



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

1. COURSE

CE2T4. Transportation Engineering (Mandatory)

2. GENERAL INFORMATION

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|-----------------------------------|---|---|
| 2.1 Course | : | CE2T4. Transportation Engineering |
| 2.2 Semester | : | 8 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 |
| | | <ul style="list-style-type: none">• CE2G1. Soil Mechanics I. (5th Sem) |
| 2.8 Prerequisites | : | <ul style="list-style-type: none">• CE2H1. Fluid Mechanics I. (5th Sem)• CE2T3. Geodesy. (7th Sem) |

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Transportation Engineering is the introductory survey course of the Highway, Geomatics, and Transportation (DAVG) specialization area. It gives students a panoramic view of every major transportation mode – highways, railways, ports, and airports – introducing the planning and economic framework common to all of them, the traffic control devices and intelligent transportation systems (ITS) used to operate road networks, and the fundamental alignment, operations, planning, hydraulic, and geometric design concepts specific to railway, port, and airport facilities. The course does not go in depth into any single mode; each is developed further in a dedicated course later in the specialization (e.g., Transportation Planning, Ports), for which this course lays the conceptual foundation.

5. GOALS

- Describe the fundamentals of multimodal transportation planning and economic evaluation, recognizing how road, rail, port, and air transportation systems integrate within a transportation network.
- Recognize the function, design principles, and technologies of traffic control devices and intelligent transportation systems (ITS) used to manage road traffic.
- Identify the fundamental alignment, operations, and capacity concepts of railway transportation systems.
- Identify the fundamental planning, maritime hydraulics, and structural design concepts applied to port terminals.
- Identify the fundamental planning and geometric design concepts applied to airports.

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 (2 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 : [Mannering2013]	

Unit 2: Traffic Control Devices (2 hours)	
Competences Expected: ABET-6	
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 : [Mannering2013]	

Unit 3: Intelligent Transportation Systems and Connected Vehicles (3 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 4: Railway Alignment Design (3 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Horizontal alignment and curve design for railway track • Vertical alignment and grade design for railway track • Superelevation (cant) and transition curve design • Track gauge and kinematic envelope (clearance) standards • Alignment design criteria by service type (freight, passenger, high-speed)	• Design horizontal alignment and curves for a railway track [Usage] • Determine vertical alignment and grades for a railway track [Usage] • Compute superelevation and transition curve lengths for a design speed [Assessment] • Describe track gauge standards and kinematic envelope requirements [Familiarity] • Select alignment design criteria appropriate to the service type [Usage]
Readings : [Profillidis2014]	

Unit 5: Railway Capacity and Operations (4 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Railway line and network capacity analysis • Timetabling methods and conflict resolution • Operations planning for freight and passenger service • Train dispatching and control center operations	• Analyze railway line and network capacity [Assessment] • Develop a conflict-free railway timetable [Usage] • Plan freight and passenger railway operations [Usage] • Describe train dispatching and control center functions [Familiarity]
Readings : [Profillidis2014]	

Unit 6: Port Planning (2 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Port master planning process • Site selection criteria for port development • Port system planning within national and regional logistics networks • Cargo and vessel traffic demand forecasting	• Develop a port master plan [Usage] • Evaluate candidate sites for port development [Assessment] • Describe how a port fits within a national or regional logistics network [Familiarity] • Forecast cargo and vessel traffic demand [Usage]
Readings : [Thoresen2014]	

Unit 7: Maritime Hydraulics for Ports (2 hours)	
Competences Expected: ABET-6	
Topics	Learning Outcomes
• Wave generation, propagation, and transformation analysis • Tide and current characterization for port design • Harbor agitation and resonance (seiche) analysis • Design metocean conditions and return-period selection	• Analyze wave generation, propagation, and transformation at a port site [Usage] • Characterize tides and currents relevant to port design [Familiarity] • Assess harbor agitation and resonance risk for a proposed layout [Assessment] • Select design metocean conditions for a given return period [Usage]
Readings : [USACE2002]	

Unit 8: Berth and Quay Design (3 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Quay wall design (gravity, sheet pile, and piled structures) • Berth dimensioning for design vessel classes • Mooring systems and bollard layout • Fender system selection and energy absorption design	• Design a quay wall for specified soil and loading conditions [Assessment] • Dimension a berth for a design vessel class [Usage] • Lay out a mooring system and bollard arrangement [Usage] • Specify a fender system based on berthing energy absorption requirements [Assessment]
Readings : [Tsinker2004]	

Unit 9: Airport Planning and Demand Forecasting (3 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Airport master planning process and site selection • Airport system planning within the regional and national context • Aviation demand forecasting methods • Airport capacity analysis and level of service	• Describe the airport master planning process and site selection criteria [Familiarity] • Integrate an airport within a regional airport system plan [Usage] • Forecast aviation demand using established methods [Usage] • Conduct airport capacity analysis and evaluate level of service [Assessment]
Readings : [Horonjeff2010]	

Unit 10: Airside Geometric Design (4 hours)	
Competences Expected: ABET-2	
Topics	Learning Outcomes
• Aerodrome reference code and airport reference code (ARC) classification • Runway orientation analysis and wind rose evaluation • Runway and taxiway geometric design standards • Safety area separations, runway/taxiway strips, and obstacle-free zones • Apron and aircraft holding bay geometric design	• Classify an aerodrome according to its reference code [Familiarity] • Determine runway orientation from wind rose analysis [Usage] • Design runway and taxiway geometry following FAA/ICAO standards [Assessment] • Verify required safety area separations and obstacle-free zones [Assessment] • Lay out aprons and aircraft holding bays [Usage]
Readings : [Horonjeff2010]	

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