New Course EFD Template

PURDUE UNIVERSITY | College of Engineering

Engineering Faculty Document
No.: 57-24
October 23, 2023

TO: The Engineering Faculty

FROM: The Faculty of the Lyles School of Civil Engineering

RE: New graduate course – CE 52900 Smart Construction

The Faculty of the Lyles School of Civil Engineering has approved the following new graduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM:

CE 59700 Smart Construction, 3 credits

Spring 2023 (19); Spring 2022 (12); Spring 2021 (1)

No Prerequisites

TO:

CE 52900 Smart Construction

Spring

Three total credits

No Prerequisites

Technologies are embedded throughout all communities, and the boundaries between humans and technologies are shrinking considerably. As a result, the construction industry is also changing rapidly. The questions are: Are we ready for this change? What skills are required to be better prepared as a future workforce? This course covers how these smart and advanced technologies are set to revolutionalize the construction industry to achieve specific mission objectives (e.g., improving safety, quality, and productivity). This course will give students the opportunity to learn conceptual and practical foundations for designing and developing systems while also learning to harness technology to ensure a new generation of CPHS would include humans in the loop. This course will be project-based, and students learn by actively engaging in various real-world case-studies. Other topics include challenges in human-computer interaction, the internet of things, human behavior modeling, VR/AR/MR, wearable sensors, machine learning and artificial intelligence, trust in human-robot interaction, and ethics and fairness in the emerging smart technologies in the construction industry.This course follows Bloom's taxonomy to

increase knowledge (cognitive domain), develop skills (psychomotor domain), or develop emotional aptitude (affective domain). The instructor will incorporate various techniques in each of the course concepts to facilitate higher-order thinking in their students by building up from lower-level cognitive skills. Each concept will be taught in five phases:1) Knowledge (i.e., Lecture, podcasts, readings before class)2) Understanding (i.e., presentations, peer-review, discussion)3) Application (i.e., case studies, problem-solving demonstration)4) Analyzing and Evaluating (i.e., simulation, discussion)5) Creating, Reflecting, and Debriefing (i.e., group presentations, case studies, discussion, reflection)

RATIONALE:

The construction industry's shift towards smart construction practices is inevitable; it is critical to ensure our students, as the next generation of leaders, are equipped with the skills and knowledge needed to excel in this evolving field. This course will prepare our students with fundamental knowledge and hands-on experience on technological advances in the built environment. The comprehensive overview of conceptual and practical foundations for designing and developing sensing and monitoring technologies helps not only prepare graduates for the challenges and opportunities facing the construction industry's digital transformation, but also enhancing their employability and contributing to the industry's growth and sustainability.

Head/Director of the Lyles School of Civil Engineering

Link to Curriculog entry: https://purdue.curriculog.com/proposal:25718/form

CE 52900
Smart Construction
SPRING 2023

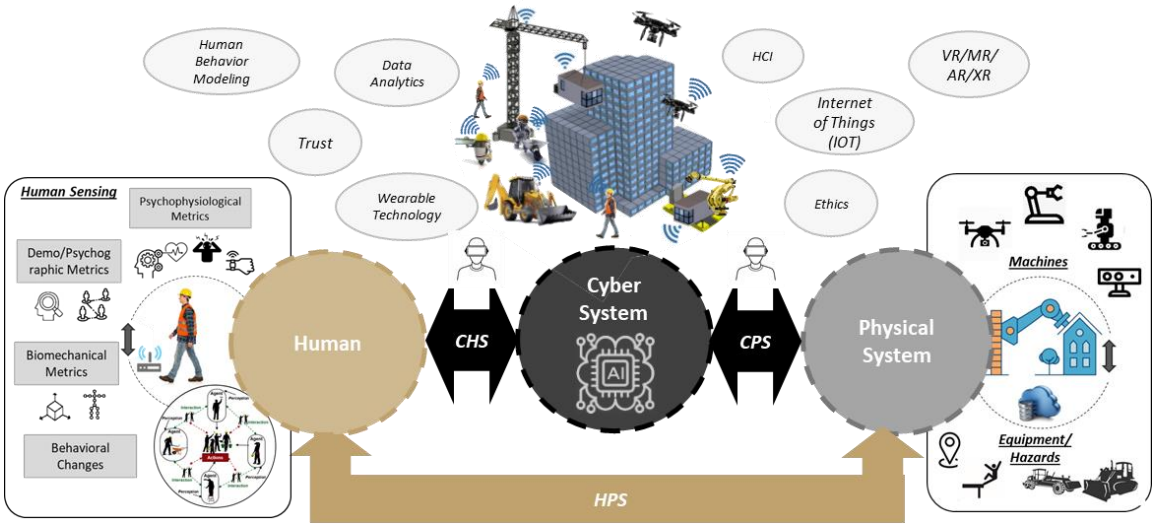
Instructor:
Sogand Hasanzadeh

Tuesdays & Thursdays, 10:30 am - 11:45 am | WALC 3132

Course Learning Outcomes

This course is designed to allow students to:

- LO 1: Explain conceptual and practical foundations for designing and developing sensing and monitoring technologies
- LO 2: Apply the knowledge and problem-solving skills to real-world case studies
- LO 3: Identify the advantages and challenges of the state-of-the-art technologies to outline gaps in knowledge and the necessity for research in the construction industry.
- LO 4: Integrate effective scholarly writing and teamwork strategies as reflect the environment and communication in a professional civil engineering/construction setting



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I. Contact Information

Instructor:

Sogand Hasanzadeh

Assistant Professor
Construction Engineering and Management and
The Lyles School of Civil Engineering

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550 W Stadium Ave, Purdue University
West Lafayette, IN 47907

Office:(765) 496-5210 | E-mail: Sogandm@purdue.edu

Office Hours: *by appointment, please email the instructor.*

II. Course Description

Technologies are embedded throughout all communities, and the boundaries between humans and technologies are shrinking considerably. As a result, the construction industry is also changing rapidly. The questions are: *Are we ready for this change? What skills are required to be better prepared as a future workforce?* This course covers how these smart and advanced technologies are set to revolutionalize the construction industry to achieve specific mission objectives (e.g., improving safety, quality, and productivity). This course will give students the opportunity to learn conceptual and practical foundations for designing and developing systems while also learning to harness technology to ensure a new generation of CPHS would include humans in the loop. This course will be project-based, and students learn by actively engaging in various real-world case-studies. Other topics include challenges in human-computer interaction, the internet of things, human behavior modeling, VR/AR/MR, wearable sensors, machine learning and artificial intelligence, trust in human-robot interaction, and ethics and fairness in the emerging smart technologies in the construction industry.

This course follows Bloom's taxonomy to increase knowledge (cognitive domain), develop skills (psychomotor domain), or develop emotional aptitude (affective domain). The instructor will incorporate various techniques in each of the course concepts to facilitate higher-order thinking in their students by building up from lower-level cognitive skills. Each concept will be taught in five phases:

1) Knowledge (i.e., Lecture, podcasts, readings before class)
2) Understanding (i.e., presentations, peer-review, discussion)
3) Application (i.e., case studies, problem-solving demonstration)
4) Analyzing and Evaluating (i.e., simulation, discussion)
5) Creating, Reflecting, and Debriefing (i.e., group presentations, case studies, discussion, reflection)

The class will be held every Tuesday and Thursday (*In-person*) at WALC 3132.

PS: If you are are in quarantine or waiting for COVID results (*Please coordinate with the instructor for ZOOM link*)

III. Course Material

There is no textbook. Research monographs and papers from the current literature will be used. All reading materials will be posted on Brightspace. Reading assignments should be completed prior to class. Students should read the reading materials assigned thoughtfully and carefully.

IV. Course Evaluation

Class Discussion, Participation, and Professionalism	**(25%)**	Productive involvement in class presentations and discussions are required. Class participation and professionalism (P&P) shall be factored into the student's final grade and is at the full discretion of the instructor. Class participation demonstrates interest, preparation, and understanding. It also serves to heighten active learning. Professional attitude and behavior are expected of all students. Professionalism demands timely submission of deliverables and showing up for class on time.
Class Projects	**(35%)**	The 3 class projects are group assignments. You should electronically turn in the project and present it,if required. We will use BrightSpace for electronic submission.
Final Project	**(25%)**	The final project aims to increase awareness of contemporary construction technologies. Each team (2-3 students) will select the relevant topic within the scope of the course for their systematic review paper. More detail will be provided in the class. Each group will submit their paper and present it to the class. Each person will peer-review the paper of two other groups. Each team member shall complete a Peer Review form for each of the team projects. The individual scores will be adjusted based on Peer Review feedback. Differential grades are possible.
Quiz	**(12%)**	Quizzes are related to reading assignments.
Reflection	**(3%)**	This is an individual task due by the end of the semester

V. Grading Strategy

In this class grades reflect the sum of your achievement throughout the semester. Final grades are assigned based on the total number of percentage points accumulated.

VI. Attendance Policy

Students must email Dr. Hasanzadeh (sogandm@purdue.edu) and notify her of their anticipated absence before the session or at least 24 hours after the session. Students are expected to attend all classes in-person or online unless they are ill or otherwise unable to attend class. If students feel ill, have any symptoms associated with COVID-19, or suspect they have been exposed to the virus, they should stay home and contact the Protect Purdue Health Center (496-INFO). In addition, students need to inform the instructor of any conflict that can be anticipated and will affect the timely submission of an assignment or the ability to take an exam or submit projects.

Classroom engagement is extremely important and associated with your overall success in the course. The importance and value of course engagement and ways in which you can engage with the course content even if you are in quarantine or isolation, will be discussed at the beginning of the semester.

Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflicts, when advance notification to an instructor is not possible, the student should contact the instructor/instructional team as soon as possible by email, through Brightspace, or by phone. In cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Our course Brightspace includes a link to the Dean of Students under 'Campus Resources'.

VII. Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies

Nondiscrimination Statement: Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in our course Brightspace under University Policies.

Accessibility: If you are a student registered with the Disability Resource Center and you are in need of academic accommodations and have an Accommodation Letter from the Disability Resource Center, please contact Dr. Hasanzadeh and schedule a virtual meeting as soon as possible to discuss your needs. Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

Emergency Preparation: In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis."

Violent Behavior Policy: Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity. See the following website for additional information: http://www.purdue.edu/policies/pages/facilities_lands/i_2_3.shtml

VIII. Course Schedule

CE 597 -Smart Construction- Spring 2023							(Last update 04/24/2023)
Sessions		**Date**	**Module**	**Learning Objectives**	**Description**	**Final Project Milestone**	**Class Projects**
1	T	10-Jan	***Introduction***				
2	TR	12-Jan	***Module 1: Construction Industry 4.0***	* Obj 1-1: Integrate opportunities afforded by the concepts, principles, and components of Industry 4.0 ito construction industry's needs and context. (LO 1, LO 2) * Obj 1-2: Formulate those aligned opportunities into a viable strategic, tactical and operational paradigms for change in the Construction 4.0 field. (LO 2, LO 3) * Obj 1-3: Reflect on the current state of the construction industry to propose more effective tech adoptiong strategies. (LO 2, LO 3, LO 4)	Intro and Syllabus		
3	T	17-Jan			Lecture		
4	TR	19-Jan			Discussion		
5	T	24-Jan			Discussion		
6	TR	26-Jan	***Module 2: Cyber-Physical Systems***	* Obj 2-1: Summarize the fundamental approach for developing a cyber-physical system (CPS) (LO 1) * Obj 2-2: Apply the CPS fundamental approach to real-world case studies in order to explore CPS application areas. (LO 1, LO 2) *Obj 2-3: Reflect on efficiency and effectiveness of CPS comapred to traditional monitoring methods (LO 3, LO 4)	Lecture		
7	T	31-Jan			Activity/Discussion		*Project 1 (Start)*
8	TR	2-Feb			Lecture /Discussion		
9	T	7-Feb			Lecture		
10	TR	9-Feb			Lecture	*Final Project: Paper Topic (1)*	
11	T	14-Feb			Discussion	*Final Project: BOX, Keyword,*	
12	TR	16-Feb			Activity/Discussion	*Final Project: Research*	
13	T	21-Feb	***Module 3: Digital Twins and Smart Cities***	* Obj 3-1: Summarize the fundamentals for Digital Twin and its development through years (LO 1) * Obj 3-2: Explore industrial success story of Digital Twin (LO 1, LO 2) * Obj 3-3: Apply Digital Twin fundamentals to create a real-world case study (LO2, Lo3, LO4)	Activity/Discussion		
14	TR	23-Feb			Lecture		
15	T	28-Feb			Lecture_ recorded		*Project 1 (Due)*
16	TR	2-Mar			Activity/Discussion		
17	T	7-Mar			Activity/Discussion	*Final Project: Create Protocol (4) & Search for Relevant Papers (5)*	
18	TR	9-Mar				*Final Project: Summary of*	*Project 2 (Start)*
19	T	14-Mar	***Spring Break (No Class)***				
20	TR	16-Mar					
21	T	21-Mar	***Module 4: Human Factors and Cyber-Human- Systems***	* Obj 4.1: Recognize the human role in connected elements of modern Industry 4.0 based on 5C architecture model. (LO 1) * Obj 4.2: Classify the human cognitive biases in digital workplace and evaluate their impacts on effectiveness of technologies. (LO 1, LO 2) * Obj 4.3: Reflect on technology adoption strategies considering cognitive, emotional, and contextual concerns. (LO 3, LO 4)	Lecture		
22	TR	23-Mar			Activity/Discussion		
23	T	28-Mar	***Module 5: Cyber-Physical-Human Systems (CPHS) and Internet of Things (IoT)*** *(Human-in-the-loop smart*	* Obj 5.1: Summarize implications, characteristics, technical frame, and key technologies of CPHSs for intelligent construction. (LO 1, LO 2) * Obj 5.2: Differenciate IOT, Embedded Systems, and CPS through real-worl case studies (LO 1, LO 3)	Activity/Discussion	*Final Project: Draft Outlines*	*Project 2 (Due)*
24	TR	30-Mar			Activity/Discussion		*Project 3 (Start)*
25	T	4-Apr			Activity/Discussion	*Final Project: Reporting (Writing 2)*	
26	TR	6-Apr			Lecture		
27	T	11-Apr			Lecture	*Final Project: Reporting (Writing 2)*	
28	TR	13-Apr			Lecture		
29	T	18-Apr			Lecture		*Project 3 (Due)*
30	TR	20-Apr	***Module 6: Visualization (VR/AR/XR/MR) and Robotics in Construction***	* Obj 6.1: Reflect of robotics applications in AEC industry and its evolutions. (LO 1, LO 3, LO 4) * Obj 6.2: Evaluate the current status of robotics in AEC through case-studies. (LO 2) * Obj 6.3: Understand differences between visualization technologies (VR,AR, MR, XR) and Integrate opportunities afforded by these technologies for improving AEC industry (LO 1, LO 2, LO 3)	Lecture	*Final Project: Submit the paper (9)*	
*	T	25-Apr			Presentation	*Final Project: Submit presentation (10)*	
*	TR	27-Apr	***Final Project Presentations***		Presentation	*Final Project: Submission and start Peer-review * (11)**	