

## **Master of Science in Rail, Transport and Logistics**

**All modules carry 5 ECTS Credits each.**

### **1) Decision Support Systems for Transport and Logistics Processes**

This module equips students with the latest mathematical modelling approaches and computer-based support to address common logistical decision problems companies face today. Students will gain the necessary proficiency in problem-solving models and algorithms to represent different problem types and address real-world situations. They will be able to discern problem types, understand the limits of optimisation and appreciate the importance of having a decision support system in logistics.

**Hours: 45 / Semester: 1**

### **2) Public Transport Planning**

This module equips students with the foundational knowledge in public transport planning and organising of public transport networks, beginning with an in-depth discussion about the advantages and disadvantages as well as the functional characteristics of transit modes and their capacity. The geometry and types of transit lines and transit networks will be closely examined during this module. In addition, students will also be acquainted with public transport schedules, learn how to plan an integrated public transport system with a seamless trip / travel experience of the passengers, how to accelerate bus operation, and improve the efficiency of the public transport operation.

**Hours: 45 / Semester: 2**

### **3) Statistical Methods for Transport and Logistic Process**

This module introduces students to transportation science, which involves analysing empirical data and applying statistical methods in real-world situations. Students learn to analyse data by deploying the suite of analytical tools and software to identify patterns, gaps, and opportunities to make scientifically founded business decisions. Through this module, they would be able to gain a deep level of understanding of probability and statistical concepts.

**Hours: 45 / Semester: 1**

### **4) Traffic Impacts, Evaluation of Transport and Logistic Process**

The module focuses on sustainable transport solutions by deepening students' understanding of the intimate relationship between transport and its environment. Through interactive discussions, hands-on exercises and group activities, students will learn more about the various strategies for achieving a sustainable transport system. In addition, students will also acquire the necessary knowledge of the principles and concepts to assess and evaluate transport and logistics systems while gaining deeper insights into the advantages and drawbacks of different assessment methods, including application areas and constraints of assessment procedures.

**Hours: 45 / Semester: 1**

### **5) Transport and Urban Planning**

This module offers the foundational knowledge of transport, mobility, and urban planning, in which students advance their understanding of the reasons for traffic, spatial and temporal traffic distribution, the relationship between infrastructure planning and design, the assignment of functions in cities and conurbations, and dependencies between supply and demand. Students will also learn to apply travel demand modelling using the 4-step algorithm to estimate travel demand.

**Hours: 45 / Semester: 1**

#### **6) Introduction to Business Logistics**

The course will provide basics in the core principles of business logistics, where students gain insights into the functional logistics process and the pivotal role logistics play in a competitive landscape. Providing an incisive portrait of the various aspects of logistics processes, students engages in discussions and lessons to explore ways of optimising logistics in small groups working with real-life case studies to apply theory in practice, including also the opportunity to develop their critical thinking on the potential of information technology and digitisation in logistics.

**Hours: 45 / Semester: 1**

#### **7) Introduction to Supply Chain Management**

This module provides students with an insightful overview of supply chains' fundamental concepts, theories, and applications, covering its main challenges and planning methods. It aims to stimulate critical thinking and equips students with the strategic ability to find the insights behind theories that will help them to match the right supply chain for different types of products, align their supply chain planning in inventory management, procurement and sourcing as well as risk management to create value in supply chains.

**Hours: 45 / Semester: 2**

#### **8) Airport and Harbour Design**

This module gives an in-depth insight into the necessary components of airports and harbours and the planning processes for developing these sites. Students will enjoy the intellectual stimulation as the module reviews the various methods for operating airports and harbours through the lens of multiple aspects of the pre-planning process, such as environmental impacts leading to the ultimate choice of the location. Students will also learn about the essential components of airports, including the fundamental design concepts and operation and maintenance procedures necessary to manage key infrastructures successfully.

**Hours: 45 / Semester: 3**

#### **9) Basics of Traffic Flow and Traffic Control**

This module offers the foundational knowledge of transport, mobility, and urban planning, in which students advance their understanding of the reasons for traffic, spatial and temporal traffic distribution, the relationship between infrastructure planning and design, the assignment of functions in cities and conurbations, and dependencies between supply and demand. Students will also learn to apply travel demand modelling using the 4-step algorithm to estimate travel demand.

**Hours: 45 / Semester: 1**

#### **10) Consumer Industry Supply Chain Management**

The transformation that the consumer industry underwent over the past years has ushered in a new wave of technologies, such as analytical demand planning or integrated sales and operations planning, to ensure their operations are well integrated from suppliers through to customers with decisions made from an end-to-end perspective. This module addresses the key issues of logistics and supply chain management from the perspective of national and international consumer goods producers, wholesalers, retail chains and e-commerce companies from the fast-moving consumer goods, lifestyle and retail sectors. Students will be able to gain a solid understanding of the logistics framework across the value chain by analysing each step from the producer to the consumer. Students will also closely examine and analyse the possibilities of designing and integrating supply, engaging in close discussions on real-life case studies to apply theory in practice.

**Hours: 45 / Semester: 2**

### **11) Design and Applications of Material Handling Systems**

This module provides an incisive portrait of the issues that happen throughout the various stages of the supply chain. From the movement, storage, handling, and control to the protection of materials, goods, and products throughout the manufacturing, distribution, consumption and disposal process, students will closely study every stage of evaluating and selecting systems, mechanical equipment, systems and related controls. In addition, the module will also cover the principles of material handling systems and gain appreciation of leveraging internet of things technologies and ambient intelligence to optimise processes.

**Hours: 45 / Semester: 3**

### **12) Green Supply Chain and Risk Management**

At the intersection between sustainability and productivity, organisations find their competitive edge as they navigate the new revolutionary wave of business in this 21st century. This module aims to provide students a rigorous insight into green supply chains, their drivers and objectives emphasising on innovative methodologies and techniques to reduce its carbon footprint while increasing the company's short- and long-term profits. Students will also gain an in-depth understanding of the threats and growing vulnerability of global and local supply chains and strategies for mitigating and avoiding these risks.

**Hours: 45 / Semester: 3**

### **13) Healthcare Logistics**

High stakes in nature, managing healthcare logistics is practically a life-and-death scenario. This module emphasises the multifaceted and unique aspects of managing logistics and the supply chain in the healthcare industry undergoing disruptive changes by first introducing students to the fundamentals of healthcare management before deep-diving into the strategic aspects of procurement and logistics in healthcare. The industry is currently undergoing a phase of deregulation, which leads to privatisation, professionalisation and internationalisation. This framework will be intensively discussed, raising several pertinent decision situations that enable students to appreciate the sophistry in planning its logistics. In addition, students will also advance their understanding of the mechanisms of the healthcare value chain, develop a sound knowledge of appropriate tools and techniques in managing the slew of supply chain activities and evaluate the logistics processes in this particular field.

**Hours: 45 / Semester: 2**

### **14) Highway Design**

The module covers comprehensive insight into highway planning design of safe, highly efficient and sustainable. It covers knowledge of road transport networks, the driver vehicle- infrastructure interactions which served as guiding principles for road geometric design and pavement design, structural and functional performance, Nature-Based Solutions (NBS) transport infrastructure, transport infrastructure for electromobility, and Pavement Management Systems. The students will study and apply road planning strategies and tools by designing the road alignment for a new project through a case study.

**Hours: 45 / Semester: 1**

### **15) Industrial Logistics**

With an increasing number of logistics functions being outsourced to third-party logistics service providers (LSPs), a new set of challenges emerge that are different from traditional industrial management practices in many respects. The successful management of one's supply chain is critical to understanding LSP's complementary role in a company and how it can make a positive impact by improving efficiency and generating economic value. This module offers a critical insight into the global LSP industry, its key players and best management practices. Students are also introduced to the relevant theoretical concepts of advanced service management. In addition, students will understand the typical business models and management issues relevant to successful dealings with logistics outsourcing partners, thus preparing them for a successful career in the logistics services arena.

### **16) Logistics Service Provider (LSP) Management**

With an increasing number of logistics functions being outsourced to third-party logistics service providers (LSPs), a new set of challenges emerge that are different from traditional industrial management practices in many respects. The successful management of one's supply chain is critical to understanding LSP's complementary role in a company and how it can make a positive impact by improving efficiency and generating economic value. This module offers a critical insight into the global LSP industry, its key players and best management practices. Students are also introduced to the relevant theoretical concepts of advanced service management. In addition, students will understand the typical business models and management issues relevant to successful dealings with logistics outsourcing partners, thus preparing them for a successful career in the logistics services arena.

**Hours: 22.5 / Semester: 1**

### **17) Planning of Intralogistics System**

This module provides students with a solid foundation of some of the key methods and procedures in the field of material flow and logistics planning. Students will learn to apply the range of tools and assessment methods to develop different planning alternatives by beginning the module with the actual collection of data for detailed analysis. Students will also gain proficiency in applying qualitative and quantitative evaluation methods to select the best planning alternative. The course will also place an emphasis on intensifying students' theoretical foundation through working on a practical case study conducted in small groups.

**Hours: 45 / Semester: 2**

### **18) Transportation Modelling and Simulation Tools** This module deepens students' skills and knowledge in using macro- and micro-simulation to assess traffic engineering and transport

planning measures. The theoretical background of the methods implemented in the tools will be reinforced through extensive practical exercises using state-of-the-art software, followed by systematic analysis and discussions on how real-world simulation projects are structured. Students will learn to demonstrate their capability to set up a realistic simulation by gathering real-life data within the Singapore road network.

**Hours: 45 / Semester: 1**

### **19) Rail Transport and Rail Planning**

This module emphasises the foundational requirements and procedures for rail infrastructure planning on the premise of running behaviour and the performance of rail vehicles. Through discussions and in-person lessons, students will examine closer into the specific wheel-rail interface, the effective forces guiding the wheel sets (equivalent conicity), the determination and evaluation of track quality, the requirements for designing track alignment and layout, the tools to determine cant and cant deficiency, the procedures to design transition elements, the tilting train technology, the operational demands and respective track arrangements. Through this lesson, students will be able to confidently plan and design rails for passenger comfort and safety.

**Hours: 45 / Semester: 1**

### **20) Rolling Stock**

This module advances students' knowledge of rolling stock, focusing on the various rail concepts, such as high-speed trains and their interior designs, freight trains and freight wagons, and Mass Rapid Transit. The course pays particular attention to the wheel-rail interaction, running behaviour in curves and straight tracks, propulsion concepts, running gear and vehicle construction, body shells, bogie design, safety issues and environmental aspects such as energy efficiency and greenhouse gas emission in rail transportation. Existing and emerging applications of various engineering concepts through case studies will also be discussed in closer detail.

**Hours: 45 / Semester: 1**

### **21) Trackworks**

This module advances students' knowledge of trackworks, emphasising their understanding of forces acting between vehicle and track, the load distribution within the track superstructure into the substructure (Earthworks or civil structure), environmental impacts on the track performances, as well as the requirements for the design and construction of rail infrastructure. This module will pay particular attention to track design, the construction, maintenance and renewal of tracks for a variety of rail infrastructures (conventional and high-speed). In addition, students will also engage in intensive discussions on the conceptual design and structural performance of both traditional and ballastless track systems in learning about the logics and rationales behind the concepts.

**Hours: 45 / Semester: 2**

### **22) Train Control and Signalling Systems**

This module enables students to form a solid foundation in train control and signalling systems, in which the benefits and challenges of techniques used will also be closely analysed in lessons. The module will also deep dive into turnout, signals, track-based equipment, facilities, electronic interlocking and train control systems. Students will gain greater insights as the risk analysis and assessment of electronic systems and management of train schedules and transport risk are discussed in closer detail in this module.

**Hours: 45 / Semester: 2**

#### **24) Ballastless Track Systems**

One of the ground-breaking innovations in the railway infrastructure space, ballastless tracks are increasingly adopted globally due to their superior ride comfort, safety and low levels of care and maintenance. In this module, students learn in depth the requirements and procedures for ballastless track system design for high-speed and conventional mainline rail infrastructure. This specialised course also deep dives into the special features of Metro and light rail systems, train-track interactions, alignment and track layout for urban rail systems, the sources, propagation and effects on surrounding buildings and measures to counteract noises and vibration. Through this lesson, students will learn to design a variety of state-of-the-art tracks, such as special floating slab tracks, green tracks, tram tracks and embedded track systems, and assess their environmental impacts.

**Hours: 45 / Semester: 2**

#### **25) Modelling of Rail Infrastructure Using CAD-FEM-MBS**

This module introduces students to some of the most important computational tools and methods of planning infrastructure. Using Computer Aided Design (CAD) software, students will be able to apply these tools, requirements and rules set for railway planning proficiently on a student's project. Students will also learn about Finite Element Method (FEM) for the modelling and analysis of track structures, subsystems and components used for the design and evaluation of performance. Different approaches to creating Geometry models of these elements will be explored, particularly for rail/sleepers using ANSYS. Students will also learn about the basics of importing geometry files for FE analysis using ANSYS Workbench, applying simple analysis meshing methods, and understanding the compatibility of data transfer across different platforms in depth. The module will also use Multi-Body Simulation to simulate and analyse dynamic effects activated by vehicles running along track equipped with different track geometry and quality.

**Hours: 45 / Semester: 2**

#### **26) Traffic Operation and Control (ITS)**

This module enhances students' understanding of the general approach to traffic control and Intelligent Transportation Systems (ITS) in the urban and motorway context. It offers a critical understanding of the principles of different systems and their technical approaches while placing emphasis on the analysis of ITS applications in urban, extra-urban and integrated systems. The module will also deep dive into the objective, measures, methods, and algorithms of implementing ITS, building on students' knowledge gained in the modules "Basics of Traffic Flow and Traffic Control and "Transportation Modelling and Simulation Tools".

**Hours: 45 / Semester: 2**

#### **27) Transportation Modelling and Simulation Tools**

This module deepens students' skills and knowledge in using macro- and micro-simulation to assess traffic engineering and transport planning measures. The theoretical background of the methods implemented in the tools will be reinforced through extensive practical exercises using state-of-the-art software, followed by systematic analysis and discussions on how real-world simulation projects are structured. Students will learn to demonstrate their capability to set up a realistic simulation by gathering real-life data within the Singapore road network.

**Hours: 45 / Semester: 1**

### **28) Tunnel Works and Geotechniques**

In this module, students gain a comprehensive overview of tunnel works and geotechniques, covering the key aspects of the investigations conducted prior to the start of the project. Students will learn about the fundamentals of soil investigation, the basics of foundation, and earth construction in traffic ways. The course will also dive into the tunnelling methods and the techniques covering the various calculating methods and the prediction of settlements by tunnelling in loose soils.

**Hours: 45 / Semester: 2**

### **29) Urban Road Design**

This module provides students with foundational knowledge and analytical skills on urban road design in megacities by beginning with a detailed evaluation and discussion of the characteristics of various modes of transport and their advantages and disadvantages. Students will be able to appreciate the design rationale behind every single road design as they learn to analyse the challenges and needs of transport infrastructure in urban areas of big cities and agglomerations and consider correlations such as land use, capacity of passenger transport and environmental issues. Through this module, students will be able to proficiently apply the knowledge they have learned in planning, designing, and organising urban streets as spaces for living and develop solutions to organise transport efficiently for all modes and mobility needs.

**Hours: 45 / Semester: 2**