



Missouri University of Science and Technology

Graduate Certificate Program in Standards and Safety in Electrical and Computer Engineering

Pourya Shamsi

09/12/2025



Greetings

These slides cover

- ▶ Introduction
- ▶ Goals and Objectives
- ▶ Course Development
- ▶ Delivery
- ▶ Lessons Learned
- ▶ Next Steps

Introduction – Title and Institutions

Graduate Certificate Program in Standards and Safety in Electrical and Computer Engineering

Award Number: 70NANB23H237

- Lead Organization:
 - Missouri University of Science and Technology
 - 202 Centennial Hall, 300 W. 12th St., Rolla, MO
 - 65409-1330
 - Phone: (573) 341-4134
 - Email: research@mst.edu
- Subcontract Organization:
 - ELTEK International Laboratories
 - 248 Hughes Ln, St Charles, MO 63301
 - Phone: (636) 949-5835
 - Email: Ed.Vanvooren@ELTEKlabs.com



Introduction – Team Members

- Lead Organization:

Principal Investigator:

- **Pourya Shamsi**, PhD, Woodard Associate Professor of Excellence in Electrical and Computer Engineering,
▪ shamsip@umsystem.edu

Co-Investigators:

- **Mehdi Ferdowsi**, PhD, Associate Dean of Research and Schlumberger Professor of Electrical and Computer Engineering,
▪ ferdowsi@umsystem.edu
- **Jonathan Kimball**, PhD, Department Chair and Fred W. Finley Distinguished Professor in Electrical and Computer Engineering,
▪ kimballjw@umsystem.edu

Subcontract Organization:

Lead Investigator:

- **Ed Van Vooren**, President and CEO of ELTEK International Laboratories,
▪ Ed.Vanvooren@ELTEKlabs.com

Co-Investigators:

- **Jeniffer Palmer**, Vice President of ELTEK international laboratories,
▪ Jennifer.Palmer@ELTEKlabs.com

Introduction – Period of Performance

- Period of performance: 3 years
- Award date: Sep. 2023
- Project start date: Jan. 2024
 - (delays due to federal registrations of the subcontractor)
- Status: We are nearing the end of our 2nd year (Dec. 2025)
- Change of scope:
 - In March 2024, the subcontractor decided that they cannot cover the costs of industrial workshops. We had a meeting with the program officer at the time, Dr. Raj Madhavan, and he emphasized that the priority is with academic education. So, we did not transfer additional funds for the workshops and instead, redirected the scope to create more course modules.

Introduction – Big Picture and Workforce Development

- The anticipated short-term impact of this program is the development of a framework to increase the prevalence of standards and standardization education at U.S. accredited institutions of higher education.
- The long-term impact of this program is training the next generation of engineers who are aware of how standards are developed and maintained, different standardization agencies, testing methods, and how to properly choose and apply standards in their respective fields of engineering.
- This program will significantly strengthen U.S. workforce development by equipping graduate and undergraduate students, as well as industry professionals, with practical knowledge of standards, testing, and certification processes—ensuring a pipeline of highly qualified engineers who can enhance product quality, safety, and compliance across critical industries.

Goals and Objectives – Proposal Goals (slide 1 of 2)

- The main objective of this project is to develop curricula and educational material for training graduate and undergraduate-level students to understand standards, standard development, and standardization processes in engineering and sciences.
- This program will explore rules and guidelines in developing standards, testing, certification processes, and common standards used in engineering and particularly in electrical and computer engineering including IEC, UL, ISO, VDE, ITU, CSA, IPC, SAE, ... as well as MIL-STD

Goals and Objectives – Proposal Goals (slide 2 of 2)

- Develop two new courses:
 - EE5571: Introduction to Standards and Standardization (general engineering focus).
 - EE5572: Common Standards and Testing Practices in Electrical and Computer Engineering.
- Establish a graduate certificate program at Missouri S&T in standards and standardization, available both in-person and online (synchronous and asynchronous).
- Create portable training packages including curricula, lecture recordings, assignments, and instructor materials to be shared with NIST and other U.S. universities.
- Publish and disseminate outcomes through conference presentations, journal papers, newsletters, and Missouri S&T's Scholarsmine server.
- Develop instructor training material to support adoption of the program by other institutions.
- Build long-term sustainability by creating a framework that can be replicated at other universities and industry training centers across the U.S

Goals and Objectives – Outcomes

- **Graduate Certificate Program**
 - A fully developed certificate in standards and standardization at Missouri S&T.
 - Two new core courses (EE5571 and EE5572) integrated into the program.
- **Course Delivery Options**
 - Offered in both synchronous (regular semester) and asynchronous (accelerated distance learning) formats, allowing completion in as little as 3–5 weeks.
- **Replicable Model**
 - A certificate “package” (curricula, course modules, recordings, training materials, and instructor guides) designed for easy deployment at other U.S. institutions.
- **Dissemination and Publication**
 - Conference presentations at Missouri S&T Teaching and Learning Conference (a long-standing regional conference on education and educational technologies)
 - Papers on course development methods, program impact, and outcomes.
 - Public access to materials via Missouri S&T’s Scholarsmine server.
- **Evaluation Results**
 - Data on trainee learning outcomes, feedback, and workforce impact to measure program effectiveness and guide improvements.

Goals and Objectives – Alignment with National Priorities

- This project aligns tightly with U.S. national and NIST priorities by creating a standards-literate engineering workforce through stackable academic credentials and openly packaged for replication across universities and industry.
- It directly supports NIST’s mission to “**advance measurement science, standards, and technology**” and FY-25 priorities to drive standards for critical and emerging technologies while strengthening U.S. manufacturing and supply chains;
- It also advances the U.S. Government’s National Standards Strategy for Critical and Emerging Technology, which explicitly calls for educating and training a new standards workforce and expanding standards-related curricula in higher education;
- And it complements the National Strategy for Advanced Manufacturing’s goal to grow and diversify the advanced-manufacturing talent pool.
- By training students and incumbent engineers in standards selection, testing, and certification—and disseminating asynchronous, portable courseware nationwide—the program enhances product quality, safety, and compliance, with particular benefits for small and medium manufacturers.

Course Development – Proposed Course 1: EE5571

- **EE5571:** Introduction to Standards and Standardization, aims to teach students the processes of developing, coordinating, and maintaining standards, including forming working groups, drafting and revising standards, exploring metrics and measurement challenges, and understanding testing and compliance requirements.
- **Reference Book:** *Primer on Engineering Standards*, O. Greulich, M. Jawad, 9781119466178
- **Modules:** Introduction, Role of Standards, Voluntary Consensus Standards, Limited Consensus Standards, Jurisdictional Standards, Standard Development Processes, Types and Conformity, Standard Interpretation, Good Standards and How to Get Involved

Course Development – Proposed Course 2: EE5572

- **EE5572:** Common Standards and Testing Practices in Electrical and Computer Engineering, is designed to introduce students to major ECE-specific standards (e.g., UL, IEC, ISO, SAE, MIL-SPEC), with emphasis on safety integrity levels, testing methods, and practical requirements for compliance in electrical and computer engineering applications
- **Reference:** We will be using standard documents as the reference. However, references are not shared nor are mandatory (due to license and cost)
- **Modules:** Modules will include individual standards that we are covering and adding. Such as UL1741, IPC2221, FCC47 Part 15, DO-160,
- The goal is to have an open course where new modules can constantly be added over the years.

Course Development – Course Structure and Offline Courses

- Due to shortage of teachers on our campus, we decided to deliver this course (and some of our existing courses) in the offline asynchronous mode.
- Offline mode means a teacher pre-records all course videos and prepares course notes and places them on our campus Canvas server. Students will take the course without any live class sessions. They can watch the videos on their own time and submit the assignments when due.
- The professor will set up the assignments and updates the due dates for each semester the course is offered and grades them when submitted.
- This will minimize the burden on the department for higher level classes where students can manage on their own.

Course Development – Module Development and Test Runs

- We have developed some modules of both courses. Course 1 is nearing completion. Course 2 is open and we will add to it as we go.
- We have already offered some of the modules as parts of EE6500 and EE5570 courses and have collected some data regarding the quality and impact.

Course Development – Course 1 Timeline

- We have developed many of the modules for this course. However, we have not finished it yet. We are adding more modules corresponding to the chapters of the reference book plus examples from common standards in electrical engineering. We have also added to the content of the chapters based on some new material or more historical examples and storylines.
- We have already offered some of the modules as additional content in some other courses such as EE5570 and EE6500. But not as an independent course.
- We are expecting to finish this course this fall.

Course Development – Course 2 Modules

- Course 2 consists of many modules on some of the most common standards relevant to electrical engineering in the US including some of the industrial safety standards such as UL1741, renewable energy standards such as IEEE1547, safety standards in automotive applications such as ISO 26262, DO-160 for aerospace applications, FCC 47 Part 15 for emissions in power converters, ...
- Our goal is to continually add to this course to make it a major reference for all electrical engineers across the U.S.
- Many of the long-standing mass employers of our students have expressed high interest and enthusiasm for this course as it will cut their training period regarding some of the major standards used in the U.S. in our specific field.

Delivery – Offline Packaging and Deployment

- The delivery of both courses are in the form of offline recorded material through Canvas. However, institutions who do not have Canvas can still use the material as each module has its own notes, recorded lectures, and assignments.
- The recordings will be shared with interested institutions as well as NIST.
- The courses are designed to be self-sufficient with all the material needed already included in the package. No teacher-time is needed other than to look over the assignments and final grading.
- Both courses are already setup in our campus's Canvas platform and we are adding to them.

Delivery – Title II Compliance

- **Title II** of the Americans with Disabilities Act (ADA) requires public institutions, including universities, to ensure that all programs and services are accessible to individuals with disabilities. For college courses, compliance is critical not only for meeting legal obligations but also for fostering inclusivity—ensuring that lectures, course materials, online modules, and assessments are fully accessible. This commitment strengthens educational equity, broadens participation in STEM fields, and upholds institutional accountability to federal standards.
- Our Center for **Advancing Faculty Excellence (CAFE)** has provided captioning services and multi-pilar offline course validation for our developed courses free of charge.

Delivery – Surveys From Test Runs (slide 1 of 4)

- **There are 2 major topics we are getting feedback for:**
 - **Delivery Method**
 - **Course Content:** Final survey will be done when all modules are packed into one course. As of now, all students are satisfied with the content considering that it is an addition to their existing course material and they can keep the documents for their future use.

Delivery Method: As mentioned previously, we have to deliver the course in a fully offline, asynchronous model. Meaning that there is no live teacher and students will watch pre-recorded videos and access the provided notes.

The following slides highlight some of the more important feedback questions.

Delivery – Surveys From Test Runs (slide 2 of 4)

- Questions Regarding the Async. Mode with Permanent Access to Recordings**

	Completely disagree	Somewhat disagree	No difference	Somewhat agree	Completely agree
An offline mode of the course allowed you to learn at your own pace.	8%	4%	8%	12%	68%
Missing sessions is an issue with in-person mode.	12%	4%	32%	24%	28%
I watched every recorded session.	8%	0%	4%	16%	72%
At least I watched the sessions that I deemed are relevant to my work.	4%	0%	4%	16%	76%
Offline mode allowed me to take this course without it interfering with my job.	0%	0%	8%	16%	76%
Offline mode allowed me to fast forward parts of the course I don't care for much.	4%	4%	16%	36%	40%
Offline mode allowed me to rewatch some sessions.	4%	0%	0%	8%	88%

Delivery – Surveys From Test Runs (slide 3 of 4)

- Questions Regarding the Offline Delivery Method

	Completely disagree	Somewhat disagree	No difference	Somewhat agree	Completely agree
Live interactions with the teacher in the classroom makes me learn more.	8%	0%	32%	16%	44%
Canvas chat box and email do not fill the void in having live interactions with the teacher.	16%	0%	24%	28%	32%
Instead of offline classes, you should offer evening distance classes. (Action Taken)	8%	8%	52%	20%	12%
If the class is offered in the evening synchronous mode instead, I would attend every sessions	16%	8%	32%	24%	20%
I took this class because no other classes were available.	60%	28%	4%	4%	4%
Offline course seemed longer than the in-person course.	24%	12%	40%	12%	12%
Overall, I was happy with the quality of the lectures and recordings.	0%	4%	0%	24%	72%

Delivery – Surveys From Test Runs (slide 4 of 4)

- Questions Regarding the Content

	Completely disagree	Somewhat disagree	No difference	Somewhat agree	Completely agree
The topic of this course was not relevant to me.	80	8	12	0	0
I feel I learned new topics.	0	4	8	16	72
feel I can speak with more confidence in a job meeting.	0	8	4	28	60
I feel I got exposed to a strong tool I can use in my designs.	0	0	16	36	48
Overall, I was happy with the quality of the lectures and recordings.	0	4	0	24	72

Delivery – Average Enrolment

- We are expecting the average enrolment to be roughly around 30 students per year.
- This number comes from the average enrolment for EE5570 which also covers some of the standards for high voltage testing for equipment.

Outcomes – Publication of Our Survey Results

- We have already requested for our first paper to be presented at Missouri S&T Teaching and Learning Conference, a regional long-standing conference on education and educational technologies.
- The conference is in March 2026 in Rolla, Missouri.
- Afterwards and as more data is collected, and the final paper will be published with NIST.

Lessons Learned – Challenges with Module Development

- One challenge that we faced was regarding the 2nd course on various standards in Electrical Engineering.
- Faculty from other areas of EE are neither interested nor have the knowledge to develop material relevant to specific standards of their areas.
- As a result, we cannot benefit from their support, and we are developing modules that are not specifically in our area such as UL1998 which is a widely used standard on software safety in embedded controllers within the U.S.

Next Steps – Course Deployment

- After both courses are complete, we will work with NIST to deploy the courses to interested institutions.
- Also, we will have a link for institutions to directly download these modules from our server free of charge with rights to offer at their own institutions.

Acknowledgements

- We gratefully acknowledge the support of the **National Institute of Standards and Technology (NIST)** and the **U.S. Department of Commerce**, whose funding has made this project possible. Their investment in advancing standards education and workforce development is critical to strengthening U.S. innovation, safety, and competitiveness.

Thank You

