



National University of Engineering (UNI)
School of Civil Engineering
Syllabus 2027-I

1. COURSE

CE3T4. Traffic Engineering and Urban Road Design (Mandatory)

2. GENERAL INFORMATION

2.1 Course	: CE3T4. Traffic Engineering and Urban Road Design
2.2 Semester	: 9 th Semester.
2.3 Credits	: 4
2.4 Hours	: 3 HT; 2 HP;
2.5 Duration of the period	: 16 weeks
2.6 Type of course	: Mandatory
2.7 Learning modality	: Face to face
2.8 Prerequisites	: CE2T4. Transportation Engineering. (8 th Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Traffic Engineering and Urban Road Design is the traffic-operations course of the Vialidad, Geomática y Transporte (DAVG) track, building on the transportation-systems foundation established in Transportation Engineering (CE2T4) to address how vehicular flow is measured, modeled, controlled, and made safe on urban streets and highways. The course opens with the planning context in which traffic facilities are sized and sequenced, and the geometric design practices used to translate planning decisions into context-sensitive urban roadway cross-sections. It then develops the analytical core of traffic engineering: traffic flow theory, highway capacity and level-of-service analysis, and the design of control strategies for both unsignalized and signalized intersections using national and MUTCD-equivalent standards. The course continues with macro/microsimulation modeling and arterial/freeway operations, intelligent transportation systems and connected-vehicle technologies, the estimation of a proposed development's traffic impact and the mitigation measures it requires, and closes with road safety engineering: crash data analysis, safety audits, and the Vision Zero safe-systems approach.

5. GOALS

- Explain the transportation planning process and apply travel demand and economic analysis methods that establish the context for traffic engineering decisions.
- Apply context-sensitive, multimodal geometric design principles to urban streets and complete-street cross-sections.
- Analyze traffic flow characteristics, highway capacity, and level of service for a range of transportation facilities.
- Design traffic control strategies – including signal warrant analysis, phasing, signage, and pavement markings – for unsignalized and signalized intersections.
- Utilize macro/microsimulation models and apply ITS/connected-vehicle technologies to evaluate and improve traffic operations.
- Estimate the traffic impact of proposed developments and design the mitigation measures required to maintain acceptable operating conditions.
- Analyze crash data and conduct road safety audits to recommend countermeasures under a Vision Zero safe-systems approach.

6. COMPETENCES

ABET-1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (Usage)

ABET-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. (Usage)

ABET-6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (Usage)

7. TOPICS

Unit 1: Transportation Planning and Economics (4 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Transportation planning process and institutional framework • Travel demand modeling and forecasting methods • Four-step travel demand model • Data collection methods for transportation planning • Economic evaluation and benefit-cost analysis • Activity-based modeling and advanced forecasting techniques • Multimodal transportation planning and integration • Sustainable transportation and environmental considerations • Public participation and stakeholder engagement • Performance measures and system monitoring	• Explain the transportation planning process and institutional relationships [Familiarity] • Apply travel demand forecasting methods to predict future travel patterns [Assessment] • Implement the four-step travel demand model for regional analysis [Usage] • Design data collection programs for transportation studies [Assessment] • Conduct benefit-cost analysis for transportation projects [Usage] • Utilize activity-based models for advanced travel demand analysis [Assessment] • Develop integrated multimodal transportation plans [Usage] • Incorporate sustainability principles into transportation planning [Assessment] • Facilitate public participation processes in transportation planning [Familiarity] • Establish performance measures and monitoring systems for transportation networks [Assessment]
Readings : [Ortuzar2011]	

Unit 2: Context-Sensitive and Multimodal Design (8 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Context-sensitive design process and stakeholder-based criteria flexibility • Complete streets principles and multimodal accommodation • Traffic calming elements for urban and residential streets • Three-dimensional coordination of horizontal and vertical alignment • Aesthetic and environmental considerations in geometric design • Access management and driveway spacing criteria	• Explain the context-sensitive design process and when design flexibility is appropriate [Familiarity] • Apply complete streets principles to accommodate multiple travel modes [Usage] • Select traffic calming elements appropriate to an urban or residential context [Assessment] • Coordinate horizontal and vertical alignment for a three-dimensionally consistent design [Assessment] • Consider aesthetic and environmental factors in geometric design decisions [Familiarity] • Apply access management criteria to driveway and intersection spacing [Usage]
Readings : [AASHTO2018], [NACTO2013]	

Unit 3: Traffic Flow Theory and Capacity Analysis (16 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Traffic flow characteristics and fundamental relationships • Highway capacity analysis using HCM methodology • Level of service concepts and analysis procedures • Traffic control devices and MUTCD standards • Signal timing and phasing design • Intersection capacity and delay analysis	• Explain traffic flow theory and fundamental traffic stream parameters [Familiarity] • Perform highway capacity analysis for various facility types [Assessment] • Determine level of service for transportation facilities [Usage] • Apply MUTCD standards for traffic control device design and placement [Assessment] • Design signal timing plans for isolated intersections [Usage] • Analyze intersection capacity and calculate control delay [Assessment]
Readings : [Roess2019], [HCM2022]	

Unit 4: Traffic Control Devices (14 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Classification and design of regulatory, warning, and guide signs • Sign placement, sizing, and retroreflectivity standards • Pavement marking types, materials, and placement standards • Traffic signal warrant analysis and justification studies • Signal phasing, sequencing, and vehicle/pedestrian detection design • Signal equipment, controllers, and maintenance considerations	• Classify traffic signs according to national/MUTCD-equivalent standards and select the appropriate sign for a given condition [Familiarity] • Specify sign placement, size, and retroreflectivity per design standards [Usage] • Design a pavement marking plan for a given roadway section [Assessment] • Conduct a signal warrant analysis to justify installing a traffic signal [Assessment] • Design signal phasing and detection layouts for an intersection [Usage] • Evaluate signal equipment and controller requirements for an installation [Familiarity]
Readings : [MUTCD2023], [Roess2019]	

Unit 5: Traffic Operations and Management (8 hours)	
Competences Expected: ABET-1,ABET-6	
Topics	Learning Outcomes
• Arterial analysis and signal coordination • Freeway operations and bottleneck analysis • Traffic simulation and microsimulation modeling • Incident management and traffic management centers • Roundabout design and capacity analysis	• Develop coordinated signal systems for arterial corridors [Usage] • Evaluate freeway performance and identify operational bottlenecks [Assessment] • Utilize traffic simulation models for complex operational analysis [Usage] • Implement incident management strategies and traffic management operations [Assessment] • Design roundabouts and analyze their operational performance [Usage]
Readings : [Roess2019], [Barcelo2010]	

Unit 6: Intelligent Transportation Systems and Connected Vehicles (4 hours)	
Competences Expected: ABET-6	
Topics	Learning Outcomes
• ITS architecture and system components • Traffic detection and surveillance technologies • Advanced traffic management systems • Traveler information systems and real-time data • Connected vehicle technologies and V2X communication • Autonomous vehicle systems and infrastructure requirements • Adaptive signal control and traffic-responsive systems • Electronic toll collection and congestion pricing • Transit signal priority and bus rapid transit systems • Data analytics and artificial intelligence in transportation	• Explain ITS architecture and identify system components [Familiarity] • Select appropriate traffic detection technologies for specific applications [Assessment] • Design advanced traffic management system deployments [Usage] • Implement traveler information systems and dissemination strategies [Assessment] • Describe connected vehicle technologies and communication protocols [Familiarity] • Evaluate infrastructure requirements for autonomous vehicle deployment [Assessment] • Apply adaptive signal control algorithms for traffic optimization [Usage] • Analyze electronic toll collection systems and pricing strategies [Assessment] • Integrate transit signal priority in multimodal networks [Usage] • Utilize data analytics and AI for transportation system optimization [Assessment]
Readings : [Sussman2005]	

Unit 7: Traffic Impact Studies (4 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Trip generation and distribution estimation for proposed land developments • Site access and driveway operational impact analysis • Mitigation measure design and improvement requirements	• Estimate trip generation and distribution for a proposed development using standard trip generation rates [Usage] • Analyze the operational impact of a proposed site's access and driveways on the adjacent street network [Assessment] • Design mitigation measures required to maintain acceptable levels of service around a proposed development [Assessment]
Readings : [ITE2021], [ITE2020]	

Unit 8: Road Safety Engineering (4 hours)	
Competences Expected: ABET-6	
Topics	Learning Outcomes
• Crash data analysis and identification of high-risk locations • Road safety audits and systematic safety reviews • Vision Zero and the safe systems approach to street design • Pedestrian and bicycle safety countermeasures	• Analyze crash data to identify high-risk locations and contributing factors [Assessment] • Conduct a road safety audit for a roadway or intersection [Usage] • Explain the Vision Zero safe systems approach to street design [Familiarity] • Recommend pedestrian and bicycle safety countermeasures for a given location [Usage]
Readings : [HSM2010]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY