3A7 – Transportation and Highway Engineering [5 credits]

Module organisation
The module is divided into two parts, Transportation Engineering and Highway Engineering

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<tr>
<th>Engineering Semester</th>
<th>Start Week</th>
<th>End Week</th>
<th>Lectures per week</th>
<th>Total</th>
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<td>1</td>
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<td>3</td>
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PART 1: HIGHWAY ENGINEERING

Lecturer: Prof. Margaret O’Mahony [margaret.omahony@tcd.ie]

Module Objectives
The objective of this part of the module is to enable students to differentiate between road pavement structures, to analyse road pavement structures, to differentiate between the different types of materials used and to design road pavements. The introduction of the design concepts, material properties and performance criteria are used together with vehicle loading criteria to demonstrate to the students how they are combined to design and construct road pavements. Another objective is to distil the principles of geometric design, both vertical and horizontal. To give the students the satisfaction of producing for themselves a full road pavement design, they are taken through one of the available methods and they perform examples so they can see how the principles and their application come together in a design.

Learning outcomes
At the end of this section of the module, the student will be capable of

1. Selecting the appropriate materials for use in different road layers
2. To evaluate the quality and performance of unbound and bound road materials
3. Perform road pavement design and analysis
4. Drawing up an appropriate road monitoring and maintenance programme
5. Interpret geometric design fundamentals, in relation to safety and driver comfort, focusing on horizontal and vertical alignment
6. Design the geometric curves of a road pavement

Module content
1. Introduction
2. Unbound Flexible Pavement Materials – Capping material and subbase
3. Bitumen – Properties and laboratory tests for property characterisation
4. Bituminous Materials – Open textured macadam, hot rolled asphalt, mastic asphalt and dense bituminous macadam
5. Flexible Pavement Design – Principles of design, design method and examples
6. Rigid Pavements – Properties of concrete, rigid pavement design and construction
7. Geometric Design – Fundamentals of forces on vehicles travelling on curved sections of road,
   Horizontal and vertical alignment, designed on the basis of safety and driver comfort

Textbooks
Highway Engineering, M. Rogers, Blackwell Publishing
Highway Engineering, CA O’Flaherty, Edward Arnold

PART II: TRANSPORT ENGINEERING
Lecturer(s): Prof. Margaret O’Mahony [margaret.omahony@tcd.ie] and Assoc. Prof. Brian Caulfield [brian.caulfield@tcd.ie]

Module organisation

Module description, aims and contribution to programme
The first objective of this part of the module is to enable the civil engineering students to formulate the fundamental principles of traffic flow, traffic characteristic measurements and their interpretation for infrastructure changes or development. The next objective is to enable them to employ what influences driver behaviour, particularly in relation to road safety, in the road design. Traffic signal timing design is included with a number of worked examples along with urban traffic control. The final objective of this part of the module is to develop the students’ thinking on how to approach the determination of solutions for urban traffic congestion problems with particular emphasis on the need for input from other disciplines in coming up with those solutions.

Learning outcomes
At the end of this section of the module, the student will be capable of:

7. Designing traffic signal timings for junctions
8. Performing the traffic studies necessary before making changes to or designing new road infrastructure
9. Exposing them to interdisciplinary approaches in solving engineering problems
10. Assess and conceptualise driver behaviour when developing engineering solutions to improve road safety
11. Appreciating the need for input from other disciplines to formulate policies for dealing with urban traffic congestion problems
12. Discuss and debate solutions to urban congestion

Module content

1. Introduction – Definitions of basic terms
3. Traffic Signal Timing Calculations – Saturation flow, optimum cycle time, effective green period and dealing with right turning traffic.
4. Urban Traffic Control
5. Driver Behaviour and Safety – Psychology of drivers, how drivers react in different situations, how to use knowledge of driver behaviour in designing engineering solutions.
6. Urban Congestion and Solutions – Public transport, demand management, promotion of non-car modes, integrated transport policies and freight management.

Textbooks
Highway Traffic Analysis and Design, RJ Salter and NB Hounsell, Macmillan
Principles of Highway Engineering and Traffic Analysis, FL Mannering and WP Kilareski, Wiley

Formal notes for the module are available on the web. The notes are placed on the web in advance of the lectures so the students can take them to lectures for annotation and insertion of their own comments.

Assessment
Assessment is performed by examination. The examination is two hours long and the paper is divided into two sections, Transportation Engineering and Highway Engineering, with three questions in each section. Students are expected to answer 4 questions, two questions from Section A and two questions from Section B.