



**GRADUATE STUDY: TRAFFIC AND TRANSPORT, ITS AND LOGISTICS**  
**SEMESTER (III)**

**Syllabus**

Academic year 2021/2022

Course:		<b>Transport Ergonomics</b>			
Head of course:		Assoc. Prof. <b>Davor Sumpor</b> , Ph.D.			
Co-lecturers:		<b>Sandro Tokić</b> , mag. ing. traff.			
Semester: <b>III</b>	Course code: <b>171774</b>	Lectures: <b>30</b>	Auditory exercises: <b>20</b>	Laboratory exercises: <b>10</b>	ECTS credits: <b>5</b>
Group for lectures: <b>30 - 45 students</b>			Group for auditory and laboratory exercises: <b>30 - 45 students</b>		

**Objective of the course:**

- Improve the students' knowledge and cognitive and psycho-motoric skills which are required for ergonomic assessment of the traffic and work environment in the system "human – transport means – traffic environment", necessary for achieving the humane and economical work of drivers and other traffic participants, during the management of the existing and/or design of new traffic and transport processes, with the long-term goals: reducing the number of traffic accidents, as well as increasing the safety and reliability of transport processes.

**Learning outcomes:**

After the completion of the course the students will be able to:

1. Identify relevant factors of drivers' workload.
2. Apply statistical methods for processing field and laboratory measurements.
3. Evaluate all relevant performance factors of traffic participants' performance that affect the safety of transport processes.
4. Assess the causes and types of errors on practical examples or during laboratory performance measurements.
5. Create simple research design of performance measurements as well as relevant performance factors measurements.
6. Recommend guidelines in the multidisciplinary team for environmental adaptation to traffic participants.





## LECTURES and EXERCISES

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1.	<ul style="list-style-type: none"> <li>Introduction with syllabus, literature and scoring system.</li> <li>Introduction.</li> <li>Development of ergonomics.</li> <li>Classification of ergonomics.</li> </ul>	L	Davor Sumpor	2	The distribution of the credit system in the written form.
	<ul style="list-style-type: none"> <li>The difference between behaviourist and cognitive approaches to research</li> <li>Methodology for determining of statistical objective risk on the example of road traffic in the USA and GB</li> </ul>	AE	Davor Sumpor	2	
2.	<ul style="list-style-type: none"> <li>The use of statistics in ergonomics</li> <li>Harmonic analysis of body lengths on the basis of harmonic circle by Zederbauer and Muftic</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Calculate range of standing height of the central 90% of the random and sufficient sample for the mixed population</li> <li>Assignments with normal distribution for static and kinematic anthropometric measures</li> <li>Calculate the length of limbs from respondents standing height</li> </ul>	AE	Sandro Tokić	2	
3.	<ul style="list-style-type: none"> <li>Physiological anthropology</li> <li>Anthropometry</li> <li>Physiological-anthropological analysis of driving comfort</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Measuring anthropometric measures of drivers using Lafayette anthropometers -and digital scale with mechanical altimeter Tanita WB 3000.</li> </ul>	LE	Davor Sumpor	2	
4.	<ul style="list-style-type: none"> <li>Ambient factors of drivers' thermal comfort</li> <li>Quality of air</li> <li>Illumination, luminance and contrast in working environment</li> </ul>	L	Davor Sumpor	2	



	<ul style="list-style-type: none"> <li>Measuring Illumination, thermal comfort parameters and other ambient factors in working environment using device Metrel MI 6401 Polly EU</li> </ul>	LE	Sandro Tokić	2	
5.	<ul style="list-style-type: none"> <li>The driver from the perspective of psychology</li> <li>Human factors in driving</li> <li>Visual factors in driving</li> <li>Perception of road in driving</li> <li>Human error in behaviour in traffic</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Theoretical, open and dynamic TCI interface model "driver's capability-task requirements" according to Fuller in road traffic</li> <li>Forced reduction of the drivers task severity by speed limit</li> </ul>	AE	Davor Sumpor	2	
6.	<ul style="list-style-type: none"> <li>Sensory system of humans</li> <li>Daily or circadian rhythms</li> <li>Factors of total human reaction time in cognitive-motoric tasks (PRT)</li> </ul>	P	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Creating complex experimental design for performance measurement, with two independent variables, six independent groups of male subjects, tests with two levels of complexity of performance, comfort control and/or environment parameters using device Metrel MI 6401 Polly EU.</li> </ul>	LE	Davor Sumpor	2	
7.	<ul style="list-style-type: none"> <li>Energy required for working</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Creating complex experimental design for performance measurement, with two independent variables, six independent groups of female subjects, tests with two levels of complexity of performance, comfort control and/or environment parameters using device Metrel MI 6401 Polly EU.</li> </ul>	LE	Davor Sumpor	2	
8.	<ul style="list-style-type: none"> <li>Determination of segmental masses of humans.</li> <li>Determination of the position of body centre of gravity.</li> </ul>	L	Davor Sumpor	2	



	<ul style="list-style-type: none"> <li>Calculation of segmental masses of respondents by the Donskij-Zacijorskij regression method</li> <li>Determination of the points of gravity because of respondents' own weights beyond the static equilibrium position according to Muftic and associates</li> </ul>	AE	Davor Sumpor	2	
9.	<ul style="list-style-type: none"> <li>Determining the size of the human workload during the driving of vehicle.</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Survey of subjective disturbances of drivers</li> <li>Calculation of the lumbar moment <math>M_L</math> depending on body mass index BMI for hypothetical sitting working position</li> <li>Research of functional dependence <math>M_L = M_L(BMI)</math> for <math>n</math> subjects</li> </ul>	AE	Davor Sumpor	2	
10.	<ul style="list-style-type: none"> <li>Ergo-assessment of traffic and working environment factors</li> <li>Driver distraction factors</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Ergonomic assessment of proposals for improvement of road transport infrastructure elements using by IRAP methodology</li> </ul>	AE	Sandro Tokić	2	1 <sup>st</sup> quiz at the end of 8 lectures and 8 exercises
11.	<ul style="list-style-type: none"> <li>Ergonomic design of the working space in vehicles and locomotives.</li> <li>Systems for engine driver assistance.</li> </ul>	L	Zdravko Toš	2	
	<ul style="list-style-type: none"> <li>Algorithm for the design of symmetrical driver cab based on anthropomeasures range of the central 90% for mixed drivers' population, the parameters of vision field, hand reach, as well as basic eight levels of seats adjustment,</li> </ul>	AE	Davor Sumpor	2	Acceptance of topics proposed by students to the lecturers for obligatory seminar papers
12.	<ul style="list-style-type: none"> <li>Ergo-assessment of the cockpit</li> </ul>	L	Davor Sumpor	2	



	<ul style="list-style-type: none"> <li>Algorithm of analysis of the factors of ergonomic assessment from the groups of factors human factor and transport means (cockpit) with regard to the causes of pilot errors and safety</li> </ul>	AE	Davor Sumpor	2	
13.	<ul style="list-style-type: none"> <li>Ergo-assessment of transport sub-processes : handling with passengers and/or baggage.</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Analysis of the systems of concurrent factors of workload during loading of hand luggage in the cargo compartment of passenger aircraft Airbus A320</li> </ul>	AE	Davor Sumpor	2	
14.	<ul style="list-style-type: none"> <li>Impact of noise to the performance and workload of the drivers</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Measuring temporary (SPL) and equivalent level (L<sub>eq</sub>) of audible traffic noise using noise analyzer Nor140.</li> <li>Recording a daily accumulated dose of noise using a noise dose meter PCE - 355.</li> </ul>	LE	Davor Sumpor	1	
	<ul style="list-style-type: none"> <li>Conversion of the recorded noise dose on the amount for the nominal 8 hours.</li> <li>Conversion of the noise dose according to different standards (NIOSH, OSHA, EU, RH)</li> </ul>	AE	Davor Sumpor	1	
15.	<ul style="list-style-type: none"> <li>Relevant impact factors on safety and reliability of road vehicle drivers</li> <li>Driver assistance systems</li> </ul>	L	Davor Sumpor	2	
	<ul style="list-style-type: none"> <li>Field or laboratory measurements of audiograms using Audiometer Bell Plus HDA280 for respondents and / or traffic participants.</li> </ul>	LE	Davor Sumpor	1	
	<ul style="list-style-type: none"> <li>Analysis of results considering the sex, age, working age, etc.</li> </ul>	AE	Davor Sumpor	1	2 <sup>nd</sup> quiz (for lectures and exercises from weeks 9 to 15)

L = Lectures; AE = Auditory Exercises; LE = Laboratory Exercises; S = Seminars





## STUDENT OBLIGATIONS AND EXAMS

### Achieving the status of the course "completed for a student":

The student achieves the status of the course "completed for a student" for  $\geq 70\%$  of attendance during the lectures (10 credits from Table 1) and attendance at  $\geq 70\%$  of exercises (10 credits from Table 1). There are no pre-conditions from other courses except basic knowledge of descriptive statistics. If part-time students attend consultations, this is regarded as attendance in class, if absence from class has been excused and announced to teachers. The attendance in the percentage lower than 70% at lectures and exercises may be compensated by making an additional seminar paper for documented absence due to a justified cause and in this case a positively graded seminar paper is worth 20 credits (Item 3 in Table 1). The scope and content of the seminar paper depends on the number of absences.

**Written exam:** written evaluation of the cognitive skills of applying empirical facts and theoretical knowledge, as well as logical thinking in analytical tasks and theoretical models or algorithms of procedures, with the aim of achieving learning outcomes from 1 to 6.

### There are two ways of passing the exam:

- a) **Written quizzes** – consist of written tests twice during the semester. The first quiz can be attended by all students enrolled in the course in the current academic year. The second quiz at the end of the semester can be attended by the students who have been attending at least 70% of the classes and have acquired a positive grade from the obligatory seminar paper defended orally during consultations or at any time agreed with the lecturer (minimum or more than 10 credits, Item 4 – Table 1), and have acquired more than zero credits at the 1<sup>st</sup> quiz. From the positively graded both quizzes it is possible to acquire 10 to 20 credits (each quiz – maximum 10 credits).
- b) **Written test** – consists of a written exam at regular examination periods. The written exam can be attended by students who achieve the status of the course "completed for a student" in the course Transport Ergonomics (if not exempted from the written part of exam, according to Table 2, or if they want to achieve a better grade than the one obtained in the written quizzes), provided they have received a positive grade from the obligatory seminar paper defended orally at the time of consultation or at time agreed with the lecturer (minimum 10 credits or more, Item 4, Table 1). For successful completion of the written part of the exam it is possible to obtain 10-20 credits.

**Oral exam:** verbal evaluation of the cognitive skills of applying empirical facts and theoretical knowledge, as well as logical thinking on different theoretical models, with the aim of achieving learning outcomes from 1 to 6.

**Seminar works** (mandatory): The students independently prepare a seminar work, independently studying the recent professional and scientific literature, and finally present the seminar work in lecturer's consultations with the aim of achieving learning outcomes 1, 3, 4 and 6.





**Research participation reports:** After participating in the measurements, students are obliged to write a short report containing the research hypothesis, a description of the research design, a description of the measurement process and a description of how to use measurement equipment, as well as a critical review of the expected results in accordance with the scientific and professional literature, with the aim of achieving learning outcomes 2 and 4.

Research participation report of student researchers who conduct the measurements together with the lecturers can replace the mandatory seminar work.

**Oral exam** after positively graded written part of the exam:

After exemption from the written part of the exam (minimum 40 or more credits from all items from 1 to 6 in Table 1), or a positive grade of the written part of the exam (minimum 10 credits, Item 7, Table 1); with a positive grade of the obligatory seminar paper orally defended during the consultation or at time agreed with the lecturer (minimum 10 and more credits, Item 4, Table 1) the student attends the oral (theoretical) part of the examination.

The students who acquire a minimum of 56 or more credits from all items from 1 to 6 in Table 1 are exempted from oral part of examination (see Table 2).

**Extra credits:**

**The obligatory seminar paper** defended orally at the time of consultation (minimum 10 credits, Item 4 of Table 1). The student proposes the topic of the seminar paper to one of the lecturers of their own choice, and the chosen lecturer accepts and approves of the topic, and evaluates the completed seminar paper. During the individual preparation of the seminar paper, students develop the cognitive skills of critically evaluating hypotheses and scientific knowledge from the recent and relevant literature. The development of critical thinking and logical reasoning is evidenced by proposing own solutions for the investigated problem in the Chapter Discussion and proposing one's own conclusions in the Chapter Conclusion, in accordance with the research hypothesis set out in the Chapter Introduction.

The students who will participate in field research with the lecturers (measuring, recording, interviewing, surveying), or who will be co-authors on a expert or scientific paper, or who will be awarded with Rector's award or Dean's award, may be exempted from writing the obligatory seminar paper or written exam, depending on the extent of their involvement. After participating in a field or laboratory research, students are required to write a Research Participation Report, and the development of psychomotor skills is based on participation in the implementation of simpler research designs, as well as gaining the skills in handling measurement devices and / or instruments. Student is required to prepare a Research Participation Report.





## LITERATURE

### a) Obligatory literature:

1. Sumpor, D.: **Ergonomija u prometu i transportu**, fakultetski priručnik, Sveučilište u Zagrebu, Fakultet prometnih znanosti, Zagreb, 2018., ISBN: 978-953-243-108-7
2. Kroemer, K.H.E., Grandjean, E.: **Prilagođavanje rada čovjeku**, Naklada Slap, Jastrebarsko, 2000. (Original: Kroemer, K.H.E., Grandjean, E.: **Fitting the Task to the Human**, A Textbook of Occupational Ergonomics, Fifth Edition, Taylor & Francis, London, 1997.)
3. Dewar, R.E, Olson, P.L.: **Human Factors in Traffic Safety**, Lawyers & Judges Publishing Company Co., Tuscon, USA, 2007.
4. Sumpor, D.: **Laboratory Equipment Catalogue of Laboratory for Applied Ergonomics in Traffic and Transport**, University of Zagreb, Faculty of Transport and Traffic Sciences, Zagreb, 2013. (available on <http://static.fpz.hr/FPZWeb/files/katalog-laboratorijske-opreme/Laboratorij-za-primjenjenu-ergonomiju-u-prometu.pdf>)

### b) Recommended literature:

1. Woodson, W. E. et al.: **Human Factors Design Handbook**, 2<sup>nd</sup> ed., McGraw-Hill, Inc., New York, 1992.
2. Sanders, M.S., McCormick, E.J.: **Human Factors in Engineering and Design**, 7<sup>th</sup> ed., McGraw-Hill, Inc., New York, 1993
3. National Cooperative Highway Research Program REPORT 600: **Human Factors Guidelines for Road Systems**, Second Edition, Transportation Research Board of the National Academies, Washington, 2012.
4. Mučić, O.: **Biomehanička ergonomija** (Biomechanical Ergonomics), Fakultet strojarstva i brodogradnje, Sveučilište u Zagrebu, 2009., [http://www.fsb.unizg.hr/kbioerg/Preuzimanja/Biomehanicka\\_Ergonomija.pdf](http://www.fsb.unizg.hr/kbioerg/Preuzimanja/Biomehanicka_Ergonomija.pdf)
5. Mučić, O., Veljović, F., Jurčević – Lulić, T., Milčić, D.: **Osnovi ergonomije** (Basics of Ergonomics), Univerzitet u Sarajevu, Mašinski fakultet Sarajevo, Sarajevo, 2001.
6. Mučić, O., Milčić, D.: **Ergonomija u sigurnosti** (Ergonomics in Safety), Visoka škola za sigurnost na radu, Zagreb, Iproz, Zagreb, 2001.
7. Mišigoj-Duraković, M.: **Kinatropologija**, Kineziološki fakultet Sveučilišta u Zagrebu, Zagreb, 2008.
8. Ujević, D. et al.: **Theoretical Aspects and Application of Croatian Anthropometric System**, Faculty of Textile Technology, University of Zagreb, 2009.
9. Wickens, C.D., Hollands, J.G.: **Engineering Psychology and Human Performance**, 3<sup>rd</sup> ed., Prentice Hall, Upper Saddle River, New Jersey, 2000.
10. Dadashi, N., Scott, A., R. Wilson, J., Mills, A.: **Rail Human Factors "Supporting reliability, safety and cost reduction"**, Published by: CRC Press/Balkema, Taylor & Francis Group, 2013.
11. Welford, A. T. et al.: **Reaction Times**, Academic Press, London, 1980.
12. Drenovac, M.: **Kronometrija dinamike mentalnog procesiranja**, Sveučilište Josipa Juraja Strossmayera, Filozofski fakultet, Osijek, 2009.
13. Croatian Ergonomics Society: Proceedings of the conference **Ergonomics 2016-Focus on Synergy**, Zagreb, 2016.







14. Croatian Ergonomics Society: Proceedings of the conference *Ergonomics 2013*, Zagreb, 2013.
15. Croatian Ergonomics Society: Proceedings of the conference *Ergonomics 2010*, Zagreb, 2010.
16. Croatian Ergonomics Society: Proceedings of the conference *Ergonomics 2007*, Zagreb, 2007.
17. U.S. Department of health and human services: *Criteria for a recommended standard, Occupational Noise Exposure*, Revised Criteria 1998, Cincinnati, Ohio, 1998. (available on [www.cdc.gov/niosh/docs/98-126/pdfs/98-126.pdf](http://www.cdc.gov/niosh/docs/98-126/pdfs/98-126.pdf))

## METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN

### 1. LECTURES

Lectures accompanying material exposed in authorized materials (presentations and written templates) in detailed in the required and supplemental literature, and perform combined: the use of a Power Point presentation for the final shape of the model calculations or analysis algorithm, the conditions of application of verbal presentation and explanation of details, and with while further elaboration algorithm procedure and / or computational model calculations on the board. In the lecture, the team encourages discussion of issues that commits.

### 2. AUDITORIAL EXERCISES

Auditory exercises are performed in a way to solve numerical tasks of teaching units explained in lectures, or to analyze algorithms and procedures of individual models of ergonomics evaluation, or the results of measurements obtained during laboratory exercises are analyzed.

Students are provided by complete authorized instructional material in print form.

Students, in small groups, are simultaneously solving numerical problems on the board or on computers (Excel) and also participate in the analysis of algorithm procedures and model calculations. The team discussion and comparisons with real examples of the application of engineering practices is encouraged. Students are given an optional homework (optionally - ergonomic evaluation of realistic traffic situations).

### 3. LABORATORY EXERCISES

Laboratory exercises are performed in a way to include students into research and/or project drafts and measurements in real and/or laboratory conditions, as respondents and/or students researchers, using devices of the Laboratory for applied ergonomics in traffic and transport or other laboratories of FPZ.

Instruction for implementation in print form are provided to students (level of information available in the instructions depends on whether students participate as respondents or student researchers, depending on the level of personal motivation and the level of required previous knowledge).

### **Note: Individual and/or group viewing negative written test**

Individual at the time of consultation or a designated period after each colloquium and / or written exam. If necessary and at the request of a group of students in the form post exam exercises in order





to explain the most common mistakes typical, after discussion with the team responses to individual student issues.





## 5. DOCUMENTATION

Kept electronic records of presence in lectures and exercises (students carry out records using student cards). In Excel spreadsheet earned points for attendance at lectures and exercises, making compulsory seminar paper, as well as to partially pass the written exam over two colloquia. The points obtained under the conditions in Table 1 are several times during the semester published at specified places (bulletin boards and official web portals).

There is a paper and electronic record database in Excel for all students achieving the status of the course "completed for a student" and the exam date.

## 6. SCORING SYSTEM

**Table 1** - The scoring system for the monitoring of students and explained credit values in ECTS credits

no	Segment:	Required credits to be achieved:		Remark:	ECTS credits
		Min.	Max.		
1.	Presence in lectures:	10	10	Presence $\geq$ 70%	<b>0,5</b>
2.	Presence at the training:	10	10	Presence $\geq$ 70%	<b>0,5</b>
3.	Seminar paper (as needed)	20	20	<i>Replacement items 1. 1 and 2.</i>	<b>1</b>
4.	Seminar paper (mandatory):	10	20	Preparation at home and oral presentation at the time of consultation	<b>1</b>
5.	Participation in research and / or measurements (students associates on projects), co-authorship on an expert or scientific paper, Rector's award, Dean's award	10	20	<i>Replacement items 4. or for 4. and 6. (depending on the volume)</i>	<b><math>\Sigma</math> 1 - 3</b>
6.	Colloquies (written 2x per semester):	$\Sigma$ 10	$\Sigma$ 20	Numeric part (tasks)	<b><math>\Sigma</math> 2</b>
7.	Written exam (terms):	10	20	<i>Replacement items 6.</i>	<b>2</b>
8.	The verbal part of the exam:	/	/	Theoretical part with lectures	<b>1</b>
$\Sigma$	Overall points:	<b><math>\Sigma</math> 40</b>	<b><math>\Sigma</math> 60</b>	Overall ETCS points:	<b><math>\Sigma</math> 5</b>

### Assessment and evaluation of student during teaching and on the final exam:

Final evaluation is based on attendance, written exam, compulsory seminar paper and verbal parts of exam





**Table 2** - Explanation of the credit values in evaluations

CREDITS:	Estimate based on attendance, seminar paper and two colloquies (or written exam) - [4 ECTS]:	The final score [5 ECTS]:
40 - 45	Sufficient (2)	Exemption from the written part of the exam, the final score after oral exam
46 - 50	Good (3)	
51 - 55	Very good (4)	
56 - 60	Excellent (5)	Exemption from verbal parts of exam

All 5 ECTS can be gained in total only if the student has received a positive opinion on the oral part of the exam, or according to Table 2 free verbal parts of exam, the student is in index 5 credits recorded simultaneously with the entry of the final grade.

**Information for students** (scoring system, implementation plan, learning outcomes, syllabus, literature, consulting teachers, announcement of results of examinations or colloquium, and all other information):

- <https://moodle.srce.hr/2021-2022/>
- <http://www.fpz.unizg.hr>

**Student assistants:** Additional individual work with the students through individual consultations for assignments from auditory exercises and / or research designs from laboratory exercises, for optional homework, as well as for insight into the negatively written part of the exam.

