

Material Removal Processes (MCL 136)
Major I

F.M. 40

Time: 2 hr(Exam time) +30 mins (for uploading the answersheets in Moodle)

All answers must be brief and to the point. Assume any relevant data wherever required. All parts of a question must be answered together.

1. Give short answers for the followings with proper explanations. Use sketches wherever relevant to explain in details. 10x2=20
 - i. Explain with proper sketch why for ceramic single point cutting tools a negative rake angle is always preferred?
 - ii. What is a rim and core structure as obtained in high performance ceramic tool and what is its significance?
 - iii. With sketch explain the elasto-plastic contact length as prevalent in a single point machining operation and why its knowledge is important?
 - iv. Explain with neat sketch any suitable method which can be used to measure cutting temperature when a conductive workpiece is turned using a ceramic cutting insert.
 - v. Why is it not advisable to use straight carbide tool (WC+Co) for machining of steels?
 - vi. In an electrodischarge machining (EDM) process why the tool is kept as a cathode? Why normally air is not used as the dielectric in EDM process?
 - vii. Explain how in a waterjet machining (WJM) process the water pressure is amplified? What is the role of an accumulator in the WJM process?
 - viii. Find out an expression for finding the velocity of the abrasive waterjet in Abrasive Waterjet Machining process.
 - ix. What is grit number in context to the abrasives as used in grinding wheels? For high surface finish during grinding which grit number (low or high) is generally preferred and why?
 - x. Distinguish between a half bridge and a full bridge strain measuring system as used in strain gauge based dynamometers.

2. A batch of 10 cutting tools could produce 500 components while working at 50 rpm with a tool feed of 0.25 mm/rev and depth of cut of 1mm. A similar batch of 10 tools of the same specification could produce 122 components while working at 80 rpm with a feed of 0.25 mm/rev and 1 mm depth of cut. How many components can be produced with one cutting tool at 60 rpm. 4

3. Orthogonal turning is performed on a cylindrical workpiece with the shear strength of 250 MPa. The following conditions are used: cutting velocity is 180 m /min, feed is 0.20 mm/rev, depth of cut is 3 mm, chip thickness ratio = 0.5. The orthogonal rake angle is 7° . Applying Merchant's theory for analysis, find out the shear and frictional forces. 4

4. A blind hole is being generated by the boring process. The diameter of the hole is 25 mm and the thickness of the plate is 60 mm. The cutting velocity used in the process is 60 m/min and the feed is 0.2 mm/rev. If required, assume the approach and the overrun each of 2mm, and find out the actual machining time (in min) for making the blind hole. 3

5. With neat schematic explain the ploughing phenomenon as observed in a grinding operation. What is wheel loading phenomenon and mention any two detrimental effects of such wheel loading. 2+2=4
6. Explain what is specific energy requirement during machining and mention why the non-conventional processes mostly have a high specific energy requirement compared to the conventional machining processes? Explain with appropriate reasons why the Abrasive Jet Machining process is not normally used for machining of the ductile work materials? 1+2+2=5
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