CE 269 – Traffic Engineering (3 credits)

Instructor: Tarun Rambha
Email: tarunrambha@iisc.ac.in
Timings and Location: TTh 8:30 – 10:00, Online
Course Website: http://civil.iisc.ac.in/~tarunr/ce269.html

Course Description:
This course is intended to introduce you to modeling tools and design principles used to study highway and urban traffic. The methods can be broadly classified into microscopic and macroscopic frameworks and have their own advantages and disadvantages. In addition, we will classify the performance of facilities using empirical 'back-of-the-envelope' calculations guided by the highway capacity manual. The course will be self-contained and background in elementary calculus and programming is assumed.

Reading Material:
The following books could be used as references. Additional reading material will be shared during the lectures.

1. Ni, D. (2015). Traffic Flow Theory: Characteristics, experimental methods, and numerical techniques. Butterworth-Heinemann.
2. Treiber, M., & Kesting, A. (2013). Traffic Flow Dynamics: Data, Models and Simulation, Springer-Verlag Berlin Heidelberg.
3. Gartner, N. H., Messer, C. J., & Rathi, A. (2002). Traffic Flow Theory - A State-of-the-Art Report. TRB Special Report 165.
4. Knoop, V. L. (2018). Introduction to Traffic Flow Theory: An introduction with exercises. [PDF]
5. Boyles, S. Lownes, N. E., & Unnikrishnan, A. (2020). Transportation Network Analysis. [PDF]

These texts/manuals will be additionally used for some of the design portions.

1. Mannering, F. L., & Washburn, S. S. (2020). Principles of highway engineering and traffic analysis. John Wiley & Sons.
2. Wolshon, B., & Pande, A. (2016). Traffic engineering handbook. John Wiley & Sons.
3. Roess, R. P., Prassas, E. S., & McShane, W. R. (2004). Traffic engineering. Pearson/Prentice Hall.
4. Highway Capacity Manual, Sixth Edition: A Guide for Multimodal Mobility Analysis (2016)
5. Indian Highway Capacity Manual (Indo-HCM) (2017)

Assignments:
The course will have four written assignments and a term project. The written assignments will contain small simulation tasks using VISSIM/SUMO. All assignments must be typed and submitted electronically. Students are encouraged to discuss the problems with their classmates but one must write their own solutions. **Plagiarism is strictly prohibited and will be penalized.**[1] The term project will require you to present how a traffic facility is designed along with a case study. A project report is due on the day of the final.

Examinations:
The course will have one mid-semester and one comprehensive end-semester examination. Both examinations are in-class and cheat sheets will be allowed.

[1] http://www.iisc.ac.in/about/student-corner/academic-integrity/

Grading:
Students will be graded on a 100-point scale. The weights for different components of the course areas follows: written assignments (30%), mid-semester exam (20%), and end-semester exam (50%, of which 30% is for the written section and 20% is for the project).

Lesson Schedule:
Table 1 lists the topics that will be covered in different lectures. Minor adjustments may be made as the semester progresses. Each week, lecture slides for the subsequent week will be uploaded on the website and you are encouraged to read the posted material before coming to the class. In Module I, we will discuss microscopic models for uninterrupted highway traffic. In Module II, we apply macroscopic models to study network-level models and phenomenon such as shocks. In Module III, we will look at signalized and unsignalized intersections. Finally, Module IV will cover some miscellaneous topics and will involve a few guest lectures.

Table 1: Course Schedule.

Module I - Terminology and Microscopic Models	
Lecture 1	Introduction
Lecture 2	Fundamental Diagrams
Lecture 3	Level of Service and Designing Highways
Lecture 4	Car Following Models
Lecture 5	Lane Changing Models
Lecture 6	Calibration and Simulators
Module II - Macroscopic Models	
Lecture 7	Macroscopic Traffic Models
Lecture 8	Method of Characteristics
Lecture 9	Shock Waves
Lecture 10	Cell Transmission Model
Lecture 11	Node Models
Lecture 12	Extensions of the LWR Model
Module III - Interrupted Traffic	
Lecture 13	Signalized Intersections
Lecture 14	Delay Analysis and LoS
Lecture 15	Signalized Corridors and Networks
Lecture 16	Roundabouts and Simulators
Lecture 17	Introduction to Queuing Theory
Lecture 18	Unsignalized Intersections
Module IV - Special Topics	
Lecture 19	Dynamic Traffic Assignment
Lecture 20	Macroscopic Fundamental Diagrams
	Guest Lectures
	Term Project Presentations