed during the planning and the first five years for successful implementation of the academic program.

Other Departments on Campus

Although housed in the Mechanical Engineering Department, this will not be the only department supporting the Nuclear Engineering program. ME has consulted with the Departments of Physics, Chemistry, Chemical Engineering, and Electrical and Computer Engineering about curriculum and other support materials and resources those departments can offer ME to further the Nuclear Engineering degree objectives.

Mechanical Engineering External Advisory Board

The Mechanical Engineering External Advisory Board (EAB) is another important source of support for the Nuclear Engineering program. The EAB is comprised of engineering executives from industry, governmental agencies, universities, and private consulting firms. It should be noted that two current members of ME-EAB including its Chair (Dr. Lumsdaine from ORNL) have expertise and background in Nuclear Engineering. The EAB meets twice a year to offer advice to the department chair, the faculty and other administrative officers on strategies and means for accomplishing the mission of the department including development of resources. Members of the EAB also provide support throughout the year for many of the department's specific initiatives and programs including the proposed NE to exploit the rapidly changing technical diversity of mechanical engineering, and to foster closer ties between the department and its constituents. Additional members from the Nuclear Industry will be added in the future as necessary.

Recruitment of New Faculty and Staff

Tennessee Tech already has well established engineering programs with associated infrastructure including Library, Information Technology, Classrooms, Office of Communication and Marketing, and Student Support Services. The estimated cost to support the proposed BSNE program are tied to recruiting new faculty and purchasing new equipment (from the secured $3 million funding) to support related laboratory courses. As indicated in the table below, we expect to recruit a founding director (at the Associate or Full Professor level) and a research engineer during the first year of the program to implement the curriculum, set-up the laboratories and help recruit students and train any graduate teaching assistants needed for the laboratories. Two additional faculty (one Lecturer and one tenure track Assistant Professor) will be recruited in the second year, followed by another tenure track Assistant Professor in the third year of the program. The anticipated salaries, benefits and other expenditures are shown in the table.

Table 12. Estimated Costs to Deliver the Proposed Program

Estimated Cost to Deliver the Proposed Program							
One Time Expenditure							
Category	**Planning**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**6-Year Total**
Accreditation						$9,700	$9,700
Consultants	$8,000	$5,000	$5,000	$5,000	$5,000	$5,000	$33,000
Equipment*	$3 mil						$3,000,000
Information Technology							
Library							
Marketing	$10,000	$2,000	$2,000	$2,000	$2,000	$2,000	$20,000
Facilities							
Travel	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$30,000
Other							
Total One-Time Expenditures	$23,000	$12,000	$12,000	$12,000	$12,000	$21,700	$3,092,700

Recurring Expenditure							
Salaries increase by 3% per year, Benefits based on 43% estimate							
		Year 1	Year 2	Year 3	Year 4	Year 5	
Director of NE	Salary	$160,000	$164,800	$169,744	$174,836	$180,081	
	Benefits	$68,800	$70,864	$72,990	$75,180	$77,435	
Assistant Professor	Salary		$100,000	$103,000	$106,090	$109,273	
	Benefits		$43,000	$44,290	$45,619	$46,987	
Assistant Professor	Salary			$100,000	$103,000	$106,090	
	Benefits			$43,000	$44,290	$45,619	
Lecturer	Salary	$90,000	$92,700	$95,481	$98,345	$101,296	
	Benefits	$38,700	$39,861	$41,057	$42,289	$43,557	
Research Engineer	Salary	$80,000	$82,400	$84,872	$87,418	$90,041	
	Benefits	$34,400	$35,432	$36,495	$37,590	$38,718	
Total Recurring Expenditures		$471,900	$629,057	$790,929	$814,657	$839,096	
Grand Total (One-Time and Recurring		$483,900	$641,057	$802,929	$826,657	$860,796	

*Department of Education Congressional Direct one-time Grant obtained for this program. This covers cost for both equipment and IT (software). This is not included in the estimated cost.

Faculty members are appointed on 9-month appointments during the academic year. Benefits during that time period are FICA, Medicare, Group Insurance, and Retirement. Any time spent on research during the summer months does not carry the same benefit load since the group insurance is paid on the academic salary. Benefits assessed during the summer are FICA, Medicare, and Retirement.

Appendices:

Appendix A-1: Course Description for existing courses

Appendix A2: Course Description and ABET Syllabi for new for new courses

Appendix B: Assessment Instruments

Appendix C-1: New Equipment for the NE Program

Appendix C-2: Existing Equipment Available for the NE Program

Appendix A-1: Nuclear Engineering Curriculum- Existing Courses-1

Existing Courses

English Courses (9 credits)

ENGL 1010 - English Composition I

Introduces students to expressive, expository and persuasive writing. Assignments are based on personal experience and research. Student must earn a grade of C or better to pass.
3.000 Credit hours
3.000 Lecture hours

ENGL 1020 - English Composition II

Prerequisite: ENGL 1010. Builds on writing and research processes taught in ENGL 1010; emphasizes critical reading, critical thinking, and critical writing (persuasion) about a variety of written texts and other media. Student must earn a grade of C or better to pass.
3.000 Credit hours
3.000 Lecture hours

PC 2500 - Communicating in the Profess

Prerequisite: ENGL 1020 or concurrent enrollment in ENGL 1020. Overview of skills and principles related to oral communication in various professions.
3.000 Credit hours
3.000 Lecture hours

OR

COMM 2025 - Fundamentals of Communication

Introduction to the communication process, interpersonal communication, group discussion, and public speaking. Students are required to prepare and deliver speeches.
3.000 Credit hours
3.000 Lecture hours

Physics Courses (11 credits)

PHYS 2110 - Calc-based Phys I

Prerequisite: MATH 1920 (may be taken concurrently). Introduction to classical mechanics and mechanical waves, with lab. A student may not earn credit in both PHYS 2110 and any of PHYS 1310, PHYS 2010, PHYS 2109 and PHYS 2111.
0.000 TO 5.000 Credit hours
0.000 OR 3.000 Lecture hours
0.000 OR 3.000 Lab hours

PHYS 2120 - Calc-based Phys II

Prerequisite: Either (i) PHYS 2109 and PHYS 2111 or (ii) PHYS 2110 (w. lab); MATH 2110 or MATH 2120 (MATH 2110 or MATH 2120 may be taken concurrently). Introduction to classical electromagnetism and optics, with lab. A student may not earn credit in both PHYS 2120 and any of PHYS 1310, PHYS 2020, PHYS 2119 and PHYS 2121.
0.000 TO 5.000 Credit hours
0.000 TO 5.000 Lecture hours
0.000 OR 3.000 Lab hours

PHYS 2420 - Modern Physics

Prerequisite: PHYS 2119 or PHYS 2120. Introduction to modern physics. Topics include special relativity, quantum theory of light, wave nature of matter, Bohr's theory of the atom, quantum mechanics in one dimension. Selected topics from atomic, molecular, solid state, nuclear, and particle physics.
3.000 Credit hours
3.000 Lecture hours

Mathematics Courses (18 credits)

MATH 1910 - Calculus I

Prerequisite: ACT mathematics score of 27 or above and four years of high school mathematics, including algebra, geometry, trigonometry, and advanced or pre-calculus mathematics, or special permission of the Mathematics Department; or C or better in MATH 1730; or C or better in MATH 1720 and MATH 1710 or equivalent. Limits, continuity, derivatives and integrals of functions of one variable. Applications of differentiation and introduction to the definite integral.
4.000 Credit hours
4.000 Lecture hours

MATH 1920 - Calculus II

Prerequisite: C or better in MATH 1910; or equivalent AP credit for MATH 1910. Integration techniques, applications of the definite integral, polar coordinates,

parametric equations, sequences, and series.
4.000 Credit hours
4.000 Lecture hours

MATH 2110 - Calculus III

Prerequisite: C or better in MATH 1920 ; or equivalent AP credit for MATH 1910 and MATH 1920 . Analytic geometry and vectors, differential calculus of functions of several variables, multiple integration, and topics from vector calculus.
4.000 Credit hours
4.000 Lecture hours

MATH 2120 - Differential Equations

Prerequisite: C or better in MATH 1920. First order equations, linear equations of higher order, power series solutions (including Frobenius method), Laplace transforms, other topics. It is recommended but not required that students take MATH 2010 before taking MATH 2120.
3.000 Credit hours
3.000 Lecture hours

MATH 3470 - Intro/Prob & Stats

Prerequisite: C or better in MATH 1920. Probability, random variables, discrete and continuous distributions and their simulation, elementary sampling theory, and estimation with an overall emphasis on simulation of random processes (Not allowed for mathematics majors after having taken MATH 4480.)
3.000 Credit hours
3.000 Lecture hours

Chemistry (4 credits)

CHEM 1110 - General Chemistry I

General chemistry course for students pursuing a degree in a STEM-related field. Topics include atomic and molecular level structure and properties, stoichiometry, aqueous reactions, thermochemistry, and properties of gases. Associated laboratory supports lecture content and incorporates elements of atomic emission spectroscopy and stoichiometric calculations. Meets Tennessee Technological University general education requirement (Natural Sciences).
0.000 TO 4.000 Credit hours
0.000 OR 3.000 Lecture hours
0.000 OR 3.000 Lab hours

Humanities and Fine Arts (9 credits)[24]	
At least one literature course, selected from those marked with an asterisk (*), must be included in the 9 hours.	
ART 1035 - Introduction to Art	3
*ENGL 2130 - Topics in American Literature	3
*ENGL 2235 - Topics in British Literature	3
*ENGL 2330 - Topics in World Literature	3
FLST 2520 (3520) The Cultures and Peoples of North Africa	3
FREN 2510 - French Culture and Civilization	3
GERM 2520 - German Culture and Civilization	3
HIST 2210 - Early Western Civilization	3
HIST 2220 - Modern Western Civilization	3
HIST 2310 - Early World History	3
HIST 2320 - Modern World History	3
HIST 1310 - Science and World Cultures	3
MUS 1030 - Music Appreciation	3
PHIL 1030 - Introduction to Philosophy	3
RELS 2010 - Introduction to Religious Studies	3
SPAN 2510 - Spanish Culture and Civilization	3
SPAN 2550 - Latin American Culture and Civilization	3

[24] * detailed course descriptions for Humanities and Social Sciences are available at https://catalog.tntech.edu/content.php?catoid=27&navoid=5438#TTU_Courses_Recommended_for_the_TBR_General_Education_Core

THEA 1030 - Introduction to Theatre	3
Social and Behavioral Courses (6credits)	
AGBE 2010 - World Food and Society	3
ANTH 1100 - Introduction to Anthropology	3
ECON 2010 - Principles of Microeconomics	3
ECON 2020 - Principles of Macroeconomics	3
ESS 1100 - Introduction to Environmental Studies	3
EXPW 2015 - Concepts of Health and Wellness	3
GEOG 1012 - Cultural Geography	3
GEOG 1130 - Geography of Natural Hazards	3
POLS 1030 - American Government	3
PSY 1030 - Introduction to Psychology	3
SOC 1010 - Introduction to Sociology	3
WGS 2010 - Introduction to Women and Gender Studies	3

ENGR Courses (4 credits

ENGR 1110 - Engineering Graphics

Visualization skills and graphic communication techniques for engineers, sketching, computer-aided drafting, and solid modeling, drawing interpretation.
2.000 Credit hours
4.000 Other hours

ENGR 1120 - Programming for Engineers

Prerequisites: ACT Math score of 27 or above, or MATH 1720, MATH 1730, MATH 1845, or MATH 1910. Problem definition, algorithm development, flowcharting, and structured programming using a high level language. MATH 1845 or MATH 1910 can be taken concurrently.

2.000 Credit hours
4.000 Other hours

ECE Course (4 credits)

ECE 2050 - Circuits and Electronics I

Prerequisite: C or better in MATH 1920. Electric circuit quantities and components, circuit theorems, dc and ac circuit analysis, first-order transient response, operational amplifiers, circuit simulation.
0.000 OR 4.000 Credit hours
0.000 OR 3.000 Lecture hours
0.000 OR 3.000 Lab hours

Civil Engineering Course (3 credits)

CEE 2110 - Statics

Prerequisite: PHYS 2110 (PHYS 2110 may be taken concurrently); C or better in MATH 1920. Vector algebra, resultants, equilibrium, friction, centroids, moment of inertia, trusses, machines and frames, beam shear and moments.
3.000 Credit hours
3.000 Lecture hours

Appendix A-1: Nuclear Engineering Curriculum- Existing Courses-2

Existing Mechanical Engineering Courses
ME Courses (22 credits)
ME 2330 - Dynamics Prerequisites: C or better in CEE 2110; PHYS 2110. Kinematics; relative motion; kinetics, applications of Newton's Laws, work-energy principle, impulse-momentum principle, and vibrations. 3.000 Credit hours 3.000 Lecture hours Levels: Undergraduate Schedule Types: Lecture
ME 2910 - Professionalism and Ethics Prerequisite: Sophomore Standing. Professional, social and ethical issues in engineering practices; oral and written technical communication. 1.000 Credit hours 1.000 Lecture hours Levels: Undergraduate Schedule Types: Lecture
ME 3001 - Mechanical Engr Analysis Prerequisite: ENGR 1120 or CSC 1300; C or better in MATH 2010; C or better in MATH 2120. Analytical and numerical techniques are developed for problems arising in mechanical engineering. Analytical methods include applications of Laplace transforms, Fourier series and separation of variables. Numerical methods include root finding, quadrature rules, and solutions to ordinary and partial differential equations. Use of modern numerical computing tools for problem solving. 3.000 Credit hours 3.000 Lecture hours
ME 3010 - Materials & Processes in Mfg Prerequisites: ME 2910 or CEE 3110 or MET 2400; CEE 2110 with a grade of C or better, CHEM 1010 or CHEM 1110 (ME 2910 may be taken concurrently.) Processing/microstructure/property interrelations; heat treatment of steels and alloys; overview of manufacturing processes; interrelations among materials, design and manufacturing; and introduction to material selection.

3.000 Credit hours
3.000 Lecture hours

ME 3023 - Measurements/Mech Sys

Prerequisites: ECE 2850 (or ECE 2050), PHYS 2120 and CEE 3110 (CEE 3110 may be taken concurrently). Principles of measurement and calibration; basic instrumentation and measurement techniques in mechanical systems.
0.000 OR 3.000 Credit hours
0.000 OR 2.000 Lecture hours
0.000 OR 2.000 Lab hours

ME 3210 - Thermodynamics I

Prerequisites: CHEM 1110; C or better in MATH 2110. Concepts, models and laws; energy and the first law; properties and state; energy analysis of thermodynamics systems; entropy and the second law; and conventional power and refrigeration cycles.
3.000 Credit hours
3.000 Lecture hours

ME 3710 - Heat Transfer

Prerequisite: ME 3210; C or better in MATH 2120. ME 3210 may be taken concurrently. Single and multidimensional steady-state and transient heat conduction; role of convection for internal and external forced flows and in buoyancy-driven flow; and thermal radiation processes and properties.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

ME 3720 - Fluid Mechanics

Prerequisites: ME 2330. Fundamentals of fluid flow; fluid statics; systems and control volumes; continuity, momentum and energy equations; dynamic similitude; one-dimensional open channel flow; and compressible flow.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

Appendix A-2: Course Description and Syllabi for new NE courses

Nuclear Engineering Courses

Course No.	Course Name	Credits	Prerequisites
NE 2110	Intro to Nuclear Engineering	3	Physics II
NE 2120	Intro to Radiological Engineering & Detection	3	NE 2110
NE 3210	Nuclear Reactor Safety & Analysis	3	NE 2110
NE 4110	Nuclear Engineering Lab I	3	NE2110, ECE 2050
NE 4120	Nuclear Engineering Lab II	3	NE4110, ECE2050
NE 4210	Nuclear Reactor Theory and Analysis	3	NE3210, ME 3001
NE 4220	Nuclear Reactor Dynamics & Control	4	NE4210
NE 4310	Senior Design I	3	NE3210, NE4110
NE 4320	Senior Design II	3	NE4310
NE 4410	Senior Seminar	1	Senior Standing
NE 4510	Introduction to Industrial Maintenance Tech	3	NE Core
NE 4520	Advanced Reactors and Small Modular Reactors	3	NE Core
Technical Elective 1	Senior Elective	3	
Technical Elective 2	Senior Elective	3	
NE 4900	Special Topics in Nuclear Engineering	3	Senior Standing

List of Suggested Technical Electives

Course No.	Course Name	No. Of Credits
ME 4260	Energy Conversion/Conservation	3
ME 4720	Thermal Design	3
ME 4730	Numerical Heat Transfer	3
ME 4930	Noise Control	3
ME 4060	Mechanical Vibrations	3
ME 4380	Intro to Data Acq and Signal Proc	3
ME 4620	Turbomachinery	3
ME 4610	Steam Power Plants	3
Other upper division (3000 and 4000 level) engineering, technology, science or business courses may be used with prior approval of advisor, course instructor and the ME department.		3

NE 2110 – Introduction to Nuclear Engineering

1. **Credit hours:** 3
   Contact hours: 3
   Credit type: Engineering Topics

2. **Course coordinator:** TBD

3. **Textbook:** *Nuclear Reactor Dynamics and Control*, T.W. Kerlin and B.R. Upadhyaya, Elsevier-Academic Press, 2019.
   Reference: *Nuclear Energy*, R.L. Murray and K.E. Holbert, 7^{th} Edition, Elsevier Butterworth-Heinemann, 2015.

4. **Course information:**

Catalog description	Atomic structure; neutron interactions; reaction rates and nuclear power generation; nuclear fission; fast and thermal neutrons; neutron multiplication factor and reactivity; computing effective multiplication factor; neutron moderation; pressurized water reactors; boiling water reactors; pressurized heavy water reactors; balance-of-plant systems; sodium fast reactors; molten salt reactors; gas-cooled reactors; nuclear plant capacity factor; fusion energy; advanced reactors; nuclear fuel cycle.
Prerequisites	PHYS 2120
Co-requisites	None
Course category	Required course for BSNE

5. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Understand the basics of neutron interactions, fission reaction, reaction rate and nuclear power generation	1
CO2	Understand the basics of fast and thermal neutrons, neutron lifetime and generation time, neuron multiplication factor and reactivity	1
CO3	Understand the systems and principle of operation of light water reactors (PWRs and BWRs) and balance-of-plant systems.	1,2,4
CO4	Understand the systems and principle of operation of pressurized heavy water reactors (PHWR) and the CANDU reactor.	1,2,4
CO5	Understand the principle of operation and systems in sodium-cooled fast reactors (SFRs), gas-cooled reactors (GCRs), and molten salt reactors (MSRs)	1,2,4,6
CO6	Review advanced reactors and small modular reactors.	1,2,4,7
CO7	Understand the basic components of a nuclear reactor fuel cycle, with an emphasis on storage/disposal of spent nuclear fuel. Review the technology used by France for fuel reprocessing and storage.	1,2,4,5,7
CO8	Understand the principle of fusion reactors and the current design	1,2,4,5

	approaches in developing a fusion energy system.	

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

6. **Brief list of Topics:**
- Atomic structure; neutron interactions; reaction rates and nuclear power generation.
- Nuclear fission; fast and thermal neutrons; neutron multiplication factor and reactivity; computing effective multiplication factor.
- Neutron moderation; pressurized water reactors (PWRs); boiling water reactors (BWRs); pressurized heavy water reactors (PHWR/CANDU reactor).
- Balance-of-plant systems, including steam generators, steam turbine, condenser, etc.
- Sodium fast reactors (SFRs); molten salt reactors (MSRs); gas-cooled reactors (GCRs).
- Calculating nuclear plant capacity factor.
- Fusion reactors and the current design approaches in developing a fusion energy system.
- Advanced reactors and small modular reactors.
- Components of a nuclear reactor fuel cycle, with an emphasis on storage/disposal of spent nuclear fuel. Technology used by France for fuel reprocessing and storage.

1. **NE 2120 – Introduction to Radiological Engineering and Radiation Protection**

2. **Credit hours:** 3
   Contact hours: 3
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Atoms, Radiation, and Radiation Protection*, J.E. Turner, 3rd Edition, Wiley-VCH Verlag GmbH & Co., 2007.
   Reference: *Nuclear Energy*, R.L. Murray and K.E. Holbert, 7th Edition, Elsevier Butterworth-Heinemann, 2015.

5. **Course information:**

Catalog description	Radioactive decay and decay mechanisms; charged particles and energy transfer; biological effects of radiation, including radiation dose, dose equivalent, quality factors; radiation protection and exposure limits; radiation detection, radiation dosimetry, and radiation shielding; benefits and risks of radiation, and communication with the public.
Prerequisites	PHYS 2120
Co-requisites	None
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Understand basics of nuclear radiation.	1
CO2	Characterize radioactive decay mechanisms by using calculations.	1
CO3	Characterize energy transfer and biological effects of radiation.	1,2,4
CO4	Understand and calculate radiation dose, dose equivalent, and quality factors for different types of radioactive decay mechanisms.	1,2,4
CO5	Understand radiation protection and criteria for exposure limits.	1,2,3,4
CO6	Review the principles of radiation detection and radiation dosimetry.	1,2,4,7
CO7	Understand the basics of radiation shielding	1,2,4,5,7
CO8	Communicate the benefits and risks of radiation to the public.	1,2,3,4

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**

- Nuclear structure and nuclear radiation.
- Radioactive decay; decay mechanisms.
- Charged particles and energy transfer.
- Biological effects of radiation.
- Radiation dose, dose equivalent, quality factors.
- Radiation protection and exposure limits.
- Principles of radiation detection.
- Radiation dosimetry.
- Radiation shielding.
- Benefits and risks of radiation and communication with the public.

1. **NE 3210 – Nuclear Reactor Safety and Analysis**

2. **Credit hours:** 3
   Contact hours: 3
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Nuclear Engineering: Theory and Technology of Commercial Nuclear Power*, R.A. Knief, 2nd Edition, Hemisphere Publishing, New York, 1992.
   Nuclear Reactor Safety, MIT OpenCourseWear, 22.091, https://ocw.mit.edu/courses/22-091-nuclear-reactor-safety-spring-2008/pages/syllabus/ , 2008.
   Nuclear Safety in Light Water Reactors, B.R. Sehgal (Editor), Elsevier-AP, 2012.
   References: *NRC Reactor Safety Codes*, U.S. Nuclear Regulatory Commission, last updated March 2023. https://www.nrc.gov/about-nrc/regulatory/research/safetycodes.html
   NRC Nuclear Reactor Safety Research, U.S. Nuclear Regulatory Commission, last updated July 2020: https://www.nrc.gov/about-nrc/regulatory/research/reactor-rsch.html#top
   A Guidebook to Nuclear Reactors, A.V. Nero, Jr., University of California Press, 1979.

5. **Course information:**

Catalog description	Nuclear plant systems in PWRs, BWRs, SFRs and GCRs; safety systems and emergency core cooling systems in PWRs, BWRs, PHWRs & GCRs; nuclear reactor safeguard systems; defense-in-depth design; nuclear reactor accident scenarios; design-basis accidents (DBA) and beyond DBA; examples of major commercial reactor accidents (TMI-2, Chernobyl, Fukushima); indications of transients in operating reactors and emergency shutdown; regulatory issues related to reactor safety; study of reactor transients; elements of probabilistic risk assessment (PRA); thermal hydraulic and severe accident computer codes recommended by the NRC.
Prerequisites	NE 2110
Co-requisites	ME 3710
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Review and understand nuclear plant systems in PWRs, BWRs, PHWRs, SFRs and GCRs.	1,7
CO2	Understand the functions of nuclear reactor safeguard systems and emergency core cooling systems (ECCS).	1,3,5,7
CO3	Understand the principle of defense-in-depth design, design-basis accidents (DBA) and beyond DBA.	1,7
CO4	Review the causes of major commercial reactor accidents and the lessons learned. Perform a detailed Internet review.	1,7
CO5	Discuss the indications of transients in operating reactors and	1,7

	emergency shutdown.	
CO6	Review and understand the principles of probabilistic risk assessment (PRA) and reactor design.	1,4,7
CO7	Implement thermal hydraulic and severe accident computer codes recommended by the NRC.	1,5,7
CO8	Prepare a team report on a topic related to reactor safety and designing for safety and make a critical presentation to the class.	1,5,7

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**
- Nuclear plant systems in PWRs, BWRs, SFRs and GCRs.
- Safety systems and emergency core cooling systems in PWRs, BWRs, PHWRs & GCRs; nuclear reactor safeguard systems.
- Defense-in-depth design; nuclear reactor accident scenarios; design-basis accidents (DBA) and beyond DBA.
- Examples of major commercial reactor accidents (TMI-2, Chernobyl, Fukushima).
- Indications of transients in operating reactors and emergency shutdown.
- Regulatory issues related to reactor safety.
- Elements of probabilistic risk assessment (PRA).
- Study of reactor transients; implementation of thermal hydraulic and severe accident computer codes recommended by the NRC.

1. NE 4110 – **Nuclear Engineering Laboratory I**

2. **Credit hours:** 3
   Contact hours: **4**
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Measurement & Detection of Radiation*, N. Tsoulfanidis and S. Landsberger, CRC Press, Taylor & Francis, 4th Edition, 2015.
   Reference: *Radiation Detection and Measurement*, G.F. Knoll, John Wiley & Sons, 4th Edition, 2010.
5. **Course information:**

Catalog description	Radiation detection systems and measurements. Electronic devices associated with measurements. Statistical data analysis. Understand radiation sources, interactions, and various types of detectors. Develop laboratory skills and report writing, with emphasis on presentation of procedures, data, and results.
Prerequisites	ECE 2050, NE 2110
Co-requisites	None
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Understand ionizing radiation and interaction with radiation sensing media. Develop a list of vendors of radiation monitoring systems.	1,7
CO2	Determine the detector response and corresponding signals from interaction with photons, alpha and beta particles, and neutrons.	1,7
CO3	Explain the characteristics, limitations and applications of scintillating, semiconductor, and gas-filled detectors.	1,3,7
CO4	Develop the skill to interface the detectors with electronics for measurement acquisition and signal processing.	1,2,5,6,7
CO5	Analyze and display radiation energy spectra as acquired by the different radiation detectors used in the experiments.	1,6
CO6	Calculate error in experimental data and understand the sources of errors and their minimization.	1,4,6
CO7	Prepare laboratory reports, communicate results and shortcomings, and exchange ideas in a team setting.	2,3,5,6,7
CO8	Develop a list of real-world applications of radiation monitoring systems, both in nuclear power plants and in other environments.	1,3,4,5,7

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**

- Counting statistics and error prediction, graphical representation of data.
- Interaction of radiation with matter.
- Radiation sources and their characteristics.
- Radiation detectors and associated electronics.
- Radiation spectroscopy and applications.
- Scintillation detectors.
- Semiconductor detectors.
- Gas-filled detectors.
- Neutron detectors.

1. NE 4120 – **Nuclear Engineering Laboratory II**

2. **Credit hours:** 3
   Contact hours: 4
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Theory and Design for Mechanical Measurements,* R.S. Figliola and D.E. Beasley, 6th Edition, John Wiley & Sons, 2015.
   Reference: *Random Data: Analysis and Measurement Procedures,* J.S. Bendat and A.G. Piersol, 4th Edition, John Wiley & Sons, 2010.

5. **Course information:**

Catalog description	Basic measurements of process parameters including, temperature, pressure, flow rate, liquid level and machinery vibration. Apply the fundamentals of digital signal processing to extract information from sensor signals, sensor calibration and measurement accuracy. Develop laboratory skills for measurements in a fluid flow loop system and to demonstrate basic heat transfer in a nuclear reactor. Develop report writing skills, with emphasis on laboratory procedures, data acquisition, and results.
Prerequisites	ECE 2050, NE 4110
Co-requisites	None
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Understand principles of various process instrumentation, including machinery vibration monitoring using accelerometers.	1,7
CO2	Understand the principles of digital signal processing and information extraction from sensor measurements.	1,7
CO3	Conduct force and pressure measurements.	1,2,7
CO4	Conduct temperature, flow rate, and liquid level measurements; and relationships among them	1,2,7
CO5	Perform vibration monitoring of rotating machinery using accelerometers and data acquisition/analysis software. Demonstrate shaft imbalance, misalignment, bearing faults. Team effort.	1,2,3,6,7
CO6	Perform experiments to demonstrate conductive and convective heat transfer. Team effort.	1,2,3,6,7
CO7	Understand the types and uses of neutron detectors in PWRs and BWRs. Field trip to TVA's Sequoyah nuclear plant simulator.	7
CO8	Prepare written reports, showing results and graphical presentations.	3,4,5

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**

- Principles of operation of temperature, flow rate, pressure, and liquid level sensors.
- Principle of machinery vibration monitoring and fault detection.
- Basics of digital signal processing.
- Measurements using process sensors in a laboratory flow loop.
- Monitoring rotating machinery using vibration sensors.
- Laboratory experiments to demonstrate conductive and convective hear transfer.
- Principles of neutron power measurements in PWRs and BWRs; neutron detectors.
- Field trip to TVA's Sequoyah nuclear plant simulator.

1. **NE 4210 – Nuclear Reactor Theory and Analysis**

2. **Credit hours:** 3
   Contact hours: 3
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Nuclear Reactor Analysis*, J.J. Duderstadt and L.J. Hamilton, John Wiley & Sons, New York 1976.
   Reference: *Basic Nuclear Engineering*, A.R. Foster and R.L. Wright, Allyn & Bacon, Boston, 1983.

5. **Course information:**

Catalog description	Nuclear fission, chain reactions, elastic scattering, neutron cross sections, neutron moderation (slowing down), neutron energy spectrum, nuclear data; multiplication factor and reactivity; neutron transport equation; one-speed neutron diffusion model; point reactor kinetics equations and spatial effects in reactor kinetics; reactivity feedback effects; light water reactors and sodium fast reactors; multi-group diffusion theory; calculation of core power distribution.
Prerequisites	NE 3210, ME 3001
Co-requisites	None
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Understand nuclear fission, neutron cross sections, elastic scattering, chain reactions, effective multiplication factor (k_{eff}), and reactivity.	1,7
CO2	Understand and provide examples of neutron energy spectrum for various fissile isotopes; understand the use of nuclear data and provide examples.	1,2,3,7
CO3	Be able to develop the neutron transport equation.	1
CO4	Develop one-speed neutron diffusion model, point reactor kinetics equations, and neutron flux distribution in a typical reactor core.	1,7
CO5	Understand spatial effects in reactor kinetics and be able to extend point reactor kinetics to calculate spatial effects and flux shape.	1,6,7
CO6	Understand reactivity feedback effects in light water reactors and sodium-cooled fast reactors and develop the ability to calculate total feedback reactivity in an actual operating reactor.	1,4,7
CO7	Understand the dynamics of neutron slowing down in various regions of neutron energy and the effects of non-homogeneity in fuel and moderator regions on the calculation of k_{eff}.	1,7
CO8	Understand multi-group diffusion theory and its applications.	1,5

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**

- Nuclear fission, chain reactions, elastic scattering, neutron cross sections.
- Neutron moderation (slowing down), neutron energy spectrum for various fissile isotopes, nuclear data.
- Effective multiplication factor (k_{eff}) and reactivity; effect of non-homogeneity in fuel and moderator on multiplication factor.
- Neutron transport equation.
- One-speed neutron diffusion model; point reactor kinetics equations and spatial effects in reactor kinetics. Calculation of core power distribution.
- Extension of point kinetics equations to include radial and axial power shape in an operating light water reactor. This is studied as an application.
- Reactivity feedback effects in light water reactors and sodium fast reactors.
- Multi-group diffusion theory and its applications.

1. **NE 4220 – Nuclear Reactor Dynamics and Control**

2. **Credit hours:** 4
   Contact hours: 4
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Nuclear Reactor Dynamics and Control*, T.W. Kerlin and B.R. Upadhyaya, Elsevier-Academic Press, 2019.

5. **Course information:**

Catalog description	System modeling, time- and frequency-domain responses, state-space methods, and control design. Nuclear reactor kinetics, nodal modeling of core heat transfer, reactor control systems, and nuclear plant transient response are discussed. System simulation and control using PC-based software and toolboxes.
Prerequisites	NE 4210
Co-requisites	None
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Develop the ability to model basic engineering systems using fluid flow, reactor kinetics, and heat transfer principles.	1
CO2	Demonstrate the ability to solve ordinary differential equations using MATLAB/Simulink tools to study system transient response.	1,2
CO3	Understand the Laplace transform method to solve linear differential equations and to represent dynamic systems using transfer functions.	1
CO4	Compute, understand and explain the frequency response characteristics of linear systems.	1
CO5	Understand the principles of process control strategies and develop the ability to design simple proportional-integral-derivative controllers.	1,6
CO6	Model reactor system dynamics of a PWR and its control modules.	1,4
CO7	Acquire the basic skills of simulating reactor system dynamics using MATLAB/Simulink.	1,7
CO8	Develop the ability to gather technical information on control system design and to implement computing tools to demonstrate control systems.	1,5

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**

- Overview and control system terminology.
- Mathematical modeling of system dynamics; linear and nonlinear models.
- Transient analysis using MATLAB-SIMULINK.
- Laplace transform and its applications to linear systems.
- Basic neutron interactions.
- Frequency response analysis.
- Design of feedback controllers.
- Reactor system modeling and control; dynamic response s of PWRs and BWRs.
- Advanced reactors; small modular reactors (SMRs).

1. **NE 4310 – Nuclear System Senior Design Project I**

2. **Credit hours:** 3
   Contact hours: 3
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Engineering Design*, G.E. Dieter and L.C. Schmidt, 6th Edition, McGraw-Hill Book Company, 2021.
   Reference: *Fundamentals of Engineering Design*, B. Hyman, 2nd Edition, Prentice Hall, 2003.

5. **Course information:**

Catalog description	Principles of engineering design with emphasis on contemporary industrial design processes. Economics analysis with underlying principles related to cost of money and break-even analysis. Project proposal writing, preliminary design, supporting analyses and drawings with bill of materials ready to fabricate during the following semester. Preparation of a standard operating procedure (SOP) document as needed.
Prerequisites	NE 3210, NE 4110
Co-requisites	None
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Define, recognize, and distinguish the various activities embodied in a general design methodology and encountered in a real design process.	1,2,6
CO2	Define a project scope and generate concept designs. Communicate with project mentors and nuclear industry experts.	1,2,3,7
CO3	Apply computer-aided design tools to define, analyze and refine systems.	1,2,6,7
CO4	Use of project management tools to meet project timelines and objectives.	5
CO5	Basic finance principles needed for engineering professional.	1,2,4
CO6	The influence of codes and standard practices on the engineering design process.	4
CO7	Professionalism issues such as product liability, patents, teamwork, and engineering ethics related to the practice of nuclear engineering.	4
CO8	Working as a team, on a project, report, or other group assignments.	5
CO9	Preparation and delivery of written and oral presentations.	3

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**
- Introduction to engineering design.
- Problem definition: need and goal statements, objectives, and constraints.
- Communication with mentors and industry experts in developing project concepts.
- Teamwork.
- Develop design specifications for a natural circulation SMR for remote operation.
- Concept development and evaluation of concepts.
- Design and engineering analysis.
- Develop assembly drawings and detailed design, including bill of materials.
- Economics of product development and economic analysis.
- Project management and development of a standard operating procedure (SOP), with a list of tasks for continuation into the following semester.

1. **NE 4320 – Nuclear System Senior Design Project II**

2. **Credit hours:** 3
   Contact hours: 3
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Engineering Design*, G.E. Dieter and L.C. Schmidt, 6th Edition, McGraw-Hill Book Company, 2021.
   Reference: *Fundamentals of Engineering Design*, B. Hyman, 2nd Edition, Prentice Hall, 2003.

5. **Course information:**

Catalog description	Design, development, and demonstration as applied to a nuclear energy system component, instrumentation, device. The use of software platforms, equipment needed to complete the design and demonstration, and other tools (such as 3-D printing) should be part of the design tasks. Consider non-nuclear components of a power plant or an experimental system. Preparation of a project final report and presentation are required.
Prerequisites	NE 4310
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Engage in the various elements of the engineering design process.	2
CO2	Apply design for fabricating and assembly principles.	2,6,7
CO3	Develop a prototype and test the system incorporating measurements, instrumentation, and data processing.	6
CO4	Assess the design project regarding sustainability and globalization.	2
CO5	Assess the design project regarding product liability issues and protection of patents.	2,4
CO6	Apply the essential elements of engineering economics.	4
CO7	Complete a team-based, hands-on, capstone design project.	5
CO8	Engage in technical writing and presentation of design work using written and oral reports.	2,3
CO9	Apply design optimization to iteratively improve initial design concept based on other course instructional outcomes.	2

ABET student outcomes addressed by this course:

SO No.	Description
SO2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	An ability to communicate effectively with a range of audiences.
SO4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
SO7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief List of Topics:**
- Design philosophy, process, standard operating procedure (SOP).
- Project management that includes definition of tasks and milestone charts.
- Designing a non-nuclear component that interfaces with the reactor and directly affects its performance.
- In consultation with industry experts, design, develop, and demonstrate a non-nuclear instrument device.
- Understand legal issues of liability and intellectual property.
- Applications of computer software systems to aid in the design process.
- Develop a radiation detection device that displays detected radiation sources as images superimposed on the surrounding environment, by converting the detected radioactivity signal to a color-enhanced spot on a visual display. This is similar to the ii910 Acoustic Imager by Fluke Corp. (www.fluke.com)
- Design an AI-based system for monitoring a nuclear power plant equipment to improve decision making for maintenance/repair/replacement and thus enhance system reliability.
- Design considerations for a natural circulation, low-power, remotely operable light water reactor. Review the NuScale SMR design.
- Team-based project execution

1. **NE 4410 – Senior Seminar**

2. **Credit hours:** 1
   Contact hours: 1
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** Reference material provided by the instructor. Internet search by students for technical information related to the topic of their semester report.
   References: *IAEA Bulletin*, Vol. 19, No. 6.
   Ethics of Nuclear Energy, Springer, 2022.

5. **Course information:**

Catalog description	This course is designed for seniors in Nuclear Engineering. The course focuses on topics related to nuclear energy systems and radiological engineering with emphasis on ongoing activities in the nuclear industry. Students are expected to develop an understanding of engineering ethics, life-long learning, energy independence and others. Presentations by student teams and guest speakers on various topics.
Prerequisites	Senior standing
Co-requisites	None
Course category	Required course for BSNE

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Identify a topic of interest and develop an in-depth review of the topic; use Internet search and communication with the instructor and team members (2). Prepare a report and present to the class.	1,3,5
CO2	Develop an understanding of nuclear waste and its disposal.	1,3,4,5
CO3	Review the status of advanced reactors and small modular reactors (SMRs), and their future deployment.	1,3,5,7
CO4	Review and develop a case study of the status of licensing and construction of a light water reactor SMR in the United States.	1,3,5,7
CO5	Explain what it means to be a life-long learner and how to achieve it.	1,3,5
CO6	Review the engagement of the French government and Electricite de France (EdF) related to spent fuel reprocessing and deep geological waste disposal, and status of mixed-oxide (MOX) fuel fabrication.	1,3,4,5,7
CO7	Perform research into displaying radiation sources as monitored by radiation detectors in the form of a visual display, similar to an acoustic imager by Fluke Corp.	1,3,5,7
CO8	Collect technical information on fuel enrichment, spent fuel handling, and nuclear nonproliferation (source: IAEA)	1,3,5,7

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**

- Identify a topic of interest and develop an in-depth review of the topic; use Internet search and communication with the instructor and team members (2)
- Nuclear waste and its disposal.
- Status of advanced reactors and small modular reactors (SMRs), and their future deployment.
- A case study of the status of licensing and construction of a light water reactor SMR in the United States.
- Life-long learning and how to achieve it.
- Engagement of the French government and Electricite de France (EdF) related to spent fuel reprocessing and deep geological waste disposal, and status of mixed-oxide (MOX) fuel fabrication.
- Research into displaying radiation sources as monitored by radiation detectors in the form of a visual display, similar to an acoustic imager by Fluke Corp.
- Technical information on fuel enrichment, spent fuel handling, and nuclear nonproliferation (source: IAEA)

1. **NE 4510 – Introduction to Industrial Maintenance Technology**

2. **Credit hours:** 3
   Contact hours: 3
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Introduction to Maintainability Engineering*, B.R. Upadhyaya, 2023.
   Reference: *Maintainability and Maintenance Management*, J.D. Patton, Jr., 4th Edition, ISA, 2005. Additional lecture materials are provided to the students.

5. **Course information:**

Catalog description	Principles of reliability and maintainability engineering, and maintenance management. Topics include information extraction from machinery measurements; vibration monitoring and rotating machinery diagnostics; nondestructive testing; lubrication oil analysis; thermography; plant instrumentation for machinery health monitoring and maintenance on demand; establishing a predictive maintenance program, its evaluation, performance metrics. Presentation by industry experts.
Prerequisites	MATH 3470
Co-requisites	None
Course category	NE Core Elective

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Explain the principles of maintenance planning, management and evaluating maintenance performance through a case study.	1
CO2	Understand the principles of machinery measurements and develop skills in digital processing signals and interpreting results.	1,2,7
CO3	Understand the principles of condition-based maintenance techniques for rotating machinery, such as vibration analysis, electrical signature analysis, lubrication oil analysis (chemical, contamination, and wear particles), thermography, and apply them to the prevention of machinery failure.	1,2,7
CO4	Develop an appreciation for the need for systematic and technologically sound approach for plant maintenance from presentation by industry experts.	1,3,4
CO5	Understand the key technologies used in nondestructive testing, commercial equipment, and their applications.	1,7
CO6	Explain the principles of operation of process sensors and measurement devices used in predictive maintenance (PdM) systems.	1,7

CO7	Develop the ability to gather current technical information on selected reliability and maintainability topics using modern communication tools and electronic information systems, as applied to nuclear power plant systems and equipment.	1,5,7
CO8	Work on a semester project in teams of two, research the selected topic, and prepare a detailed project final report.	1,5,7

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**

- Overview of maintenance and reliability engineering; current issues.
- Maintenance planning, management, and performance metrics.
- Digital signal processing and information extraction from machinery measurements.
- Principles of vibration analysis; instrumentation for vibration measurement. Condition monitoring of rotating machinery using vibration analysis.
- Electrical signature analysis.
- Lubrication oil analysis.
- Trending machinery/process data for condition monitoring and decision making.
- Nondestructive examination (NDE) methods and demonstration of key technologies.
- Monitoring and maintenance of process instruments.
- Selected reliability and maintainability topics as applied to nuclear power plant systems and equipment.
- Semester project in teams of two - research the selected topic and prepare a detailed project final report.
- Current topics – Industry 4.0, IIOT, digital twins, smart factory.

1. **NE 4520 – Advanced Reactors and Small Modular Reactors**

2. **Credit hours:** 3
   Contact hours: 3
   Credit type: Engineering Topics

3. **Course coordinator:** TBD

4. **Textbook:** *Handbook of Small Modular Reactors*, M.D. Carelli and D.T. Ingersoll, Elsevier-Woodhead Publishing, 2015.
   Reference: *Nuclear Reactor Dynamics and Control*, T.W. Kerlin and B.R. Upadhyaya, Appendix B, Elsevier-Academic Press, 2019.

5. **Course information:**

Catalog description	Advantages and disadvantages of advanced reactors, considering cost and construction; advanced reactor marketplace; evolutionary and developmental reactors - light water reactors, pressurized heavy water reactors, gas-cooled reactors, liquid metal reactors, molten salt reactors (MSRs); small modular reactors (SMRs, 20-300 MWe) and micro-reactors (1-20 MWe) for remote deployment; features of SMRs such as small LWRs, GCRs, MSRs; dynamic characteristics of current SMRs under development and construction; IAEA report on small and medium reactors.
Prerequisites	NE 4210
Co-requisites	None
Course category	NE Core Elective

6. **Course instructional outcomes:**

CO No.	Course Outcome	ABET Student Outcomes
CO1	Understand the advantages and disadvantages of advanced reactors.	1,3,7
CO2	Evolutionary (next generation reactors), LWRs, PHWRs, gas-cooled reactors, liquid metal reactors, molten salt reactors (MSRs).	1,2
CO3	Review the development of SMRs (20-300 MWe) and micro-reactors (1-20 MWe) and their distinct characteristics.	1,2,7
CO4	Understand the features of SMRs such as small LWRs, GCRs, MSRs.	1,2,7
CO5	Study the dynamics and control of current SMRs under development, licensing and construction.	1,2,7
CO6	Review the IAEA report on small and medium reactors and need for remote deployment micro-reactors.	1,3,5,7
CO7	Understand the issues related to autonomous control of SMRs and predictive (condition-based) maintenance planning.	1,2,7
CO8	Acquire a good knowledge of the design features, instrumentation, and operation of current SMRs, one for each LWR, GCR & MSR.	1,2,5,7

ABET student learning outcomes addressed by this course:

SO No.	Description
SO1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
SO2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
SO3	an ability to communicate effectively with a range of audience.
SO4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
SO5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO6	an ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
SO7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. **Brief list of Topics:**
   - Advantages and disadvantages of advanced reactors, considering cost and construction.
   - Advanced reactor marketplace.
   - Evolutionary and developmental reactors - light water reactors, pressurized heavy water reactors, gas-cooled reactors, liquid metal reactors, molten salt reactors (MSRs).
   - Small modular reactors (SMRs, 20-300 MWe) and micro-reactors (1-20 MWe) for remote deployment.
   - Features of SMRs including safety, instrumentation, and dynamic characteristics of current SMRs under development and construction, one for each LWR, GCR & MSR.
   - Modeling and control of representative SMRs.
   - Autonomous or semi-autonomous control of small reactor systems.
   - IAEA report on small and medium reactors.

NE 4900: Special Topics in Nuclear Engineering

Credit hours: 1-3
Contact hours: 1-3
Credit type: Can be taken as NE Technical Elective

Special topics of current interest in nuclear engineering that are not covered in existing courses. Because of the impossibility of duplicating the conditions for a special topic, this particular topic may not be repeated for the improvement of a grade.

List of Suggested Technical Electives

Course No.	Course Name	No. Of Credits
ME 4260	Energy Conversion/Conservation	3
ME 4720	Thermal Design	3
ME 4730	Numerical Heat Transfer	3
ME 4930	Noise Control	3
ME 4060	Mechanical Vibrations	3
ME 4380	Intro to Data Acq and Signal Proc	3
ME 4620	Turbomachinery	3
ME 4610	Steam Power Plants	3
Other upper division (3000 and 4000 level) engineering, technology, science or business courses may be used with prior approval of advisor, course instructor and the ME department.		3

ME 4260 - Energy Conversion/Conservation

Prerequisites: ME 3220, ME 3710, or equivalent. An in-depth study of industrial steam, pumping and compressed air systems in terms of how to reduce system energy consumption.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

Mechanical Engineering Department

Prerequisites:
Prereq for ME 4260

General Requirements:
(Course or Test: ME 3220
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: ME 3710
Minimum Grade of D
May not be taken concurrently.)

ME 4720 - Thermal Design

Prerequisites: ME 3220, ME 3710, and ME 3720. Introduction to the design of thermofluid devices and systems; general design methodology, modeling, simulation, and optimization; and heat exchangers and prime movers in systems.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

Mechanical Engineering Department

Prerequisites:
Prereq for ME 4720

General Requirements:
(Course or Test: ME 3220
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: ME 3710
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: ME 3720

Minimum Grade of D
May not be taken concurrently.)

ME 4730 - Numerical Heat Transfer

Prerequisites: ME 3710, ME 3720. Fundamentals of numerical methods; steady and unsteady one-dimensional heat conduction; steady and unsteady multidimensional heat conduction; fully-developed duct flows; one- and two-dimensional convection heat transfer, and flow through porous media.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

Mechanical Engineering Department

Restrictions:
Must be enrolled in one of the following Majors:
- Civil Engineering
- Chemical Engineering
- Computer Engineering
- Electrical Engineering
- Engineering
- Mechanical Engineering

Prerequisites:
Prereq for ME 4730

General Requirements:
(Course or Test: ME 3710
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: ME 3720
Minimum Grade of D
May not be taken concurrently.)

ME 4930 - Noise Control

Prerequisites: MATH 2120 and PHYS 2110. Identification and description of noise sources and noise radiation, methods of noise measurement and criteria for noise levels, principles and techniques of noise control.
0.000 OR 3.000 Credit hours
0.000 OR 2.000 Lecture hours
0.000 OR 2.000 Lab hours

Levels: Undergraduate
Schedule Types: Laboratory, Lecture
All Sections for this Course

Mechanical Engineering Department

Prerequisites:
Prereq for ME 4930

General Requirements:
(Course or Test: MATH 2120
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: PHYS 2110
Minimum Grade of D
May not be taken concurrently.)

ME 4060 - Machine Vibrations

Prerequisite: ME 3050. Linear vibration of machine elements, lumped parameter multidegree of freedom and continuous system solutions; computer-aided solutions of linear and nonlinear systems; and simple laboratory vibration measurement and comparative vibration analysis.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

Mechanical Engineering Department

Prerequisites:
Prereq for ME 4060

General Requirements:
Course or Test: ME 3050
Minimum Grade of D
May not be taken concurrently.

ME 4380 - Intro - Data Acq & Signal Proc

Prerequisite: ME 3023, ME 3050 and ME 3060 or Instructor consent. Lab VIEW programming and data acquisition with commercial hardware digital signal processing basics including sampling, analog-to-digital conversion, quantization, aliasing, and Fourier analysis. Students enrolled in the 5000-level course will be required to complete additional work as stated in the syllabus.
0.000 OR 3.000 Credit hours
0.000 OR 2.000 Lecture hours
0.000 OR 2.000 Lab hours

Levels: Undergraduate
Schedule Types: Laboratory, Lecture
All Sections for this Course

Mechanical Engineering Department

Prerequisites:
Prereq for ME 4380

General Requirements:
(Course or Test: ME 3023
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: ME 3050
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: ME 3060
Minimum Grade of D
May not be taken concurrently.)

ME 4620 - Turbomachinery

Prerequisites: ME 3720. Presents a generalized description and unified theory pertaining to the classification, operation, selection and basic design of rotating turbomachines - pumps, fans, compressors, and turbines.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

Mechanical Engineering Department

Prerequisites:
Prereq for ME 4620

General Requirements:
Course or Test: ME 3720
Minimum Grade of D
May not be taken concurrently.

ME 4610 - Steam Power Plants

Prerequisites: ME 3220, ME 3710, and ME 3720. Energy sources, fuels, firing methods, boilers, turbine characteristics, cooling water and cooling towers, dust collection, new developments in energy generation, plant trip.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

Mechanical Engineering Department

Prerequisites:
Prereq for ME 4610

General Requirements:
(Course or Test: ME 3220
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: ME 3710
Minimum Grade of D
May not be taken concurrently.
and
Course or Test: ME 3720
Minimum Grade of D
May not be taken concurrently.)

VE 4500 - Reliability & Quality Engr

Prerequisite: MATH 3470 or ENGR (CEE) 3720. Basic engineering and statistics principles as well as advanced tools focusing on design of experiment, statistical process control and reliability engineering are presented. Theoretical and practical methods to improve the capability of systems to perform their designated functionalities, to predict the probability of their functioning without failures in certain environments for desired periods, to assess their maintainability, availability and safety based on sampled data, and to make decisions on corrective and mitigation.
3.000 Credit hours
3.000 Lecture hours

Levels: Undergraduate
Schedule Types: Lecture

Mechanical Engineering Department

Prerequisites:
Prereq for VE 4500

General Requirements:
(Course or Test: MATH 3470
Minimum Grade of D
May not be taken concurrently.)
or
(Course or Test: ENGR 3720
Minimum Grade of D
May not be taken concurrently.)
or
(Course or Test: CEE 3720
Minimum Grade of D
May not be taken concurrently.)

Appendix B: Sample Assessment Rubrics

Information about the following Assessment Instruments is included.

- Instructional Outcomes Faculty Assessment
- Instructional Outcomes Student Survey
- Alumni Survey
- Co-op Employer Survey
- External Evaluator Form for Senior Design Projects
- Performance Criteria- Outcome 1

Instructional Outcomes – Faculty Assessment (IOFA)

Mechanical Engineering Department – Tennessee Tech University

A. COURSE INFORMATION

Course No. & Title:	ME 2910 Professionalism and Ethics
Instructor:	
Semester:	

B. INSTRUCTIONAL ASSESSMENT & GRADE DISTRIBUTION

Instructional Assessment	HW	Quizzes	Exams	Projects	Other	Final Exam	Total
Weight (%)							100%

Grade Distribution	A	B	C	D	F
Number of Students:					

C. COURSE INSTRUCTIONAL OUTCOMES to STUDENT OUTCOMES MAPPING

Course Instructional Outcomes	ABET Student Outcomes	Means of Assessment HW = Homework EXAM = Exams QUIZ = Quizzes PROJ = Project LAB = Labs REPT = Reports IOSS = Instructional Outcomes-Student Surveys	Student Performance Level Superior = 4 High = 3 Moderate = 2 Low = 1
1. Recognize and examine ethical situations that affect engineering.	4		
2. Identify and anticipate professional issues as a mechanical engineer.	4		
3. Learn time management skills and how to work as a team member in a global setting.	5		
4. Identify areas of legal concern in engineering including intellectual property rights.	4,7		
5. Examine career options and planning including graduate study.	7		
6. Develop presentation, leadership and other communications skills.	3		
7. Recognize importance of personal developmental including financial planning.	7		

D. OVERALL LEVEL-OF-ATTAINMENT OF ABET STUDENT OUTCOMES (AS APPLICABLE)

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

F. ANALYSIS AND ACTIONS FOR COURSE IMPROVEMENT:

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Instructional Outcomes Student Survey

Default Question Block

ME 2910 - Professionalism and Ethics
ABET Instructional Outcomes - Student Survey (IO-SS)

Please rate each of the following **course outcomes**, based on your perceived **level of ability** in that topic, both at the time of **entering** the course and upon course **completion**.

Outcome 1: Recognize and examine ethical situations that affect engineering.

	Negligible	Low	Moderate	High	Superior
Upon Entering the course, my perceived level of ability with this outcome was:	○	○	○	○	○
Upon Completion of the course, my perceived level of ability with this outcome is:	○	○	○	○	○

Outcome 2: Identify and anticipate professional issues as a mechanical engineer.

	Negligible	Low	Moderate	High	Superior
Upon Entering the course, my perceived level of ability with this outcome was:	○	○	○	○	○
Upon Completion of the course, my perceived level of ability with this outcome is:	○	○	○	○	○

Outcome 3: Learn time management skills and how to work as a team member in a global setting.

	Negligible	Low	Moderate	High	Superior
Upon Entering the course, my perceived level of ability with this outcome was:	○	○	○	○	○
Upon Completion of the course, my perceived level of ability with this outcome is:	○	○	○	○	○

Outcome 4: Identify areas of legal concern in engineering including intellectual property rights.

	Negligible	Low	Moderate	High	Superior
Upon Entering the course, my perceived level of ability with this outcome was:	○	○	○	○	○
Upon Completion of the course, my perceived level of ability with this outcome is:	○	○	○	○	○

Outcome 5: Examine career options and planning including graduate study.

	Negligible	Low	Moderate	High	Superior
Upon Entering the course, my perceived level of ability with this outcome was:	○	○	○	○	○
Upon Completion of the course, my perceived level of ability with this outcome is:	○	○	○	○	○

Outcome 6: Develop presentation, leadership and other communications skills.

	Negligible	Low	Moderate	High	Superior
Upon Entering the course, my perceived level of ability with this outcome was:	○	○	○	○	○
Upon Completion of the course, my perceived level of ability with this outcome is:	○	○	○	○	○

Outcome 7: Recognize importance of personal developmental including financial planning.

	Negligible	Low	Moderate	High	Superior
Upon Entering the course, my perceived level of ability with this outcome was:	○	○	○	○	○
Upon Completion of the course, my perceived level of ability with this outcome is:	○	○	○	○	○

Alumni Survey Questions:

Date graduated from Tennessee Tech?

Q1 I'm comfortable making oral presentations.
Q2 I participate, at some level, in organizations that serve the profession and/or public.
Q3 I'm confident in my work and potential for professional growth and development.
Q4 I'm engaged in activities that demonstrate a commitment to personal and professional growth.
Q5 I have achieved an appropriate level of career advancement.

II.
Q1 Ability to apply knowledge of mathematics, science, and engineering.
Q2 Ability to design and conduct experiments, as well as to analyze and interpret data.
Q3 Ability to design a system, component, or process to meet desired needs within realist constraints such as economic, environmental, social, political, ethical, health and safe manufacturing, and sustainability.
Q4 Ability to function on multidisciplinary teams.
Q5 Ability to identify, formulate, and solve engineering problems.
Q6 Understanding of professional and ethical responsibility.
Q7 Ability to communicate effectively.
Q8 Possess a broad education necessary to understand the impact of engineering solution a global, economic, environmental, and societal context.
Q9 Recognize the need for and an ability to engage in life-long learning.
Q10 Have a knowledge of contemporary issues.
Q11 Have the ability to use the techniques, skills and modern engineering tools necessary engineering practice.
Q12 Have the ability to transition from engineering concepts and theory to real engineerin applications.

III. Comments:
Q1 Strengths:
Q2 Weaknesses:
Q3 Suggested Improvements:
Q4 Comments:

Scoring Scale 4/4: Strongly Agree (Superior)
Scoring Scale 3/4: Agree (High)
Scoring Scale 2/4: Neutral (Moderate)
Scoring Scale 1/4: Disagree (Low)
Scoring Scale 0/4: Strongly Disagree (Negligible)

Tennessee TECH

Center for Career Development
Box 5021 • Cookeville, TN 38505
Phone (931) 372-3296 • Fax (931) 372-6154
http://www.tntech.edu/career • career@tntech.edu

Employer's Evaluation of Co-op Student (Engineering)

Student ____________________ Work Period ____________________

Employer ____________________ Date ____________________

Instructions: The immediate supervisor will evaluate the student objectively, comparing him/her with other students of comparable academic level, with other personnel assigned the same or similarly classified jobs, or with individual standards.

ATTITUDE	ABILITY TO LEARN	DEPENDABILITY
☐ Outstanding in enthusiasm	☐ Learned work exceptionally well	☐ Completely dependable
☐ Very interested and industrious	☐ Learned work readily	☐ Above average in dependability
☐ Average in diligence and interest	☐ Average in understanding work	☐ Usually dependable
☐ Somewhat indifferent	☐ Rather slow in learning	☐ Sometimes neglectful or careless
☐ Definitely not interested	☐ Very slow to learn	☐ Unreliable
INITIATIVE	**QUALITY OF WORK**	**RELATIONS WITH OTHERS**
☐ Proceeds well on his/her own	☐ Excellent	☐ Exceptionally well accepted
☐ Goes ahead independently at times	☐ Very Good	☐ Works well with others
☐ Does all assigned work	☐ Average	☐ Gets along satisfactorily
☐ Hesitates	☐ Below Average	☐ Has difficulty working with others
☐ Must be pushed frequently	☐ Very Poor	☐ Works very poorly with others
MATURITY—POISE	**QUANTITY OF WORK**	**JUDGMENT**
☐ Quite poised and confident	☐ Unusually high output	☐ Exceptionally mature in judgment
☐ Has good self-assurance	☐ More than average	☐ Above average decision-making
☐ Average maturity and pose	☐ Normal amount	☐ Usually makes the right decision
☐ Seldom asserts himself/herself	☐ Below Average	☐ Often uses poor judgment
☐ Timid ☐ Brash	☐ Low output, slow	☐ Consistently uses bad judgment

ATTENDANCE ☐ Regular ☐ Irregular **PUNCTUALITY** ☐ Regular ☐ Irregular

OVERALL PERFORMANCE	Outstanding	Very Good	Average	Marginal	Unsatisfactory	This report has been discussed with the student	
	☐	☐	☐	☐	☐	☐ Yes	☐ No

What traits may help/hinder the student's advancement?

Additional remarks:

Student Signature ____________________ Supervisor Signature ____________________

External Evaluator Form

Wednesday, November 27, 2019 10:25 AM

Project Name	

Rating Scale: 5 = Superior 4 = High 3 = Moderate 2= Low 1 = Negligible N/A = non-applicable / not able to judge

A. Group Project		Rating	Comme
1	The design met realistic constraints (check all that apply): ___ Economic / cost analysis ___ Environmental ___ Social / political / ethical ___ Health / safety ___ Manufacturability / sustainability	5 4 3 2 1	
2	The design involved multidisciplinary knowledge and teamwork among group members (check all that apply): ___ Mechanical systems ___ Energy systems ___ Controls / vibrations ___ Manufacturing ___ Electronics / electrical engr. ___ Mechatronics ___ Chemistry / chemical engr. ___ Materials / mater. engr. ___ Structures / environmental / civil engr. ___ Other:	5 4 3 2 1	
3	The project involved the use of techniques, skills and tools of modern engineering practice (check all that apply): ___ CAD / CAM ___ Design for X ___ Finite Element Analysis ___ Computational Fluids ___ 3-D Printing / Other advanced fabrication technique ___ Other:	5 4 3 2 1	
4	The project group showed the ability to transition from engineering concepts and theory to real engineering applications	5 4 3 2 1	
5	Use of codes and/or standards (if applicable)	5 4 3 2 1	

B. Oral Presentation		Rating	Comme
1	**Professional Presentation** (check all that apply): ___ Appropriate attire ___ Projected confidence ___ Spoke loudly and clearly	5 4 3 2 1	
2	**Quality of Slides / Visual Aids** (check all that apply): ___ Easily visible ___ Slides not too busy ___ Information on the slides was understandable	5 4 3 2 1	
3	**Quality of Overall Presentation** (check all that apply): ___ Kept within time limits ___ Handled questions well ___ Effectiveness of Presentation	5 4 3 2 1	

>

Performance Criteria (PC) and Rubric for Outcome Assessment

Performance criteria used in the ME Department for Student Outcome Assessment will be used for the Nuclear Engineering. A sample rubric for Outcome 1 using the PC is shown. Similar rubrics are available for other outcomes.

SO1 - The ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Performance Indicators
PI1: Restate complex problems into subparts with proper assumptions
PI2: Identify and apply appropriate methods
PI3: Analyze data resulting from the methods
PI4: Produce a viable approach/deliverable

PIs	4 (Exemplary)	3	2	1 (Poor)
1	● Identify all influential knowns, including those directly provided in the problem statement and those requiring one to interpret a figure, table, or any other object[1] ● Break the problem into smaller parallel or consecutive components[2] ● Make reasonable assumptions to simplify the problem and understand how the assumptions affect the findings[3] ● Identify all major constraints[4]	● Identify the influential knowns directly provided in the problem's description and partially interpret the figures, tables, and other available information ● Breaking the problem into major components but missing some minor ones (see footnote 1) ● Make some of the major assumptions while understanding their impact or making all the required assumptions without understanding their impact ● Recognize most of the major constraints	● Identifying only those influential knowns that are provided directly but being incapable of interpreting the hidden information ● Missing some of the major and minor components but understanding the need to break down the problem ● Make some of the necessary assumptions without understanding their impact ● Recognize some of the major constraints	● Uncapable of extracting the knowns ● A failed, confused attempt to solve a complex problem as a whole without recognizing a need for restating the problem into subparts ● Not recognizing the need or lacking the knowledge to make the required assumptions ● Failing to identify all major constraints
2	● Identify and apply appropriate equations ● Simplify the equations by using the identified assumptions and constraints ● Employ and implement proper techniques to solve the equations ● Apply appropriate unit conversions ● Apply appropriate mathematics, including basic algebra[5]	● Identify and apply most of the appropriate equations ● Partial simplification of the equations by applying *most* of the identified assumptions and constraints ● Making some minor[6] mistakes throughout the implementation of the employed technique ● Correct unit conversions all along except the final conversion ● Apply appropriate mathematics	● Identify and apply some of the appropriate equations ● Partial simplification of the equations by applying *some* of the identified assumptions and constraints ● Making some major mistakes throughout the solution[7] ● Some incorrect unit conversions ● Making minor math mistakes	● Struggle to identify the appropriate equations ● Failing to simplify the equations by applying the identified assumptions and constraints ● Adapting the wrong technique to solve the equations ● Wrong unit conversions ● Making major mistakes in applying the mathematics
3	● Perform data analysis by employing an appropriate technique, such as qualitative techniques, statistical methods, or predictive analysis ● Identify and apply appropriate methods to visualize[8] and interpret the results ● Validate and verify the solution	● Data analysis is mostly correct ● Data visualization and interpretation is mostly correct ● Most of the required validation/verification elements exist	● Data analysis is mostly wrong ● Data visualization and interpretation is mostly wrong ● Most of the required validation/verification elements are missing	● No or completely wrong data analysis ● Results are not visualized and interpreted correctly ● No appropriate validation and verification
4	Produce a final deliverable that meets all the predefined criteria[9]	Produce a final deliverable that meets most of the predefined criteria	Produce a final deliverable that meets some of the predefined criteria	Failed to produce the expected deliverable

Appendix C-1: List of Equipment to be purchased for the Nuclear Engineering Program

NE Related Equipment List
• Light Meter • Ultrasonic Liquid Flowmeter • Temperature Readout and Sensors (10-12) • Pressure, Temperature and Electrical C.T. • Infrared Thermometer • Power Quality Analyzer • Infrared Imaging Camera • Computer Combustion Analyzer • Misc. Supplies (Safety items, tools, etc.) • Ultrasonic/Compressed air leak detector • Water Electrical Conductivity Meter • Air Velocity Meter • Pressure Gauges (6) • Air Pressure Gauges & loggers • Recording Pressure Transducers (6) • HOBO Indoor data loggers/accessories (20) • Miscellaneous Measurement Tools • Vibration Meter • Digital Micro Manometer and Pitot Tube • Two Way Radios (6) Accessories • Clamp-on Ammeter/Multimeter (2) • Ultrasonic Liquid Flowmeter HD Hysteresis Dynamometer • Thermal Imager • Basic Hydraulics Bench • Steam Turbine Power System • Dual variable-speed air compression/storage system • Pipe flow friction apparatus • Series and parallel pumping apparatus • Wind tunnel • Plasma table • CoE Shop and Project Truck-ME Share • Ed. Experiments in Laser Optics Kit • Laser Vibrometer

Appendix C-2: List of Existing Related Equipment available for the Nuclear Engineering Program

PROVIDER	DESCRIPTION	Projected Cost
Makerbot	Replicator 2X Experimental 3D Printer	$2,845
Labworks	Electrodynamic Shaker System	$13,995
Bruel & Kjaer	4 Ch. Input/2 Ch. Output Lan-X1	$9,315
PolyTec	Laser Vibrometer	$43,240
Bruel & Kjaer	B & K Controller & DAQ Card	$10,500
Adept Mobile Robots	Pioneer 3 AT Robot w/LMS500 Mapping	$9,461
The Modal Shop	Modal Analysis equipment	$7,886
Omega	(2) Flow Meters	$3,390
Bruel & Kjaer	LDS Laser USB Shaker Control System	$4,721
Nat'l Instruments	CDAQ Analog System	$5,092
Biologic USA	SP150 Chassis/Potentiostat	$9,099
PCB Piezotronics	Sound Level meter equipment	$4,869
Sick, Inc.	Laser Measurement Scanner	$8,499
Telar Corp	Temptek 5-Ton Portable Chiller	$8,742
Cole Parmer	High range tuning fork vibration viscometer	$3,682
Fisher Scientific	Water Distillation System	$2,196
Adept Mobile Robots	Pioneer 3 DX Robot	$8,710
Bruel & Kjaer	PHOTON 2 Ch. System	$9,247
Adebt Mobile Robots	Pioneer LX robot	$34,140
Pine Research	Speed Rotator	$5,370
Ametek	Advanced DC Votammetry system	$7,695

PROVIDER	DESCRIPTION	Projected Cost
The Modal Shop	Miniature shaker with integrated amp	$3,424
Schneider	Cooling Tower Monitoring Package	$9,047
ABET Technologies	Sunlite Solar Simulator	$6,864
Markforge 3D	3D Printer	$5,665
Decagon Devices	Custom Thermal Properties Analyzer	$4,050
OptiTrack	Motion Capture System	$24,849
FLIR	FLIR T640 Infrared Camera	$22,894
Testo	T350 Portable Combustion Analyzer	$14,243
FLUXUS	Portable Ultrasonic liquid flow meter	$12,967
PA Hilton	Linear Heat Transfer	$3,992
Toyota	Forklift	$24,973
Nat'l Instruments	PXI System	$17,795
Hewlet Packard	Impedance/Gain Phase Analyzer	$8,213
Tormach	CNC Machine	$10,683
Super Flow	Engine Dynamometer System	$42,185
StellarNet	Portable Spectrometer	$4,887
A & D Engineering	Viscometer	$3,100
IAC Acoustics	Sound Seal Ventilation System	$9,985
Amazon	Ultimaker 3 3D Printer	$3,495
dSpace	Stand-Alone Prototype Control System	$38,927
Dynamism	Zmorph-VX/Advanced 3D printer	$3,500
MCT	High Speed Motion Capture camera	$4,999
dSpace	Rapidpro stack system	$23,147

PROVIDER	DESCRIPTION	Projected Cost
TSI Inc.	Thermalpro Probe	$9,975
ATI Industrial Automation	Mini85 Transducer	$7,724.00
ECM	NH3CAN Kit	$3,028
Tormach	PCNC 440 Deluxe	$10,715
CDW-G	6 Dremel 3D printers and filter	$17,235
Ultimate 3D Printing	2 Raise3D Printers	$7,998
Maker Shed	A2200 Multimaterials 3d Printer	$3,009
Formech	Vac Former with Line Bender	$3,441
Ultimate 3D Printing	Ultimaker S5 3D Printers	$11,990
AutonomouStuff	Autonomous vehicle sensor/computer package	$37,180
Neptech	Gas Sampling System	$9,703
Zurich Instruments	Impedance Analyzer	$11,090
Mechatronics Lab Remodel	Lab Training Stations	$9,000
	Electronic Work Stations	$3,900
	Cobot Station + Computer	$17,000
	Advanced Simulation Station	$19,000
	Advanced Robot Manufacturing	$10,000
	Display Screens	$2,700
	Total	$711,266

DR. STEVEN GENTILE
EXECUTIVE DIRECTOR

THEC TSAC

BILL LEE
GOVERNOR

STATE OF TENNESSEE
HIGHER EDUCATION COMMISSION
STUDENT ASSISTANCE CORPORATION
312 ROSA L. PARKS AVENUE, 9TH FLOOR
NASHVILLE, TENNESSEE 37243
(615) 741-3605

Memorandum

TO: Dr. Lori Bruce, Provost and Vice President for Academic Affairs
Tennessee Technological University

FROM: Dr. Julie A. Roberts, Chief Academic Officer
Tennessee Higher Education Commission

Digitally signed by Julie A. Roberts
Date: 2024.01.19 13:39:13 -06'00'

SUBJECT: Tennessee Technological University
Nuclear Engineering, Bachelor of Science (BSNE)

DATE: January 19, 2024

Pursuant to Tennessee Higher Education Commission (THEC) Academic Policy A1.6 – Expedited Academic Programs: Approval Process, THEC staff will support the proposed Nuclear Engineering, Bachelor of Science (BSNE) degree at Tennessee Technological University (TTU). This proposed program has satisfied all requirements of the Expedited Academic Program Process including external review and satisfactory response to all recommendations and suggestions by the external reviewer, Dr. Farzad Rahnema from Georgia Institute of Technology.

Tennessee Tech University may now submit a formal request to place the Nuclear Engineering, BSNE on the Commission's agenda for consideration of approval. Please note, the request must also include the date of TTU's board approval for the proposed program.

cc: Dr. Philip Oldham, TTU, President
Dr. Steven Gentile, THEC, Executive Director
Dr. Sharon Huo, TTU, Associate Provost
Dr. Joseph C. Slater, TTU, Dean College of Engineering
Ms. Anjelica Jones, THEC, Director of Academic Affairs

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Compensation Study Results

☐ **Review** ☒ **Action** ☐ **No action required**

PRESENTERS: LaCinda Glover & Matthew Mullen, Mercer

PURPOSE & KEY POINTS: Recommend Approval

Ms. Glover and Mr. Mullen will present the results of the market salary study conducted by Mercer over the past year. This study was undertaken by the University in partnership with Mercer with the objective of developing a contemporary classification and compensation program that will allow Tennessee Tech to attract, recruit, develop, and retain the best talent to support the institution's growth and success.

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Compensation Plan

☐ **Review** ☒ **Action** ☐ **No action required**

PRESENTERS: Claire Stinson, Vice President for Planning & Finance

PURPOSE & KEY POINTS: Recommend Approval

President Oldham is recommending a multiple step approach to address salary adjustments based on the recent market salary study performed by Mercer. The first step will be funded from monies retained at the being of this fiscal year to address the results of the study. This adjustment to salaries is proposed to be retroactive to January 2024.

As a second step, President Oldham is recommending a 3% salary pool for FY2024-25. This recommendation is subject to approval of the Governor's budget which includes funding for 55% of the cost of the recommended 3% increase. The university would provide the additional 45% of cost. The adjustment to salaries would be effective July 1, 2024 for staff and August 2024 for faculty (beginning of their new academic year contract).

One or more future year adjustments will be necessary to move salaries to the median goal for overall University salaries.

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Non-Mandatory Fees

☐ **Review** ☒ **Action** ☐ **No action required**

PRESENTERS: Dr. Claire Stinson, Vice President for Planning & Finance

PURPOSE & KEY POINTS:

Ready-to-Teach: College of Education proposes a fee restructure. As a part of the University's annual review of fees it was recommended the Ready-to-Teach SAF be increased. Currently the fee is $165 per semester. The new fee, if approved, would be $250 per semester. This fee impacts students in the College of Education's teacher preparation program.

Housing: In order to keep pace with increasing personnel, maintenance and facilities costs, the University proposes to increase housing fees beginning fall 2024. The proposed 3% increase across the board for all residential units will provide funds necessary to offset rising operating costs.

Tennessee Tech University

Non-Mandatory Fee Proposal 2024-2025

TENNESSEE TECH UNIVERSITY
PROPOSED FEE CHANGES
2024-25

Description	Rates: Current 2023-24	Rates: Proposed 2024-25	Rates: Increase $/sem	Rates: Increase %	Annual Revenue Impact of Fee Change	Prior Fee Increase	Objectives and Considerations
Special Academic Fee (SAF)							
Education R2T SAF	UG - $14/hour, $165/max	UG - $21/hour, $250/max	$85/sem	52%	$ 126,553	2021-2022 Initial	*Offset rising operating costs without creating significant financial burden for students.
(Licensure Majors)	GR - $17/hour, $165/max	GR - $25/hour, $250/max	$85/sem	52%			
HOUSING:							
Residence Halls:							
Traditional Double/Triple	$3,084/sem	$3,177/sem	$93/sem	3%	$ 388,774	2023-24 $60/2%	*Offset rising operating costs without creating significant financial burden for residents.
Traditional Double/Triple - Summer Session*	$883/sem	$909/sem	$26/sem	3%		2023-24 $17/2%	
(Browning/Evins, Cooper/Dunn, Ellington/Warf, Ms Cooper/Pinkerton, Jobe/Murphy)							
Traditional Single	$3,280/sem	$3,378/sem	$98/sem	3%		2023-24 $156/5%	
Traditional Single - Summer Session*	$953/sem	$982/sem	$29/sem	3%		2023-24 $45/5%	
(Browning/Evins, Cooper/Dunn, Ellington/Warf, Ms Cooper/Pinkerton, Jobe/Murphy)							
Traditional Double as Single - Summer Session*	$1,076/sem	$1,108/sem	$32/sem	3%		2023-24 $21/2%	
(Browning/Evins, Cooper/Dunn, Ellington/Warf, Ms Cooper/Pinkerton, Jobe/Murphy)							
Murphy Super Single *(Murphy Super Single Rooms Only)*	$3,667/sem	$3,777/sem	$110/sem	3%		2023-24 $175/5%	
Crawford Double/Triple *(Crawford)*	$2,632/sem	$2,711/sem	$79/sem	3%		2023-24 $52/2%	
Crawford Single *(Crawford)*	$2,788/sem	$2,872/sem	$84/sem	3%		2023-24 $133/5%	
Engineering Village Double/Triple *(Maddux/McCord)*	$3,184/sem	$3,277/sem	$93/sem	3%		2023-24 $60/2%	
Engineering Village Single *(Maddux/McCord)*	$3,380/sem	$3,478/sem	$98/sem	3%		2023-24 $156/5%	
New Halls Double *(New Hall North/New Hall South)*	$4,070/sem	$4,192/sem	$122/sem	3%		2019-2020 $80/2%	
New Halls Single *(New Hall North/New Hall South)*	$4,520/sem	$4,656/sem	$136/sem	3%		2019-2020 $90/2%	

TENNESSEE TECH UNIVERSITY
PROPOSED FEE CHANGES
2024-25

Description	Rates				Annual Revenue Impact of Fee Change	Prior Fee Increase	Objectives and Considerations
	Current 2023-24	Proposed 2024-25	Increase $/sem	%			
Tech Village Apartments:							
One Bedroom (Small 528 sq ft) Single**	**$4,550/sem**	**$4,687/sem**	**$137/sem**	**3%**	**$ 64,371**	2023-24 $500/12%	*Offset rising operating costs without creating significant financial burden for residents.
Summer Semester**	**$1,820/sem**	**$1,875/sem**	**$55/sem**	**3%**		2023-24 $200/12%	
One Bedroom (Large 543 sq ft) Single **	**$4,700/sem**	**$4,841/sem**	**$141/sem**	**3%**		2023-24 $500/12%	
Summer Semester**	**$1,880/sem**	**$1,936/sem**	**$56/sem**	**3%**		2023-24 $200/12%	
Two Bedroom (Small 572 sq ft) Single**	**$5,070/sem**	**$5,222/sem**	**$152/sem**	**3%**		2023-24 $500/11%	
Summer Semester**	**$2,028/sem**	**$2,089/sem**	**$61/sem**	**3%**		2023-24 $200/11%	
Two Bedroom (Large 660 sq ft) Single**	**$5,365/sem**	**$5,526/sem**	**$161/sem**	**3%**		2023-24 $500/10%	
Summer Semester**	**$2,146/sem**	**$2,210/sem**	**$64/sem**	**3%**		2023-24 $200/10%	
Two Bedroom (4 Person Suite 1100 sq ft) Single***	**$6,260/sem**	**$6,448/sem**	**$188/sem**	**3%**		2023-24 $500/9%	
Summer Semester***	**$2,504/sem**	**$2,579/sem**	**$75/sem**	**3%**		2023-24 $200/9%	

Notes:

** Resident hall full summer rates are equal to summer semester rates x 2.*

*** Tech Village Apartments single rate:*

divided by 2 gives the double rate.

**** Tech Village Apartments single rate:*

divided by 2 gives the double rate.

divided by 3 gives the triple rate.

divided by 4 gives the quad rate.

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Disclosed Project Modification

☐ **Review** ☒ **Action** ☐ **No action required**

PRESENTERS: Claire Stinson, Vice President for Planning & Finance

PURPOSE & KEY POINTS:

This project (Agricultural Technology Innovation Center) was approved at the March 10, 2022, Board of Trustees meeting. It was approved with a project cost of $1,000,000 (gifts and plant funds) to renovate the existing loafing barn at Shipley Farm to enhance agriculture engineering & technology academic program.

The designer determined the renovation cost would be significantly more than the budget and it would be more economical to build a new building. The revised project cost is $1,195,000 (gift and plant funds). The original project and the revision have been approved by the State Building Commission.

Agenda Item Summary

Date: March 7, 2024

Agenda Item: Naming Opportunity

☐ **Review** ☒ **Action** ☐ **No action required**

PRESENTER(S): Phil Oldham, President

PURPOSE & KEY POINTS: Naming of the Randall and Marjorie Warden Agriculture Engineering Technology Laboratory.

The Wardens have donated funds to support the construction of the Agriculture Engineering Technology Laboratory. The President established a university committee to review and recommend naming of this facility in accordance with TTU Policy 537 (Naming Buildings, Facilities and Organizational Units). The committee recommended naming the facility the Randall and Marjorie Warden Agriculture Engineering Technology Laboratory.

Office of the President

TENNESSEE TECH

MEMORANDUM

To: **Board of Trustees**

From: **Dr. Philip Oldham, President**

Date: **January 11, 2024**

Subject: **Request Approval to Name Agriculture Engineering Technology Laboratory**

Upon receiving a request to consider naming the new agriculture engineering laboratory at Shipley Farm the "Randall and Marjorie Warden Agriculture Engineering Technology Laboratory," a committee was selected to consider and make a recommendation.

I am in support of the attached committee recommendation to name the new agriculture engineering technology laboratory the "Randall and Marjorie Warden Agriculture Engineering Technology Laboratory" at Tennessee Tech University. I respectfully request the Board of Trustees' consideration and approval.

Tennessee Tech / Campus Box 5007 / Cookeville, TN 38505 / P. 931-372-3241 / F. 931-372-6332 / **tntech.edu/president**

UNIVERSITY ADVANCEMENT

MEMORANDUM

January 2, 2024

To: Dr. Kevin Braswell – Vice President, University Advancement KAB

Dr. Philip Oldham – President PBO

From: Elizabeth Williams – Executive Director, University Advancement EW

Subject: Naming of the Agriculture Engineering Technology Laboratory

This memo is to respectfully request approval of naming of the new Agriculture Engineering Technology Laboratory at Shipley Farm as the "Randall and Marjorie Warden Agriculture Engineering Technology Laboratory" in recognition of the Warden's significant gift in February 2022.

A committee consisting of Dr. Kevin Braswell, VP of University Advancement, John Smith, AVP for University Development, and Dr. Darron Smith, Dean of the College of Agriculture and Human Ecology, met and determined the Warden's gift was sufficient to name the building.

Randall Warden is a 1976 graduate of the University. Randall chose the Agricultural Science major because it allowed him to explore multiple disciplines in agriculture (crops and soil, ag engineering technology, animal science, economics) as well as genetics and computer programming classes. He was a work-study student for over two years for the former ag engineering technology laboratory, and helped prepare for classes and activities. This experience was an important aspect of his time at the University.

Randall continued his education at Virginia Tech, earning a Master's degree in Soil Chemistry. Most of his professional career has been in the agricultural soil testing industry. He owned A&L Great Lakes Laboratories for 20 years. It was one of the largest soil testing companies in the United States.

The Warden's commitment to support the construction and/or maintenance of the new Agriculture Engineering Technology Lab is outlined in a Foundation gift agreement dated December 13, 2021.

This request is being submitted in accordance with University Policy No. 537, necessitating approval from the President and Board of Trustees, as per the established guidelines for University naming opportunities.