Exam in Modern Manufacturing Processes MPR 033

Date: 2007-10-26

Time: 14.00-18.00

Examiner: Gustav Holmqvist, tel. 5026, 0709-393275

Will visit the exam about 15.00 and 16.30.

Ass. Devices: Approved calculator, pen, pencil, eraser, ruler, and written dictionary.

Credit list: Will be put on the board outside the dept. of Materials and Manufacturing Technology, 2nd floor, staircase A, M-building, Nov 14.

Checking: Checking of your exams can be made 2007-11-15, 12.30-13.15, at the department, 2nd floor, staircase A, M-building.

Grading Fail: 0-19,5p, 3: 20-29,5p, 4: 30-39,5p, 5: 40-50p

ECTS grading: Fail**:** 0-19,5p, E: 20-22p, F: 22,5-28p, C:28,5-34p, B: 34,5p-43,5p, A: 44-50p

General instructions: For full point you must make clear that you have understood the meaning of your answer. You must show the teacher that you have understood the question and it's answer. Write detailed answers and motivate and explain yourself. Write clearly and readable. Good Luck!

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1. Surface Topography

a) How can the tip of a stylus be used as a mechanical filter? (1,5 p)

b) What is *skewness* (Rk) and how can that give complementary information to the average roughness (Ra) of a surface topography? (2,5 p)

Metal forming

2. Drawing is one of the fundamental processes within sheet metal forming.

a) What type of parts can be manufactured by this process? Exemplify! (1p)
b) Explain the principle for a typical drawing operation (with a sketch!). (2p)
c) Which material properties are the most important for the drawability? (2p)

3. Bending

There are some important factors to consider when bending is used to form sheet metal. Describe briefly the practical meaning of the following five factors. Also describe which parameters (such as material and process parameters) that may influence each of them and/or how these effects can be minimised.

a) Springback (1p)
b) Workpiece length (1p)
c) Crack initiation at the outer edges (1p)
d) Minimum permissible bend radius (1p)
e) Bending near holes (1p)

4. Hydroforming

a) What are the *advantages* of hydroforming? For full scoring three different areas of advantage should be mentioned and explained shortly. (3 p)

b) What are the *disadvantages* of hydroforming? Mention four different disadvantages or explain shortly two different disadvantages. (2 p)

Unconventional machining methods

5. Abrasive Waterjet Cutting

a) Define and explain at least three geometrical defects one might find on an abrasive waterjet cut part. For two of the errors you should also explain its cause.

(Explanation of *geometrical defect*: form errors or geometrical errors which are NOT part of the surface topography). (3 p)

b) Describe how the abrasive waterjet is formed, using the traditional (injection) technique. Make a sketch of the cutting head. The pump unit does NOT need to be explained. Also shortly describe what constitutes the jet (what does it contain?) after leaving the nozzle. (2 p)

6. Laser Cutting

Laser light has to be transmitted from the laser source to the cutting head. There are two different laser types, commonly used for cutting, which use two different methods for transmission of the laser light.

a) Which are the laser types (laser media)? (1 p)

b) What two different methods (technologies) of transmission of the light do these laser types use, and how does this influence the possibility of automation? Also – what basic property of the laser light is the cause of this difference? (3 p)

Flame cutting:
c) What specific role does oxygen have when cutting in mild steel? (1 p)

7. Electrical Discharge Machining

a) Describe how conventional EDM works. Include the important parts of the machine and explain how the process works. You do NOT need to explain the electric circuit or the removal mechanisms in detail. (4 p)

b) If comparing EDM and USM: What material property typically explains why a material which can be machined with USM can not be machined with EDM? (1 p)

Metal Cutting

8. Grinding

a) What is difference between conventional grinding and creep-feed grinding? How can creep-feed grinding be more economical? (2 p)

b) Define the grinding ratio, G. Why is it of economical importance? (1 p)

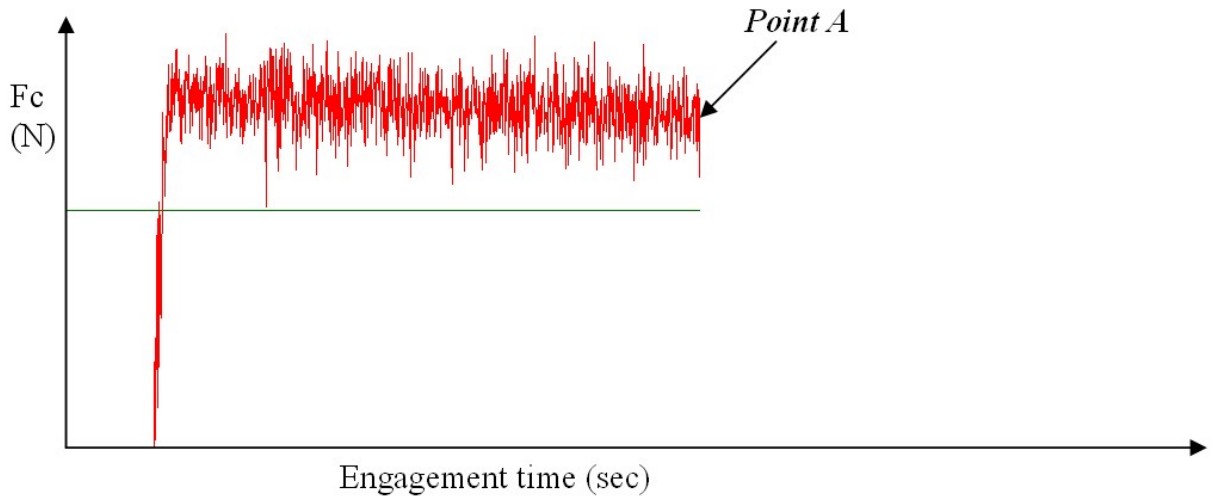
c) Which of the two processes *grinding* and *hard turning* has the highest energy consumption per unit volume removed? In your motivation you should include chip thickness and specific cutting force. (2 p)

d) CBN (or PCBN) is a material found as an abrasive in grinding discs, and also in metal cutting tools. Mention one advantage of CBN compared to diamond. (1 p)

9. Metal Cutting Fluids

a) What is an emulsion? What ingredients do you always find in an emulsion? (1 p)

b) See figure in below. At ***Point A*** the coolant is switched off by the programme in a CNC machine. Continue to draw the force behavior after point A. Make a new sketch in the hand-in. Explain the mechanism behind what happens. (*Hint:* Think about the tests that you performed in the lab). It does not matter if you use MQL or emulsion in your reasoning. (4 p)



10. High-Speed Machining

a) In HSM one can not just increase the rotational speed and hope for the best. Mention at least *three different things that have to be considered/changed – and how - before starting* to work with HSM. Think for example of the machine, the tool and of parameter settings. (1,5 p)

b) Which type of cooling is recommended for HSM? Explain why this is the case. (1,5 p)

c) Below pictures exemplify an advantage of HSM in aluminium. What is the advantage and how is this beneficial? (2 p)