CEE418, Public Transportation Systems

T/Th 11:00 am - 12:20 pm
3310 Newmark Civil Engineering Bldg (or online[1])

Instructor
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Course Description
This course aims to provide an in-depth overview of the fundamental principles of efficient operations, management, and planning of public transportation systems. In particular, we plan to analyze the capabilities and limitations of transit systems; how to determine the optimal scale and layout of a transit system; and how to practically implement the design and operate the system. Some of the topics are based on recent research findings.

This course deemphasizes facts (e.g., transit usage statistics and system characteristics) in order to promote basic principles and concepts that can be applied to public transportation systems across multiple modes (e.g., bus, shuttle, light rail). There is also little coverage over other (albeit important) topics such as financing, regulation and urban land use policy, because other courses may have already been covering them. We go beyond the specifics of any particular systems in order to offer overarching modeling techniques that will be useful to a wide range of transportation engineering students. This course may also be suitable for students from other related disciplines (e.g., urban planning and industrial engineering).

Prerequisites:
CEE310, or consent of instructor

[1] Restricted to online non-degree, online MCS, online MSAE, online MSME, and online MSCE students. Center for Innovation in Teaching & Learning (CITL) restrictions and assessments apply, see http://online.illinois.edu. For more details on this course section, please see http://engineering.illinois.edu/online/courses/. Non-Degree students may enroll on a space-available basis with consent of Program Coordinator, Meg Griffin (mgriffin@illinois.edu).

Textbook

- Daganzo, C.F. and Ouyang, Y. "*Public Transportation Systems: Principles of System Design, Operations Planning and Real-Time Control*." World Scientific Publisher, 2019. https://www.worldscientific.com/worldscibooks/10.1142/10553

References

- Vuchic, V. "Urban Transit: Operations, Planning and Economics." John Wiley and Sons, New Jersey. (2005)
- Ceder, A. "Public Transit Planning and Operation: Theory, Modeling and Practice" Butterworth-Heinemann. (2007)
- Larson, R.C., and Odoni, A.R., "Urban Operations Research", Prentice-Hall, Englewood Cliffs, N.J. (1981).

Grading Policy

For 4 hours:
- Mid-term exam: 20%
- Homework: 20%
- Mini-projects: 25%
- Term project: 30%
- Class Participation: 5%

For 3 hours:
- Mid-term exam: 25%
- Homework: 25%
- Mini-project: 15%
- Term project: 30%
- Class Participation: 5%

Homework. Students will be graded on a series of homework problem sets. Those wishing to receive 4 credit hours may solve more subproblems in each assignment. The **typeset** solution (submitted on **Compass**) is due at the **start** of class on the date indicated, and the solutions may be discussed later in class. Late homework will result in half credit. Late homework will not be accepted once the assignment has been graded and returned (normally within a week).

Mini Projects. The textbook provides four open-ended mini-projects which cover (1) corridor planning, (2) network layout design, (3) bus fleet management, and (4) bus bunching prevention. They can be completed in groups of 2-4 students. All students are expected to complete either mini-project (1) or (2), while those wishing to receive 4 credit hours will need to complete another mini-project, either (3) or (4).

Term Project. Students are expected to finish a comprehensive term project in groups (3-4 students) and submit a research report (publishable quality) by the end of the semester. The focus of the project could be on development of models and/or algorithms for transit system planning, design, operations, control, or performance evaluation under different operational strategies and real-time information. Considerable flexibility exists for the scope and theme of the term project; please consult with the instructor or TAs early. Student groups should be formed by the fourth week, and project abstracts are due by the fifth week. At the end of the semester, each group will make an in-class presentation reporting the project.

Optional: Those who are interested in gaining empirical design experience in a global setting may choose to complete our international term project. This year, if there is enough interest, we will select 7-8 students from this course to participate in a transit system design project in China. We will partner with the Department of Civil Engineering at Tsinghua University, where a similar transit course is offered concurrently, to form groups that consist of students from both institutions. The majority of the collaborative

work will be conducted remotely during the semester, while the final phase involves a week-long field trip to Tsinghua University and the location of project, in either late April or early May (tentative dates). More details about this international project option will be provided in a separate handout.

Tentative Schedule (subject to change)

					Due Dates	
Week	Class	Date	Subject	Discussion Topics	Mini-Project	Term Project
1	1	21-Jan	Intro	Introduction: Basics, General Ideas, Standards		
	2	23-Jan		Introduction: Tools (video recording)		
2	3	28-Jan	Planning	Demand Issues; Shuttle Systems, Fixed Demand		
	4	30-Jan		Shuttle Systems, Adaptive Demand		
3	5	4-Feb		Modal Comparisons		
	6	6-Feb		Idealized Corridor Hierarchies		
4	7	11-Feb		Corridors (detailed analysis, standards)		Form Groups
	8	13-Feb		Corridors (standards vs. generalized costs)	1	
5	9	18-Feb		Inhomogeneous Corridors	1	Project Plan
	10	20-Feb		Idealized Grid Systems (issues)	1	
6	11	25-Feb		Realistic Grid Systems (no hierarchy, issues)	1	
	12	27-Feb		Hybrid Systems (modal comparisons)	1	
7	13	3-Mar		Hierarchical Systems, Adaption	1	
	14	5-Mar		Flexible transit (general concepts; taxis)	#1 Due	
8	15	10-Mar		Flexible transit (dial-a-ride, ride-sharing)	2	
	16	12-Mar		Flexible transit (vehicle-sharing, jitney)	2	
9		17-Mar		Spring Break; no class		
		19-Mar		Spring Break; no class		
10	17	24-Mar	Management & Operations	Vehicle Fleets (1 route)	2	
	18	26-Mar		Vehicle Fleets (n routes)	2	
11	19	31-Mar		Staffing (1 run)	2	Progress Report
	20	2-Apr		Staffing (n runs)	#2 Due	
12	21	7-Apr		Vehicle Movement (theory, systems of systems)	3	
	22	9-Apr		Vehicle Movement (pairing)	3	
13	23	14-Apr		**Mid-term Exam**	3	
	24	16-Apr		Vehicle Movement (pairing avoidance)	3	
14	25	21-Apr		Control Strategies	3	
	26	23-Apr	Epi-log	Economics Revisited	4	
15	27	28-Apr		Economics Revisited	4	
	28	30-Apr		CUMTD field visit (pending confirmation)	4	
16	29	5-May		Project presentations		
		7-May		Reading Day	#3 or #4 Due	
		TBD		International trip & project (optional)		Final Report Due