Spring 2022

CE 350-002: Transportation Engineering

Branislav Dimitrijevic

NJIT
CIVIL AND ENVIRONMENTAL ENGINEERING

CE 350-002 Transportation Engineering Spring 2022

Brief Course Description

This course will discuss the principles and practices of transportation engineering and urban transportation planning. The major topics of this course cover 1) highway geometric design, 2) capacity analysis of highways and intersections, and 3) travel demand forecasting. The course will have a group project investigating real world example problems related to traffic impact analysis studies for transportation facilities.

Prerequisites: CE 200, CE 200A. A study of the principal modes of transportation, with emphasis on the planning, design and construction of facilities for modern transportation systems.

Course Objectives

1. Understand the principles and practices of transportation engineering and urban transportation planning.
2. Understand the interactions between transportation planning and land use planning, economics, social planning and master plans.
3. Gain the facility of utilizing the state of the art techniques and models in the field.
4. Have the capability to identify and solve transportation problems within the context of data availability and limitations of analysis tools

Canvas: https://njit.instructure.com/courses/20784

Instructor Info & Office Hours

Branislav Dimitrijevic, Ph.D.
Office: 286 Tiernan Hall | E-mail: dimitrijevic@njit.edu | Office Phone: 973-596-6463
Office Hours: Mondays, 1:30PM to 4:30PM, or by appointment

- The office hours are conducted both in person and virtually via WebEx in the instructor's personal WebEx meeting room: https://njit.webex.com/meet/bxd1947

Lecture Hours and Location

Mondays and Wednesdays, 10:00AM to 11:20AM
Kupfrian Hall, Room 103 (KUPF 103)

- This course is delivered in a face-to-face instruction mode.
- **IMPORTANT!** As per University-wide pandemic protocol, the classes during the first two weeks of the semester (January 18 through January 30) will be held in a synchronous online format.

- Unless otherwise indicated, all online instruction will be conducted in synchronous mode using WebEx. The instructor will provide the WebEx meeting information by email and will post it in Canvas prior to class.

Textbook

F.L. Mannering and S.S. Washburn. Principles of Highway Engineering and Traffic Analysis, **7th Edition**, John Wiley & Sons, Inc., ISBN 978-1-119-49396-9

Lecture Notes and Materials

- The lecture notes and other materials will be posted in Canvas prior to class.
- Some lectures (equivalent to Modules in Canvas) will include recorded videos of homework solutions and in-class examples. The students are expected to review those videos to solidify the concepts and calculations presented in class, and as part of the preparation for exams.
- Canvas Chat and Discussion Forum can be used to post questions and discuss the course materials and assignments with the instructor and fellow students. Students can also send e-mails to the instructor through Canvas, or call the instructor's office with course-related questions.

Course Schedule

Week	Date	Mode	Topic/*Assignment*
1	1/19	Online	- Course Overview - Introduction to Transportation Engineering (Chapter 1)
2	1/24	Online	- Fundamentals of Traffic Flow (Chapter 5.1 ~ 5.3)
	1/26	Online	- Greenshields Model of Traffic Flow (Chapter 5.3) - **Assignment #1**
3	1/31	In-person	- Introduction to Queuing Theory and Models (Chapter 5.5 ~ 5.6)
	2/2	In-person	- Queuing Models of Traffic Flow (Chapter 5.6) - **Assignment #2**
4	2/7	In-person	- Highway Capacity and Level of Service Analysis Part 1: Basic Freeway Segment (Chapter 6.1 ~ 6.4) - Highway Capacity and Level of Service Analysis Part 2: Multi-Lane Highway (Chapter 6.5) - **Assignment #3**
	2/9	In-person	
5	2/14	In-person	- Highway Capacity and Level of Service Analysis Part 3: Two-Lane Highway (Chapter 6.6 ~ 6.7) - Lab: Highway Capacity Software – Freeway Analysis (CEE Computer Lab, Colton Hall 3rd Floor Room 318) - **Assignment #4**
	2/16	In-person	**Exam #1**

Week	Date	Mode	Topic/*Assignment*
6	2/21	In-person	- Traffic Control and Analysis at Signalized Intersections Part 1 (Chapter 7.1 ~ 7.3)
	2/23	In-person	- Traffic Control and Analysis at Signalized Intersections Part 2 (Chapter 7.4 ~ 7.5)
7	2/28	In-person	- Lab: Highway Capacity Software – Intersection Analysis (CEE Computer Lab, Colton Hall 3rd Floor Room 318)
	3/2	In-person	- **Assignment #5**
8	3/7	In-person	- Lab: Traffic Simulation using VISSIM software (CEE Computer Lab, Colton Hall 3rd Floor, Room 318)
	3/9	In-person	
9	3/14	No class	- Spring Recess
	3/16	No class	
10	3/21	In-person	- **Exam 2**
	3/23	In-person	- Road Vehicle Performance: Braking Forces, Stopping Distance (Chapter 2)
11	3/28	In-person	- Geometric Design of Highways: Introduction (Chapter 3.1 ~ 3.2) - Vertical Curves – Fundamentals (Chapter 3.3) - **Assignment #6**
	3/30	In-person	- Vertical Curve Design and Stopping Sight Distance, Part 1 (Crest and Sag Vertical Curves) (Chapter 3.3)
12	4/4	In-person	- Vertical Curve Design and Stopping Sight Distance, Part 2 (Passing Sight Distance and Sag Curves with Overpass) (Chapter 3.3) - **Assignment #7**
	4/6	In-person	- Horizontal Curves – Fundamentals (Chapter 3.4)
13	4/11	In-person	- Horizontal Curve Design – Design Speed and Stopping Sight Distance Considerations (Chapter 3.4)
	4/13	In-person	- Horizontal Curve Design – Design Speed and Stopping Sight Distance Considerations (Chapter 3.4) - **Assignment #8**
14	4/18	In-person	- Geometric Design of Highways: Combined Vertical and Horizontal Alignment (Chapter 3.5) - **Assignment #9**
	4/20	In-person	- Travel Demand and Traffic Forecasting (Chapter 8)
15	4/25	In-person	- Travel Demand and Traffic Forecasting (Chapter 8)
	4/27	In-person	- Group Project Presentations (Part 1)
16	5/2	In-person	- Group Project Presentations (Part 2)
17	TBD	In-person	- **Final Exam**

Grading

Assignments:	15%
Exam 1:	20%
Exam 2:	20%
Final Exam:	20%
Group Project:	25%

Grading Scale

A:	100-90
B+:	89-85
B:	84-80
C+:	79-75
C:	74-70
D:	69-60
F:	Below 60

Attendance Policy:

- Each student may be excused to miss up to two classes with prior permission/VALID reason. Each subsequent class absence will be reported to the Dean of Students and may affect student's standing and grade.
- Five (5) or more missed classes may result in an F grade.

Withdrawals

To ensure consistency and fairness in application of the NJIT policy on withdrawals, student requests for withdrawals after the deadline will not be permitted unless extenuating circumstances (e.g., major family emergency or substantial medical difficulty) are documented. The course Professors and the Dean of Students are the principal points of contact for students considering withdrawals.

Code of Academic Integrity

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is the instructors' professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

Syllabus Information

The dates and topics of the syllabus are subject to change; however, students will be consulted with and must agree to any modifications or deviations from the syllabus throughout the course of the semester.

Exam/Homework Policies

Exams: Unless otherwise noted, the exams will be conducted in-person. Exam #1 and Exam #2 will be conducted during the regular class hours, as indicated in the class schedule. The date and location of the final exam will be announced as part of the University-wide final examination schedule. The students will be provided the exam problems at the beginning of the examination period and will have a specified amount of time (e.g., 80 minutes for Exams 1 and 2, 120 minutes for the Final Exam) to complete the exam and submit the solutions to the instructor/proctor. Each student must submit the calculation sheets used to derive the solutions for the exam problems. The students can utilize the formula sheet during the exams, as approved by the instructor. In the event that exams must be conducted virtually (e.g., due to changes in the University pandemic policies), the instructor will provide timely and detailed information and instruction on the examination process.

Homework: Homework assignments will be assigned to reinforce course learning objectives. The assignments will be targeted to provide practice for methods that may be included in course exams. There will be approximately eight-to-nine homework assignments during the semester. Homework should be turned in at the start of the class period identified by the instructor. No late homework will be accepted. Homework assignments will be posted in Canvas, and solution videos will be posted in Canvas as well.

Collaborating, sharing, and/or copying of exam/homework is **NOT** allowed. Credit will not be given to individuals who either initiate, allow, or participate in such behaviors. The NJIT honor code will be upheld at all times and any violation will be brought to the immediate attention of the Dean of Students.

Group Project

The class will be divided into multiple groups, each consisting of 3-4 students. Each group will be assigned an intersection in the vicinity of NJIT campus to conduct a Level of Service analysis, determine deficiencies in intersection operations, identify and evaluate potential solutions. The proposed solutions will be evaluated using Highway Capacity Software (HCS) and a microscopic traffic simulation software VISSIM. The software is available on the workstations at the CEE Computer Lab (Colton Hall, Room 318) and may be provided by the instructor for personal use on student's computers for the duration of the course. Each group must submit the list of group members by the end of the 4th week of the semester, and the presentation of the group project will be held in the 14th week of the semester. The format of the presentation is free, but the presentation must include the following sections:

1. Goal and objectives of the project.
2. Spatial and temporal scopes of the project.
3. Project site description (e.g., intersection geometry, traffic condition, signal phase sequence, etc.).
4. Summary of the traffic flow data – current conditions (e.g., approach volume, green time, yellow time, saturation flow rate, etc.).
5. Description of the identified problems and proposed solutions (improvements).
6. Summary of the Level of Service analysis using HCS (current conditions vs. improvements).
7. summary of the traffic simulation analysis using VISSIM (current conditions vs. improvement).

8. Conclusions and Recommendations (if any).

Due to the circumstances caused by the COVID-19 pandemic, the students may not be able to collect the traffic flow data at the intersection assigned to their team. In such cases the team will work with the instructor to obtain the current conditions data, including the traffic flow data and the signal timing data. Each group will then use the data (collected or obtained in collaboration with the instructor) to develop a model of the intersection in HCS and VISSIM, optimize the signal timing, and evaluate the intersection performance.

Hardware and Software Requirements

- Each student is expected to have a personal computer with a web-camera in order to attend the synchronous online delivery of the course, and to access the course materials provided in Canvas. The web-camera is required for the class meetings (lectures) conducted online.
- Engineering Scientific Calculator – would come handy during the exams.
- Smartphone, tablet, or other devices can also be used to access the digital course materials and facilitate communication with the instructor and fellow students. However, the use of smartphones and similar devices during the exams will not be allowed. It is also not allowed to use the smartphones or tablet computers during the class other than in conjunction with the class lecture as appropriate.
- Microsoft Office Word and Excel (or similar software capable of reading and editing Word and Excel files)
- PDF reader/scanner software
- Transportation modeling software HCS (version 7) and VISSIM – will be made available in the CEE Computer Lab.

Other Class Polices

Cell Phones and mobile devices (e.g., Laptop, iPad/Tablet PC, iPod, etc.): Cell phones should be turned off prior to coming to class. Texting and the use of mobile devices during the class shall not be allowed.

Outcomes Course Matrix – CE 350 Transportation Engineering

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 1: Demonstrate the principles and practices of transportation engineering and urban transportation planning.			
Discuss public transportation facilities.	2, 7	1, 2	Discussions and homework.
Use analytical tools to design transportation facilities.	2, 7	1	Homework, hands-on laboratory exercises, group project, exams.
Implement design of transportation facilities.	2	1, 2	Graded group project.
Student Learning Outcome 2: Recognize the interactions between transportation planning and land use planning, economics, social planning and master plans.			
Link transportation to land use, economics, social planning, and master plans.	2, 4	2, 3	Homework and exams.
Develop interactions between each of the above factors.	2, 4	2, 3	Homework and exams.
Give examples of growth due to improvement in transportation.	2	2, 3	Discussions, exams, and homework.
Student Learning Outcome 3: Employ state of the art techniques and models in the field.			
Introduce need for forecasting models.	1, 2, 7	1, 2	Homework and exams.
Discuss application of models.	1, 2, 7	1, 2	Homework and exams.
Assign large scale problems.	1, 2, 7	1, 2	Graded group project.
Student Learning Outcome 4: Identify and solve transportation problems within the context of data availability and limitations of analysis tools.			
Discuss how to obtain data necessary for transportation studies.	7	1, 2	Homework, graded group project
Match up analysis tools, data sets and problems to solve.	2, 7	1, 2	Homework, laboratory exercises, group project.
Introduce problems to be solved using analysis tools.	2, 7	1, 2	Homework, group project, exams.

CEE Mission, Program Educational Objectives and Student Outcomes

The mission of the Department of Civil and Environmental Engineering is:

- to educate a diverse student body to be employed in the engineering profession
- to encourage research and scholarship among our faculty and students
- to promote service to the engineering profession and society

Our program educational objectives are reflected in the achievements of our recent alumni:

1 – Engineering Practice: Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.

2 – Professional Growth: Alumni will advance their skills through professional growth and development activities such as graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.

3 – Service: Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Our Student Outcomes are what students are expected to know and be able to do by the time of their graduation:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Revised: 12/19/19