Module 16 (New)	**Computation for Transportation Engineering**
Module code and mode of delivery	Code EEP55C23 Delivery mode: Hybrid (see below)
Module ECTS Weighting	5 ECTS
Semester of delivery	1
Module Contact Hours	Scheduled hybrid lectures (synchronous online and in-situ f/f) 22 hours, Independent student reading/Reflection using asynchronous materials in VLE 55 hours, Tutorials (f/f in-situ as appropriate) 22 hours, Continuous assessment 16 hours, Summative assessment 10 hours.
Module Coordinator	Prof Biswajit Basu
Module teaching staff and academic titles	Adjunct Assistant Prof Andrea Staino
Module description—content	Global mobility demand is rapidly increasing, and it calls for efficient and sustainable ways to move people and goods. Emerging technologies, digitalisation and advances in computing power have brought new tools and concepts for smart mobility development that will have a significant impact on people's lives and on society in general. This module covers aspects of computational algorithms in general applied to transportation systems with some special attention to railway transportation. Focus will be on techniques to approach a variety of topics on image recognition, passenger flow estimation, traffic planning and control. Emphasis will be given to Machine Learning methods for image analysis and anomaly detection. Due to strong industry connection in delivery, the module will make use of case studies from recent and ongoing research projects.
Module learning aims/objectives	1. To enable students to formulate and analyse dynamical models for transportation systems. 2. To develop capabilities to formulate algorithms for image analysis and decision making related to transportation engineering. 3. To enable students to design algorithms for operation and maintenance of transportation systems.
Module learning outcomes	On successful completion of the module students should be able to: **MLO16.1** Formulate digital twin models for transportation system maintenance. **MLO16.2** Critically assess anomaly detection methods for transportation systems.

	MLO16.3 Describe how time-series based models can be used for transport operation and maintenance. **MLO16.4** Apply special imaging techniques for traffic sign recognition and passenger flow analysis. **MLO16.5** Describe and critically assess imaging techniques for multi-task learning. **MLO16.6** Describe industry standard digital tools for rolling stock analysis. **MLO16.7** Describe and critically assess imaging techniques for multi-task learning. **MLO16.8** Describe, evaluate and apply signalling principles for railway transportation systems. **MLO16.9** Develop simulation tools for traffic scheduling and optimization. **MLO16.10** Formulate and solve problems in traffic management and control.
Module assessment, separate components and their weighting to be mapped into SITS	The module contains a mixture of tutorials and conventional lab sessions where students will be able to seek assistance on their assignments. There will be 22 lecture hours (i.e, 2 lecture hours per week from the start of the semester). The guideline for a 5 ECTS module is for 125 hours of student effort including class hours. ASSESSMENT MODE(S) Assessment will be based on 60% Continuous Assessment and 40% final exam. Continuous Assessment will be a mixture of algorithm design assignments and in-class tests. The students on the course will be guided through adapting assignments to complement their chosen project if possible. SYLLABUS • Computational models for mobility - Maintenance applications - Digital twins for maintenance - Time series analysis - Anomaly detection methods - Imaging techniques for transportation applications - Traffic signs recognition - Passenger flow applications - Multitask learning - Traffic management - Traffic simulation and analysis - Traffic scheduling and optimization • Aspects of Machine Learning - Neural networks - Quantum Machine Learning overview

	• An introduction to Railway Systems - Rolling stock and signalling principles - Notions of railway operation • Case studies