250ST2132 - Traffic

**Coordinating unit:** 240 - ETSEIB - Barcelona School of Industrial Engineering

**Teaching unit:** 751 - DECA - Department of Civil and Environmental Engineering

**Academic year:** 2019

**Degree:**
- MASTER’S DEGREE IN SUPPLY CHAIN, TRANSPORT AND MOBILITY MANAGEMENT (Syllabus 2014). (Teaching unit Optional)
- MASTER’S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Teaching unit Optional)

**ECTS credits:** 5

**Teaching languages:** English

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**Teaching staff**

**Coordinator:** Pro. Francesc Soriguera

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**Opening hours**

**Timetable:** Friday 16-19h by appointment (e-mail).

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**Prior skills**

The course is grounded on fundamental concepts from classical theories of traffic flow. The application of these theories requires making use of fundamental tools (graphical and analytical) regarding transportation operations (e.g. trajectories diagrams, cumulative curves and queuing theory, measurement and estimation). The development of the course takes this background for granted, as it is acquired in the 1st course of the masters’ degree. The course is grounded on fundamental concepts from classical theories of traffic flow. The application of these theories requires making use of fundamental tools (graphical and analytical) regarding transportation operations (e.g. trajectories diagrams, cumulative curves and queuing theory, measurement and estimation). The development of the course takes this background for granted, as it is acquired in the 1st course of the masters’ degree.

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**Requirements**

Pre-requisite: Have passed or being enrolled in the subject 250ST013 - Operations in Transport and Logistics

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**Degree competences to which the subject contributes**

**Specific:**

- CESCTM2. Develop procedures for collecting transportation data that take into account their specificity, namely to apply appropriate treat, analyze and draw conclusions for appropriate use in models that require techniques.
- CESCTM4. Know and apply the modeling techniques and simulation optimization to solve the problems of design, operation and management of transportation systems.
- CESCTMF. Original to perform individually and present and defend before a university tribunal, consisting of a project in the field of logistics, transport and mobility research or professional nature in which synthesize and integrate the skills acquired in the teaching exercise.
- CESC1. Analyze and optimize the operations associated with the supply chains of companies and organizations in general, both globally and in each of its parts: supply, distribution, production, transportation, storage and retrieval.
- CESC4. Know and apply the techniques of modeling, simulation and optimization to solve the problems involved the design and management of supply chains.
- CETM2. Understanding and quantifying capacity fundamentals transport systems and mobility determine the safety, quality and sustainability of transport infrastructure and optimizing the operation of these systems.
- CETM3. Knowledge for planning, management and operation of transportation systems and mobility, ability to analyze service levels to users, operating costs and environmental and social such as mass transit, and private vehicle traffic impacts, air transport, sea transport, intermodal transport and urban mobility.
250ST2132 - Traffic

Teaching methodology

Two hours of lecture per week plus two hours of discussion every two weeks. Discussion sessions may not require physical presence. The semester lasts a maximum of 15 weeks.

No textbook is assigned to this course. Rather, the background readings for the course (e.g., portions of monographs, journal publications, etc.) have been compiled into a reader that will be distributed among the students. In general, the lectures will follow these materials closely. The professor will typically announce required reading assignments in advance. Ideally you would bring the reader (or suitable portions of it) to each lecture.

The students will be assigned practical exercises to be solved during the course. These will include 3 individual homework assignments and 2 group mini-projects.

Learning objectives of the subject

General Objectives
The course will examine the attributes of highway transportation systems, including traffic flow features and theories. Emphasis will be given to principles and concepts and their application.

Specific objectives
The course will address issues regarding freeway/highway traffic operation (i.e., diagnosis). Discussions will include methods of measuring traffic variables and of processing these measurements to evaluate prevailing conditions, to identify bottleneck locations, to uncover bivariate relations, etc. Considerable discussion will also be devoted to techniques for modeling traffic. This is only the first part of a traffic operations course. Freeway management techniques and highway traffic control (e.g., signal systems) are out of the scope of the course.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 30h</th>
<th>24.00%</th>
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<tbody>
<tr>
<td></td>
<td>Hours small group: 15h</td>
<td>12.00%</td>
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<tr>
<td></td>
<td>Self study: 80h</td>
<td>64.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time: 12h 30m</th>
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</thead>
<tbody>
<tr>
<td>1-Review of traffic fundamentals</td>
<td></td>
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<tr>
<td>Description:</td>
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<tr>
<td>Description:</td>
<td>31h 15m</td>
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<tr>
<td>Related activities:</td>
<td></td>
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<tr>
<td>Mini-Project 1</td>
<td></td>
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<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time: 31h 15m</th>
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<tbody>
<tr>
<td>2-Diagnosis</td>
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<tr>
<td>Description:</td>
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<td>Related activities:</td>
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<tr>
<td>Homework 1</td>
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</tbody>
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## 1-Review of traffic fundamentals

- **Variables and definitions**
- **Fundamental traffic equation**
- **Conservation equation**
- **Speed of a shock wave**
- **Moving observer**
- **Traffic diagrams**
- **KW theory**
- **Examples and limitations**

## 2-Diagnosis

- **Edie's generalized definitions**
- **Bivariate relationships**
- **Processing joint measurements**
- **Identifying bottlenecks**
- **Using N,T curves to identify bottlenecks**

## 3-Kinematic Wave Theory (KWT)

- **Kinematic Wave Theory (KWT)**
- **KWT (inhomogeneous roads)**
- **Relation to N curves**
- **Back of the Queue curve (BOQ)**
- **BOQ curves for under-saturated signalized intersections**
- **Newell?s simplified Theory**
- **Simplified theory of kinematic waves**
- **Examples**
- **Off-ramps**
Qualification system

The final course grade will be derived from the performance on the homework assignments (individual) and mini-projects (in groups). All the activities have the same value. Re-submissions or late submissions (i.e. after the in class correction, whether or not there has been an on-time submission) are accepted until the last session of the course. In this case, the final grade of the activity is obtained as the arithmetic average of the on-time and late submission grades. No submission on-time implies a zero grade for this part of the average. There is no final exam.

Regulations for carrying out activities

There is no final exam.

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### 4-Cell Transmission Model

**Learning time:** 31h 15m  
Practical classes: 7h 30m  
Laboratory classes: 3h 45m  
Self study: 20h

**Description:**  

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### 5-KWT extensions and car following models

**Learning time:** 18h 45m  
Practical classes: 4h 30m  
Laboratory classes: 2h 15m  
Self study: 12h

**Description:**  
KWT with different driver types. Moving bottlenecks. Limitations of KWT. Car following theories. Newell’s car following. Sharp shocks.

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### Description:

- 4-Cell Transmission Model (CTM).
- Homogeneous links.
- Merging, diverging (CTM).
- Congested off-ramps.
- KWT with different driver types.
- Moving bottlenecks.
- Limitations of KWT.
- Car following theories.
- Newell’s car following.
- Sharp shocks.
Bibliography

Basic:


Complementary:


Others resources:

Hyperlink

ATENEA - Digital Campus

https://atenea.upc.edu/moodle/login/index