# CE 331-001

Transportation Engineering

Fall 2020
3 Credits
Time: TR 8:00-9:15 am
Location: Jacobs Science Building, Room 321
Zoom: https://uky.zoom.us/j/95225435402

## Instructor Information

Instructor: Professor Greg Erhardt
Office Building & Room Number: OHR 261
Email: greg.erhardt@uky.edu
Mobile Phone: (859) 699-1761
Office Hours: Monday 10-11 am and Thursday 9:30-10:30 am

I expect to be on-campus on Mondays and Thursday. You are welcome to stop by. I will be available for Zoom office hours at the times noted above at: https://uky.zoom.us/j/2204743066

Teaching Assistant: Fahmida Rahman
Office Building & Room Number: FPAT 260
Email: fami.uky17@uky.edu
Office Hours: Monday 2-3 pm and Tuesday 2-3 pm
On-campus on Mondays and available both times at https://uky.zoom.us/j/92838336411

## Course Description

This course introduces basic concepts of transportation engineering. It focuses on principles involved in road transportation system design, operations management, and planning. Issues affecting modes other than the automobile will also be discussed. Refer to the Schedule section for detailed topics.

Prerequisites: CE 211 and engineering standing

## Format

This will be a hybrid COVID-adaptive course. While many lectures will be online, the class requires some in-person participation. We will follow the risk levels defined by the Harvard Global Health Institute. The expected participation levels are:

- Green: In-person.
- Yellow: For most class periods students will have a choice to participate in-person or online. Some in-class activities required.
- Orange: Outdoor activities, small groups, and limited in-class activities (such as exams).
- Red: Lockdown – no in-person interaction permitted.

These levels and details may be adjusted based on health considerations and teaching needs. Students will be notified of any changes, and are expected to participate accordingly. Masks and social distancing are required for all levels.

## Student Learning Outcomes

The objectives of this course are to develop basic understanding of the principles of transportation engineering and prepare students for the design and analysis of transportation systems. Students will be evaluated on the tests and final exam on their ability to accomplish the following learning outcomes of the course.

1. Compute horizontal curve components
2. Calculate vertical curve components
3. Understand impacts of human factors on roadway design
4. Compute optimum cycle length for a signalized intersection
5. Determine appropriate phasing plan for a signalized intersection
6. Evaluate alternative designs and phasing plans for a signalized intersection
7. Understand traffic flow relationships
8. Estimate level of service for multilane highways
9. Understand the goals and objectives of transportation planning
10. Use computational approaches for the 4-step transportation planning process
11. Understand the impacts of various modes of transportation and of future technologies on transportation

## Course Materials

Course materials such as supplementary notes, presentation slides, handouts, homework and solutions will also be available on the course page on Canvas, accessible using your linkblue credentials.

Optional Textbook: Fred L. Mannering and Scott S. Washburn, Principles of Highway Engineering and Traffic Analysis, 6th edition (Hoboken, NJ: Wiley, 2017). This book is valuable as a source of additional practice problems.

## Course Components

### Readings and Asynchronous Lectures

The attached course schedule contains readings that supplement the material presented by the instructor.

A series of asynchronous lectures will present background information, design and calculation procedures and sample problem solving. Lectures will generally be posted by Monday. They are organized by topic, so there may be multiple lectures covering the week's topics. Students should read the material and watch the lectures prior to class on Thursday and come to class prepared to ask and answer questions on the lecture topics.

### Quizzes

Most weeks will include a quiz covering the content of the readings and asynchronous lectures. This quiz should be completed prior to class on Thursday. Students may be called upon to demonstrate their solution to the class during the Thursday lecture.

### Synchronous Activities

This class includes synchronous activities in which the whole class is expected to be present and participating at the same time. These may include guest lectures, discussion, interactive

problem-solving, and field work. Students should be ready to ask and answer questions during these activities.

While notes are provided in the forms of presentation and handouts, students should note that they contain only summaries of course information. All required and important information will **not** be written. Students must take notes on what the instructor, guest lecturers and other students say.

## Collaboration Period and Office Hours

In most cases, the Tuesday class period will be used as a collaboration period. The instructor will be available on Zoom with breakout rooms for students to work in teams. Students are encouraged to use the time to work on quizzes and homework, complete group project work, and to ask any clarifying questions about the recorded lectures.

Students will regularly be asked submit a reflection on their learning during that class period or week. These will be submitted through Canvas and should be topical to the week's topics. Reflections may take the form:

- The most interesting/important thing I learned today is…
- The thing I will most remember from today's class is…
- I am interested in learning more about…
- One thing I am still confused by is…
- I need help with…
- Can you go over….again more slowly.
- When I was driving/walking/biking/riding, I noticed…. Why…
- One thing I have always wondered about transportation/traffic/cities is…
- A good exam question would be…
- A good quiz bowl question would be…

Students are required to ask a question or offer a reflection at least once every two weeks during the collaboration period.

## Homework

There will be homework problem sets assigned. All homework sets are available on the Canvas site. Problem sets **must** be completed in groups of two or three students. Each student in a group must contribute to the product that is handed in and all students are responsible for all material. The front page of the homework submittal should indicate each student's contribution to the submittal. Teams are encouraged to implement an appropriate quality control process to check their work prior to submitting.

Late homework will not be accepted. You should note that all important topics within the course may not be covered by homework assignments; however, they may still appear on a test.

## Projects

During the lecture periods on the dates indicated on the schedule, students will undertake special individual or group activities that may include collecting traffic data in the field. Such assignments are designed to supplement classroom learning and help students to get hands-on experience on solving real-world problems. Each group needs to submit a report for each

assignment with all group members' names appearing on the title page. The specific requirement for the report will be laid out when the assignment is given.

## Unit Tests and Final Exam

There will be two unit tests and a final exam in this class, as specified in the course schedule. The final exam will be comprehensive. For in-person exams, students will be permitted to bring a calculator and an equation sheet to each exam. The equation sheet must be one 8.5x11 inch piece of paper on which the student may write anything they want, on both sides. Equation sheets must be in the student's own handwriting and may not be copied or typed. Although the class examples and homework problems provide practice for many of the quantitative components of the course work, test questions may also be based on the more qualitative information in lectures and readings. Rules for online exams will be determined by the instructor.

## Tentative Course Schedule

The expected course schedule is below. All components are subject to change.

| **Unit 1: Geometric Design** | | | | |
|---|---|---|---|---|
| Week | Readings | Tuesday Lectures | Thursday Activities | Assignments |
| 1 | Ch 1 | Introduction<br>Motivations | Connected & Autonomous Vehicles | |
| 2 | Ch 2.8, 2.9, 2.10 | Alignment Design<br>Stopping Sight Distance | Railroads<br>Problem Solving | |
| 3 | Ch 2.1, 2.2 | Horizontal Curves | Innovative Design<br>Problem Solving | HW 1 Due |
| 4 | Ch 2.5, 2.6 | Vertical Curves | Designing Streets for People<br>Problem Solving | |
| 5 | NACTO Excerpt | Other Design Topics | Field Trip: Bike & Pedestrian Design | HW 2 Due |
| 6 | | Design Review | Unit Test 1: Geometric Design | |
| **Unit 2: Operations** | | | | |
| Week | Readings | Tuesday Lectures | Thursday Activities | Assignments |
| 7 | Ch 3 | Traffic Measurement<br>Traffic Flow Fundamentals | Signal Project Introduction<br>Problem Solving | |
| 8 | Ch 4.1, 4.4 | Highway Capacity Analysis<br>**Field Work: Traffic Counts** | Transit<br>Problem Solving | HW 3 Due |
| 9 | Ch 5 | Traffic Signal Systems<br>Change and Clearance Intervals | Transportation in the Developing World<br>Problem Solving | Project 1 Data Report |
| 10 | | Traffic Signal Timing Design | Virtual Field Trip: Lexington TMC<br>Problem Solving | HW 4 Due |
| 11 | | **Traffic Operations Review** | **Unit Test 2: Operations** | |
| **Unit 3: Planning** | | | | |
| Week | Readings | Tuesday Lectures | Thursday Activities | Assignments |
| 12 | | Election Day--No Class | Imagine Nicholasville Road Introduction<br>Problem Solving | Project 1 Due |
| 13 | Ch 6.1-6.2 | Transportation Planning<br>Networks and Zones | Project Development<br>Problem Solving | |
| 14 | Ch 6.3 | Trip Generation, Distribution, Mode Choice, Assignment | NEPA, Ethics<br>Problem Solving | HW 5 Due |
| 15 | | ***TEA Cup Finals*** | Thanksgiving | Project 2 Due |
| Finals | | | **Final Exam: Thu, Dec 3, 8-10 am** | |

**Color Key:**

| |
|---|
| Asynchronous Lecture |
| Synchronous Activity |
| In-Person Activity |

## Grading Policy

| | | | | |
|---|---|---|---|---|
| Homework | 10% | 90–100 | = | A |
| Quizzes and Participation | 5% | 80 – 89 | = | B |
| Projects | 20% | 70 – 79 | = | C |
| Unit Tests | 40% | 60 – 69 | = | D |
| Final Exam | 25% | < 60 | = | E |
| | 100% | | | |

Grades on the assignments and tests (with the exception of final exam) can be appealed within one of the return of the paper. No adjustment will be made beyond this period. You are responsible for checking that your grades are entered correctly into Canvas. Any change requests should be made within the one window of the grade being posted.

## Technology Information

Minimum technical requirements for UK courses and suggested hardware, software, and internet connections are available at ITS Student Hardware & Software Guidelines.

Students should have a computer with a webcam, microphone, and stable internet connection suitable for participation in an online class. Students should sign up for their own Zoom account for use in interacting with small groups and homework partners. All UK students receive a free Zoom Pro account. For collaborative problem solving, I recommend that you use your phone as a document camera, or that you use a drawing program such as the Zoom whiteboard or Google Jamboard in conjunction with a tablet.

For account help, contact UK's Information Technology Customer Services online, by email, or by phone at 859-218-HELP (4357). For general technical support, contact Engineering Computing Services via their request form.

## Communication

Most communication will be through Canvas. Students should receive the notification at UK email addresses. Students are expected to check their emails at least once a day, and should respond promptly to emails that warrant a response. Emails from the instructor and TA will be sent to your official UK email addresses. Students are expected to maintain a functioning mailbox. All students are encouraged to contact the instructor with any individual concerns regarding this course.

## Attendance

Students should attend all classes and participate in all field work associated with assignments. Excused absences are allowed in accordance with *Senate Rules 5.2.5.2.3.3*, described below. Students who do not feel well, who have a fever, who are under a quarantine order, or who may have been exposed to COVID-19 should self-isolate and avoid coming to class. They should notify the instructor as soon as possible. When practical, they should participate remotely and when not practical, a suitable make-up assignment will be arranged.

## My Expectations

I expect you to (1) complete the reading assignments and come prepared to class; (2) be attentive during lecture and actively participate in discussions; (3) come to classes in time and meet the due dates for assignments; (4) engage in critical thinking; (5) behave in a professional manner and be supportive of your classmates; (6) ask for help when you need it.

## Behavior

Students are expected to live up to the principles of the University of Kentucky creed:

- I promise to strive for academic excellence and freedom by promoting an environment of creativity and discovery.
- I promise to pursue all endeavors with integrity and compete with honesty.
- I promise to embrace diversity and inclusion and to respect the dignity and humanity of others.
- I promise to contribute to my University and community through leadership and service.
- I promise to fulfill my commitments and remain accountable to others.

The student code of conduct, along with the policies of the university and the College of Engineering, puts these principles into practice. Details of the code of conduct can be found at http://www.uky.edu/StudentAffairs/Code/part1.html.

Any form of academic dishonesty will not be tolerated. Bullying, acts of hate, or discrimination on the basis of race, sex, religion, national origin, age, disability status or sexual orientation will not be tolerated. Masks and social distancing is required for any in-person interaction. Appendix A lists detailed class and university policies.

## Resources

Appendix B lists relevant resources, including mental health resources. The Writing Center may be of value in this class.

Please ask if you need help academically, professionally, personally, or in any way. Your professors, advisors, teaching assistants, many of your peers are here to help. We many not have the answers, but we really do care about your well-being, and will do our best to find those who might.