ASPIRE – Electrified Transportation Systems Class Time: TR 4:30-6:00 PM (Mountain Time)

INTRODUCTION

Vehicles drive the nation's economy by transporting over 11 billion tons of freight and travel over 3 trillion miles per year. Transportation accounts for 50% of air pollution and 70% of petroleum use in the U.S. and claims 20% of household incomes. Looking to the future, electrification offers zero tailpipe emissions and reduced energy consumption. At 50% adoption, an electrified transportation system would cut the use of oil by 6 million barrels per day. It could also cut lifecycle ownership costs in half and reduce vehicle fuel costs by $150 billion per year. Realizing these transformations depends strongly on how EVs are charged.

Electrified Transportation System (ETS) operates at the nexus of several critical industries (such as Transportation, Power, and Information Technology) that have historically operated independently, and the existing overlap among them has little to no strategic coordination. A coherent understanding of these complex interactions is required to capture and harness convergence across these industries and scientific communities and to reshape forever the future.

The vision of the Advancing Sustainability through Powered Infrastructure for Roadway Electrification Engineering Research Center (ASPIRE ERC) funded by the National Science Foundation (NSF) is a sustainable and equitable future for transportation with widespread electrification of the roadway for all classes of passenger cars to heavy-duty trucks. This will be accomplished through seamless integration of wireless and wired charging solutions and co-optimized grid and vehicle networks that bring power to where vehicles operate, both parked and in motion. Achieving this vision requires entirely new lines of thinking on how city, highway, and electric grid infrastructure are designed, how vehicles and operators interact with those systems, and how to integrate private sector partners and public resources.

The goal of this course is to provide a survey of a large number of areas of knowledge needed to implement successfully ETS as a first step to convey competencies in the concepts of (1) systems of systems, (2) trans-disciplinarity, and (3) leadership. All senior-level or graduate students in the engineering field or areas relevant to ASPIRE are welcomed to this course.

LEARNING OBJECTIVES

The goal of this course is to provide the students with the necessary skills to:

- Define electric roads and related system components
- Differentiate between various types of charging technologies
- Understand the life-cycle analysis of EV technology considering environmental, economic, and social aspects
- Identify challenges and opportunities related to structural and electrical design and components
- Develop strategies for EV charging, marketing, and adoption
- Conduct SWOT analysis for ERS

SCHEDULE

Tentative schedule of the lectures is included in Appendix A. We will use a seminar approach in this course. Lectures are delivered by subject matter experts through webinars. Essentially, from the first week of the class until the end, you will spend about 75 minutes learning from and engaging through recorded/live lectures from experts in their respective fields.

DELIVERABLES

You will choose a specific topic to understand deeply, document thoroughly, and teach effectively to others based on a "deep dive" in the existing literature. **THERE ARE NO EXAMS IN THIS CLASS**.

a. ***Presentation and Term Paper:*** Following are the deliverables based on your assigned topic:

1. A PowerPoint presentation to teach to others on the topic of your choice

PowerPoint Presentation (1st draft due March 28 and final presentation due April 24): The last three weeks of the class are dedicated to your final presentations. The duration of the presentation should be about 15-20 minutes, followed by a 10-minute Q & A session. The grading of PowerPoint is based on the following criteria:

- Completeness and appropriateness of the preliminary presentation submitted
- Your faculty and classmates' impressions based on the criteria detailed in Table 1.

Table 1 – Criteria for Evaluating Presentations

Grade	5	3	1
Content	Shows a full understanding of the topic.	Shows a good understanding of parts of the topic.	Does not seem to understand the topic very well.
Comprehension	Can accurately answer almost all questions posed about the topic.	Can accurately answer a few questions posed about the topic.	Unable to accurately answer questions posed about the topic.
Enthusiasm	Facial expressions and body language generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language are used to try to generate enthusiasm but seem somewhat faked.	Very little use of facial expressions or body language. Did not generate much interest in the topic being presented.
Preparedness	Completely prepared and have rehearsed.	Somewhat prepared, but clear that rehearsal was lacking.	Do not seem at all prepared to present.
Stays on Topic	Stays on topic all (100%) the time.	Stays on the topic some (90%-75%) of the time.	It was hard to tell what the topic was.

2. Term Paper *(1st draft due March 28, final paper due May 9)*: The paper is a comprehensive explanation of the topic that is assigned to you. The paper template will be provided that can be accessed via Blackboard. The text should be carefully written, and the tables and figures should be of the highest quality. The grading of the report is based on the following criteria:
   - Timeliness and comprehensiveness of your intermediate deliverables.
   - Completeness and appropriateness of the preliminary draft submitted
   - The quality of final paper manuscript

b. Class Discussion: There is an interactive class discussion session scheduled every 4th Thursday (highlighted in the lecture schedule and timetable). Student groups will select a topic from the lectures presented previously. The group members will lead a 10-minute discussion following the instructions provided in Appendix C. You can use white board, sticky notes, slides, infographic, or any other interactive method to conduct the discussion. These discussions worth 40% of the final grade so all the students are required to actively participate. The instructor will also invite graduate students working on various research projects under ASPIRE to present.

GRADING

Discussion participation count a maximum of 40% toward your grade. The PowerPoint presentation will count as 30% of your grade. The term paper will count as 30% of your grade.

CLASS ATTENDANCE

Students are expected to attend all class periods. Those who fail to attend class regularly are inviting scholastic difficulty and, with the approval of the Dean of the College of Engineering, may be dropped from the course with a grade of F for repeated (5 or more) unexcused absences.

CELL PHONES AND LAPTOPS

It is disrespectful and to be on social media or doing your homework during lectures. For that reason and although some of you use your laptops to take notes, the use of laptops during the lectures is not permitted. Please turn off your cell phones during lectures.

Table 2 – Timetable for major Activities and Deliverables

Week	Tuesday	Thursday
2 1/24	Try to put teams together. Choose your topic	
3 1/31	Provide 10 keywords for the literature search	Conduct a literature search at a minimum using TRID, Google Scholar, and other sources
4 2/7	Download and organize papers from your search	Prepare for group discussion
5 2/14	Start reading, extracting relevant information, and organizing your papers	
6 2/21		
8 3/7	Prepare for group discussion • Submit a document that contains the list of references in the format discussed in Appendix B (3/7/2023 by 5.00pm MT) • Include at least ten unique papers, three theses or dissertations, and ten other sources. At least half of the documents should be from the year 2010 and later.	
9* 3/14		
10 3/21	Prepare "Introduction" and "Review and Analysis of Literature" sections of your report.	
11 3/28	Preliminary drafts of presentation and term paper (3/28/2023 by 5.00pm MT)	
12 4/4	Prepare "Gaps in the State of the Art," and "Future Trends" sections of your report	
13 4/11	Prepare for group discussion	
14 4/18	Work on finalizing your paper and prepare for your presentations	
15 4/25	Upload the final presentation online (4/24/2023 by 5.00pm MT)	
16 5/2	Work on finalizing your final deliverables	
17 5/9	Submit your final paper and celebrate that we are all done!!	

***Spring Break** **Group discussion** **Deliverables**

POLICY ON SCHOLASTIC DISHONESTY

Students are expected to be above reproach in all scholastic activities. Students who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the university. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give an unfair advantage to a student, or the attempt to commit such acts (Regents' Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22). Scholastic dishonesty harms the individual, all students, and the integrity of the university. Policies on scholastic dishonesty will be strictly enforced.

FINAL COMMENT

Good luck to all of you in this course. Please do not hesitate to ask questions in class, or, if necessary, to see me outside of class. Any specific comments that students may have on how the course might be improved are particularly welcome.

Appendix A – Tentative Lecture Schedule

Week	*Session 1*		*Session 2*	
	Topic	***Instructor***	***Topic***	***Instructor***
1 1/17	Introduction	Instructor of Record	Systems of Systems Concept	Regan Zane, USU
2 1/24	Introduction to Electrical System Components	Dragan Maksimovic, UCB	Role of Battery Management in EVs	Scott Trimboli, UCCS
3 1/31	Traditional Plugin Charging	Abhilash Kamineni, USU	Inductive Charging	Steve Pekarek, Dionysios Aliprantis Purdue
4 2/7	Capacitive Charging	Khurram Afridi, Cornell	Generation and Optimization of Power Grid	Yuanrui Sang, UTEP
5 2/14	Basic Transportation Planning	Kelvin Cheu, UTEP	Analysis and Optimization of Transportation Network	Ziqi Song, USU
6 2/21	Power System Impacts of EVs	Bri-Mathias Hodge, UCB	Basic Pavement Design as related to EV technology	John Haddock, Purdue
7 2/28	Basic EV Structural Design	Marv Halling, USU	Construction and Constructability of EV Facility	Adeeba Raheem, UTEP
8 3/7	Basic Life Cycle Analysis of EV technology	Bill Tseng, UTEP	Basic Sustainability Aspects of EV technology	Jason Quinn, CSU
9* 3/14				
10 3/21	Environmental Aspects of EV technology	Jana Milford, UCB	Environmental Justice and Equity of EV technology	Ivonne Santiago, UTEP
11 3/28	Economical Aspect of EV technology	Chris Fawson, USU	Marketing Aspects of EV technology	Antje Graul, USU
12 4/4	Pricing Strategies for Charging EVs	Mandal Paras, UTEP	Strategy to Accelerate Adoption	Chris Fawson, USU
13 4/11	Role of Data Science in Electrified Transportation	Christine Lv, UCB	SWOT Analysis by DOT Representative	IIB Member
14 4/18	SWOT Analysis by Car Manufacturers	IIB Member	SWOT Analysis by Contractors	IIB Member
15 4/25	Student Term Project Presentations		Student Term Project Presentations	
16 5/2	Student Term Project Presentations		Student Term Project Presentations	
17 5/9	Student Term Project Presentations		Final Discussion and wrap up	

***Spring Break** **Group discussion** **Deliverables**

Appendix B: Format for Literature Search

To summarize others work you may want to follow these four items:

1. In a single coherent sentence give the following:
   a. name of the author, date in parenthesis;
   b. a rhetorically accurate verb such as "assert," "argue," "deny," "refute," "prove," disprove," "explain,"
   c. -a, that clause containing the major claim (thesis statement) of the work.
2. In a single coherent sentence explain how the author develops and supports the major claim (thesis statement).
3. In a single coherent sentence state the author's purpose, followed by an "in order" phrase.
4. In a single coherent sentence give a description of the intended audience and/or the relationship the author establishes with the audience.

Example: Nazarian et al. (2014) stated that the precision of the ultrasonic surface wave method is 7%.....

Another way that I have found to be useful for students is summarizing the papers in a table like the following:

Reference	Objective and Scope	Key Findings/Comments
Petersen and Peterson, 2006	Compared CMV with the point test measurements such as LWD, DCP and Geogauge	The roller measurements vary greatly with point measurements. The variation in the roller measurements is due to the difference in the area of the measurements between drum and sensors of spot tests, and the response is influenced by moisture, material and support.
Rahman et al., 2007	Studied the use of subgrade stiffness obtained from the IC technology using Bomag single smooth steel drum variocontrol intelligent roller. Three sections were considered in Kansas.	Demonstrated the potential benefits of the IC technology in identifying less stiff areas. Revealed the sensitivity of the roller measurements to moisture content variation.

Do not forget to keep the complete reference for the List of References.

Appendix C: Format of Discussion

Your Group Name	
Title of Discussion	
Date	
Main Idea	
Main Take Aways	
Gaps Identified	
Future Directions	
Final Thoughts	