

<b>University:</b> University of Žilina in Žilina	
<b>Faculty:</b> Faculty of Mechanical Engineering	
<b>Subject code:</b> 2Y034	<b>Subject name:</b> Machining of Hard-to-machine Materials
<b>Profile subject:</b> no	
<b>Type, scope and method of educational activities:</b>	
Weekly number of teaching hours in the form of lectures, exercises, seminars, clinical practice.	2 - 2 - 0 (lectures-exercises-laboratory exercises) hours
The method by which the educational activity is carried out	The teaching takes place in person.
Methods of achieving educational results	<p><b>Lectures:</b> systematic theoretical problem interpretation of the issue, problem-oriented teaching, interactive lecture with multimedia support, semester written work, consultations in connection with feedback</p> <p><b>Exercises:</b> model examples, motivational demonstration, explanation, problem-based teaching, continuous written examination</p>
<b>Number of credits:</b> 5.0	
<b>Student workload:</b> $4h * 13$ (full-time teaching) + $52h$ (self-study) = 104 hours	
<b>Recommended semester / trimester study:</b> Summer semester	
<b>Degree of study:</b> 1. degree	
<b>Prerequisites:</b>	
<p><b>Conditions for passing the subject:</b></p> <p>The subject Machining of Hard-to-machine Materials is evaluated by points. The resulting points are the sum of the points that the student gets during the semester in the exercises and the points that he gets in the exam. It is possible to get max. 100 points, of which 30 points in the exercises and 70 points in the exam. During the semester, there will be one written test of 10 points, and then the student will prepare a paper on a selected topic in the field of cutting theory related to the specific aspects. Students should work out five home works (each of 4 points) in which specific aspects of cutting process will be analyzed.</p> <p><b>Final rating:</b></p> <p>The exam consists of a written part, which includes the elaboration of a theoretical question with a maximum number of points 30. The oral part of the exam is evaluated for a maximum of 40 points. The sum of the points obtained during the exam and during the semester determines the final evaluation of the completed course.</p> <p><b>The resulting classification of the subject:</b></p> <p>Rating A: 93 - 100 points  Rating B: 85 - 92 points  Rating C: 77 - 84 points  Rating D: 69 - 76 points</p>	

Rating E: 61 - 68 points

FX rating: less than 61 points.

The specific method of evaluating the student's work during the semester and the exam will be specified at the beginning of the semester by the subject teacher. The final evaluation of the student's study results for completing the course - expressed by a grade - is governed by Art. 9 Directive no. 209 Study Regulations for the first Degree of University Studies at the University of Žilina in Žilina.

Learning Outcome Scoreboard:

Forms and methods of evaluation	Scale	Area of knowledge, skills, competences
1 test	10%	Professional knowledge, independent work with professional literature
Written semester work	20%	Professional knowledge, independent work with professional literature
Written part of the exam	30%	Professional knowledge
Oral examination	40%	Professional knowledge

#### Learning outcomes:

By completing the course Machining of Hard-to-machine Materials, the student will be able to:

- analyze of the specific aspects of plastic deformation for the different hard-to-machine materials,
- to carry out decomposition of cutting forces in the cutting zone with respect of the different machinability of materials,
- to calculate heat produced in the different regions in the cutting zone as a results of variable mechanical properties of machined materials,
- interpret knowledge about the tool wear, cutting fluids machinability of materials and tool materials with special focus on machining hard-to-machine materials,
- assess the optimal cutting conditions for the different materials with respect of their different properties.

#### Course contents:

##### Lectures

- Cutting zone, models for chip formation as results of the different machinability of materials.
- Plastic deformation in the cutting region – models. Chip classification. Chip segmentation for Ti alloys and hardened steels.
- Differences in components of cutting force as a results of variable machinability of materials.
- Temperature and heat in the cutting region. Specific aspects as a results of the different thermal conductivity of materials.
- Tool wear – T-vc relationship. Tool wear in grinding.
- Machinability of materials and cutting ability of tool materials.
- Classification of materials with respect of their machinability.
- Plastic deformation in the cutting zone as a results of dislocation slip.
- Quality of machined surface with respect of materials machinability.

- Machinability of specific materials.
- Tool materials and their applications with respect of the mechanical and other properties of machined materials.

### Exercises

- Plastic deformation in the cutting region – comparison of cutting parameters for the different materials.
- Decomposition of cutting forces during turning as a function of mechanical properties of machined materials.
- Sources of heat and heat dissipation during machining of different materials.
- Residual stresses calculations after milling and grinding Ni and Ti alloys.
- Surface roughness comparison as a function of materials properties.

### Recommended reading:

NESLUŠAN, M. – ČILLIKOVÁ, M. (2015): Teoretické základy trieskového obrábania. Žilina: Edis – vydavateľské centrum ŽU v Žiline, str.248 , ISBN 978-80-554-1032-6

NESLUŠAN, M. – ČILLIKOVÁ, M. (2007): Teória obrábania, EDIS - ŽU v Žiline, ISBN 978-80- 8070-790-3

SHAW, M.C. (1985): The Theory of Metal Cutting, [https://doi.org/10.1007/978-1-349-07529-4\\_3](https://doi.org/10.1007/978-1-349-07529-4_3), ISBN 978-1-349-07529-4

STEPHENSON, D. – AGAPIOU, S. (2019): Metal Cutting Theory and Practice, Taylor & Francis Ltd, ISBN: 0367868199

KISHAWY, H. – HOSSEINI, A. 2019: Machining Difficult-to-Cut Materials, Basic Principles and Challenges, Springer Ltd., ISBN 978-3-319-95965-8.

**A language whose knowledge is required to complete the course:** english

### Notes:

### Course evaluation

Total number of evaluated students: 0

A	B	C	D	E	FX
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

### Person securing the subject (subject guarantor):

prof. Dr. Ing. Miroslav Neslušan

### Teaching:

Name and surname of the teacher, titles	Organizational form provided by the university teacher (Lectures, exercises, laboratory work, field exercises)
prof. Dr. Ing. Miroslav Neslušan	Lectures
prof. Dr. Ing. Miroslav Neslušan	exercises

**Date of last change:** 2.12. 2022

**Approved:** prof. Dr. Ing. Miroslav Neslušan.