PURDUE UNIVERSITY | College of Engineering

Engineering Faculty Document
No.: EFD 111-24
March 22, 2024

TO: The Engineering Faculty

FROM: The Faculty of the Interdisciplinary Engineering (IDE)

RE: New Engineering Major

The Faculty of the Interdisciplinary Engineering has approved the following new Graduate Major from the College of Engineering. This action is now submitted to the Engineering Faculty with a recommendation for approval.

TITLE:

Smart Cities and Urban Informatics / Interdisciplinary Engineering

DESCRIPTION:

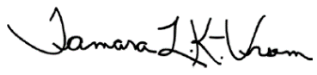
The Smart Cities and Urban Informatics Program is specifically designed for students and professionals who are eager to develop specialized skills in urban data science and resilience engineering, tailored to address the complexities cities are facing in the modern world. Specifically, the program is well-suited for those who are:

- Current Purdue B.S. students seeking to deepen their understanding of urban informatics and resilience, improve their employability in the sector of smart cities and develop technical and leadership skills in this area. This includes students from the Lyles School of Civil Engineering, School of Industrial Engineering, Department of Computer Science, or other engineering departments and the Mitchell E. Daniels, Jr. School of Business. The B.S. degree should have been awarded at the time of the start of the master's degree.
- Domestic and international bachelor students wishing to undertake graduate studies, specialize in the fields of urban data science, resilience engineering, and smart city technology, enhancing their career prospects in these areas.
- Current professionals in urban planning, engineering, computer science, public policy and related fields who are looking to update their skills with the latest in smart city technology and urban data analytics. This program offers them an opportunity to gain cutting-edge knowledge and expertise, enhancing their career prospects and enabling them to contribute to solve challenges such as climate change, resilient infrastructure, emerging technologies and decision making in cities.

RATIONALE:

Presently, about 80% of the US and EU population lives in cities. On a global scale, 70% of the population is expected to live in large cities (>1 million) and megacities (>10 million) by 2050. Increases in urbanization, the impacts of climate change, global health pandemics, and rapidly evolving technological advancements that can outpace urban policy development present complex issues that city planners, resilience officers, engineers, data scientists, and policy makers need to address. Developed through interactions with civic leaders, industry experts, and city agencies, this program will prepare students to

be future leaders in the use of engineering solutions, problem solving and technology adaptation to help address the complex issues that cities increasingly face. This program addresses the critical need to train professionals in Indiana and beyond who can navigate and resolve complex problems in urban settings. A tangible opportunity exists to take a leadership role in Indiana, the US, and globally, in Smart Cities and Urban Informatics education through the creation of a residential Professional Master's Program (PMP) in Interdisciplinary Engineering (IDE) with our College of Engineering, in both West Lafayette and Indianapolis. The Purdue Indianapolis campus provides a unique advantage by combining our strengths in a mid-size urban area with rural connections thereby allowing us to integrate many local community partners into this program. Many of the other programs are in large cities and do not have the integration of city agencies and industries. The program will capitalize on (1) Purdue Computes Initiative; (2) Indianapolis as a living lab and our strong brand name in the state and nation; (3) Experience in solving societally relevant global challenges and engagement with relevant stakeholders. The broader social, economic and environmental issues of smart cities technologies will be discussed in several courses. For example CE 564, CE 597 (Disaster Resilience and Society, a required core course) and CE 508 courses address these issues in modules related to data processing and algorithm design. Additionally, the capstone course will have the requirement that all students will need to identify, discuss and document the social, ethical and economic issues of smart city technologies. Future curriculum development will also explore the addition of the following Philosophy courses that collaboratively explore ethical dilemmas and bias in data/technologies, such as PHIL 20800 (Ethics of Data Science) and PHIL 32200 (Philosophy and Technology).



Head/Director of the Tamara Kinzer-Ursem

Link to Curriculog entry:

[Paste link to Curriculog entry.]

Smart Cities and Urban Informatics

Professional Master's Program (PMP), Interdisciplinary Engineering (IDE)

1. **Program Leaders**

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2. **Program Type (always choose Program)**: Program
Proposed Major Title: Smart Cities and Urban Informatics / Interdisciplinary Engineering
Level: Graduate

3. **Rationale**. Why is the program needed? How does the program take advantage of opportunities in Indianapolis? What is unique and distinctive about the program?

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4. **Evidence of student interest in the program**

The Smart Cities and Urban Informatics Program is specifically designed for students and professionals who are eager to develop specialized skills in urban data science and resilience engineering, tailored to address the complexities cities are facing in the modern world. Specifically, the program is well-suited for those who are:

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- Current professionals in urban planning, engineering, computer science, public policy and related fields who are looking to update their skills with the latest in smart city technology and urban data analytics. This program offers them an opportunity to gain cutting-edge knowledge and expertise, enhancing their career prospects and enabling them to contribute to solve challenges such as climate change, resilient infrastructure, emerging technologies and decision making in cities.

5. Anticipated careers and first positions

Program graduates can build careers as Data Scientists, Resilience Engineers, Urban and Regional Planners, Global development such as World Bank, Asian Development bank and more. For example, the U.S. Bureau of Labor Statistics (BLS) indicates "much faster than average" projected growth for Data Scientists over the next decade, including 17,700 projected job openings.

6. Description of similar programs at other institutions

Many AAU institutions are already offering similarly-focused residential master's programs include Georgia Tech, NYU, Rutgers, Penn, UCF, and Northeastern. UC Berkeley operates a Smart Cities Research Center.

7. Projected AY start

Soft launch in the West Lafayette campus in Fall 2024 and full launch in both WL and Indianapolis in Fall 2025.

8. Projected instructional needs including classroom space, equipment, and technology

Teaching classrooms with a computer, projector and white board – 2 (capacity: 30 students each) Office space for 3 faculty and staff members to support the program. Teaching Assistant space. Computer lab for students to work on capstone and Statistics, Machine learning and Urban AI models. Additional equipment and technology needs will be identified as the program grows in 2025 and beyond.

9. Projected faculty/instructor needs to support the program

The program has received significant interest from faculty across multiple departments in college of engineering, computer science, and Mitch Daniels school of Business. Our plan is to initially use the courses already developed by the current faculty with some redesign to launch the program. As the

program develops and based on feedback from the first cohort of students, we will identify new courses and map the hiring of new faculty (e.g. professors of practice) based on the need.

10. **Draft plan of study/requirements list**

Curriculum: List required courses (note any that are variable title).

- 30 total credit hours (9 core, 15 major, 6 capstone project), with 18 minimum from CoE
- Core courses in Urban Data Science, Resilience Engineering, and Data Visualization/Comp Stats
- Capstone project students will partner with a government agency, private sector company, or Purdue professor to apply data science and analytics to impact sustainable cities issues
- Broader social, economic and environmental implications of the technologies will be discussed in several courses including the capstone projects.

Each student in the program must complete a total of 30 credits. The 30 credits are divided as follows:

- A minimum of 18 credits from the College of Engineering
- Core Courses (9 credits)
- Major Courses (15 credits)
- Capstone Projects (6 credits)

Core Courses:

All students in the proposed major must take the following core courses totaling 9 credits:

- 1 Urban Data Science course (3 credits)
- 1 Resilience Engineering course (3 credits)
- 1 Computational Statistics, Applied Math, and Data Visualization course (3 credits)

Major Courses:

Major Courses are to be chosen from the following designated "Urban Data Science and Technology", "Resilience Engineering", and "Computational Statistics, Applied Math, and Data Visualization" course lists. Each student should take at least 2 courses (3 credits each) in the three modules including core courses.

Module 1. Urban Data Science and Technology

- **CE 564: Data Science for Smart Cities (Core)**
- CE 597: Foundations of Network Models
- CE 597: Image-based Sensing
- CE 508: Geographic Information Systems
- CE 507: Geospatial Data Analytics
- CE 597: Smart Construction
- CE 597: Intelligent Transportation Systems
- CE 569: Smart Logistics

Module 2. Resilience Engineering

- **CE 597: Disaster Resilience and Society (Core)**
- AGRY 545: Remote Sensing of Land Resources
- ASM 540 Geographic Information System (GIS) Applications, 3 credits
- CE 529: Smart Construction

- CE/POL 597: Sustainable and Resilient Systems: Behavior, Institutions, and Infrastructure (this can be integrated with "CE597 Disaster Resilience and Society" above)
- CE 597: Sustainable Design

Module 3. Computational Statistics, Applied Math and Data Visualization

- STAT 51100: Statistical Methods
- STAT 51200: Applied Regression Analysis
- STAT 51400: Design of Experiments
- MA 51100: Linear Algebra
- MA 52700: Advanced Mathematics for Engineers and Physicists I
- MA 52800: Advanced Mathematics for Engineers and Physicists II
- CE 566: Network Models for Connected and Autonomous Vehicles
- **CS 501 Introduction to Computational Science (Core) or CE 508 - Digital Mapping for Geographic Information Systems or CE 661: Algorithms in Transportation**
- MGMT 57100: Data Mining
- MGMT 57300: Optimization Modeling with Spreadsheets
- MGMT 59000: Machine Learning
- MGMT 59000: Visual Analytics
- MGMT 59000: Analyzing Unstructured Data
- MGMT 67000: Business Analytics
- MGMT 67200: Advanced Business Analytics
- ECON 57600: Statistical & Machine Learning
- IE58000: Systems Simulation

Capstone Projects:

- Students interested in solving real world problems will work with a government agency, private sector, or Purdue professor to gain hands-on experience on solving a data science problem to solve sustainable cities issues (6 credits)

Provide an example of a plan of study: type or attach as a file.

Example Plan of Study (1-year):

- Fall: 13 credits
- Spring: 13 credits
- Summer: 4 credits

Course Plan	**Semester**	**Credits**	**Credit Type**
CE 564: Data Science for Smart Cities	Fall	3	Core/Major-Module 1
CE 597: Disaster Resilience and Society	Fall	3	Core/Major-Module 2
CE 507: Geospatial Data Analytics	Fall	3	Core/Major-Module 3
STAT 511: Statistical Methods	Fall	3	Core/Major-Module 3
Seminar	Fall	1	Capstone Project
CE 661: Algorithms in Transportation	Spring	3	Core/Major-Module 1
AGRY 545: Remote Sensing of Land Resources	Spring	3	Core/Major-Module 2

MGMT 670: Business Analytics	Spring	3	Core/Major-Module 3
IE580: Systems Simulation	Spring	3	Core/Major-Module 3
Seminar	Spring	1	Capstone Project
Capstone Project	Summer	4	Capstone Project

Learning Outcomes:
Graduates of the Smart Cities and Urban Informatics Program will be able to:

- **Exhibit Interdisciplinary Proficiency in Urban Informatics**: Demonstrate an in-depth understanding and proficiency in urban data science, resilience engineering, and informatics within the context of smart cities.
- **Utilize Urban Data Science Skills Effectively**: Apply urban data science and resilience engineering skills to analyze, interpret, and solve complex urban challenges.
- **Make Informed Decisions in Urban Informatics**: Show the ability to make well-informed, interdisciplinary decisions in the realm of smart cities, urban planning, and development.
- **Communicate Across Diverse Stakeholders**: Effectively communicate complex urban informatics concepts and solutions to a diverse range of audiences, including professionals, civic leaders, and the general public.
- **Understand Broader Implications**: Display an awareness of the broader social, economic, environmental, and technological implications of urban informatics and smart city technologies.