UNIVERSITY
OF SKÖVDE

School of Engineering Science

WRITTEN EXAMINATION

Course: Material Processing Technology

Sub-course: Written Examination

Course code: MT508G

Credits for written examination: 2 ECTS

Date: 2025-01-17

Examination time: 08.15-12.30

Examination responsible: Dr Lennart Y. Ljungberg (Assoc. Professor)

Teachers concerned: Mahdi Eynian

The answers to the questions can sometimes be found in the related areas in the course book or the handouts given in the brackets after each question.

Note: L.Y. Ljungberg and M. Eynian can be contacted by telephone through the examination invigilators.

Instructions:

- ☐ Take a new sheet of paper for each teacher.
- ☒ Take a new sheet of paper when starting a new question.
- ☒ Write only on one side of the paper.
- ☒ Write your name and personal ID No. on all pages you hand in.
- ☒ Use page numbering.
- ☒ Don´t use a red pen.
- ☒ Mark answered questions with a cross on the cover sheet.

Grade points:

Maximum: 18p

Passed (G): 10 p or more
Not Passed < 10p

Examination results should be made public within 18 working days!

Good luck!

Total number of pages 4

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Part A. Quantitative problems. Motivate and show your calculations. 3 p per task! See the formulas in the end of this examination!

1. Let n = 0.5 in the Taylor equation for tool wear for cutting of steel at a depth of cut of 4 mm and feed rate of 0.25 mm. Compare the volume of material that can be removed before the end of tool life in two cases,
   - Case 1, the cutting speed is 250 m/min
   - Case 2, the cutting speed is 350 m/min

   (S3)

2. Calculate the suitable cutting speed in m/min, such that mean temperature increase is limited to 800°C when cutting Inconel with uncut chip-thickness t_0 of 0.050 mm. Use the mechanical and thermal properties listed in the table below:

	Inconel
Flow stress Y_f [MPa]	500
Thermal diffusivity $K \left[\frac{\text{m}^2}{\text{s}}\right]$	3.20×10^{-6}
Volumetric specific heat ρc, $\left[\frac{\text{N}}{\text{m}^2\text{°C}}\right]$	3.56×10^{6}

Note: make sure that all variables are used with correct and compatible SI units in the relevant equation. (S3)

Part B. Qualitative problems. Motivate your answers and if possible draw figures, even when this is not required! 3 p per task!

2. Give 3 reasons when machining operations may be required, and provide an example for each reason. (S1)

3. Tool life can be almost infinite at low cutting speeds and almost zero at too high cutting speeds. Discuss and give 3 reasons how to select a suitable cutting speed. Explain. (S1)

4. Explain the consequences of allowing temperatures to rise to high levels in the work part during cutting.

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5. Various machining methods.

   a) Explain the main principles of Chemical milling. (Ch 27.2)
   b) Draw a simple sketch showing the principles for an Electron Beam Machining process.
   c) Explain and describe two types of chips after machining.

6. Tools.
   Draw a simple picture of a used cutting tool. Show and explain three wear problems related to the tool. (Handout no 4)

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Appendix: Formulas in material processing

Taylor tool life equation $VT^n = C$

Mean temperature increase considering workpiece material properties:

$$T = 3.8 \frac{Y_f}{\rho c} \sqrt[3]{\frac{V t_0}{K}}$$

Mean temperature vs. feed and cutting speed $T_{mean} \propto V^a f^b$

Cutting Tool Material	a	b
Tungsten-Carbide	0.2	0.125
High-Speed Steel	0.5	0.375

Figure related to question B3: