



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.TECH(ME)/SEM-1/MME-103A/2012-13**

**2012**

**ADVANCED METAL CUTTING THEORY**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for the following :  $10 \times 1 = 10$ 
  - i) If  $t$  is the thickness of undeformed chip in mm,  $\phi$  is the side cutting edge angle of the single point tool and  $s$  is the feed in mm/rev, then
    - a)  $t = s \cdot \sin \phi$
    - b)  $t = s \cdot \cos \phi$
    - c)  $s = t \cdot \sin \phi$
    - d)  $s = t \cdot \cos \phi$
  - ii) In 18-4-1 HSS, the ratio corresponds to
    - a) W : Cr : V
    - b) V : Cr : W
    - c) W : V : Cr
    - d) Cr : V : W
  - iii) Relief angle on HSS tool usually varies from
    - a)  $3^\circ$  to  $10^\circ$
    - b)  $11^\circ$  to  $15^\circ$
    - c)  $16^\circ$  to  $20^\circ$
    - d)  $22^\circ$  to  $27^\circ$
  - iv) A cutting tool can never have its
    - a) Rake angle – positive
    - b) Rake angle – negative
    - c) Clearance angle – positive
    - d) Clearance angle – negative.



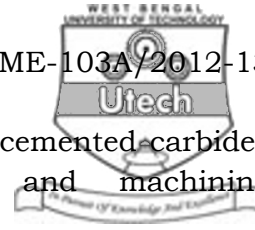
- v) Tool wear in carbide tool takes place due to
- a) diffusion
  - b) adhesion
  - c) abrasion
  - d) all of these.
- vi) In ECM the material removal is due to
- a) corrosion
  - b) erosion
  - c) fusion
  - d) ion displacement.
- vii) In Abrasive Jet Machining (AJM) the commonly used abrasive is
- a) aluminum oxide
  - b) diamond power
  - c) glass beads
  - d) boron carbide.
- viii) In USM, increasing volume concentration of abrasive in slurry would
- a) decrease MRR
  - b) increase MRR
  - c) initially decrease and then increases MRR.
- ix) For making a fine hole of 0.2 mm in diameter, the best process to use is
- a) AJM
  - b) EDM
  - c) USM
  - d) LBM.
- x) Which of the following is used as a dielectric medium in EDM ?
- a) Distilled water
  - b) Deionised water
  - c) Tap water
  - d) None of these.

**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following  $3 \times 5 = 15$

2. What are the types of cutting tool patterns observed in single point tool ? How do they affect the metal cutting performance ?



3. How do the cast-cobalt alloys differ from cemented carbides in terms of material composition and machining performance.
4. Derive the expression for the main cutting force in orthogonal cutting in terms of cutting process parameters.
5. What is Machinability ? Explain the method of representing the machinability.
6. How do you define tool life ? Explain the parameters that control tool life of a single point cutting tool.

**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

7. Discuss the nature of friction found in metal cutting. How do you explain the large value of apparent coefficient found in metal cutting.

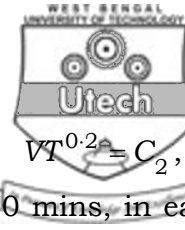
A 50 mm outside diameter mild steel tubing is turned on a lathe with cutting speed of 20 m/min, with a tool having rake angle of  $35^\circ$ . The tool is given a feed of 0.1 mm/rev and it is found by dynamometer that the cutting force is 2500 N and feed force is 1000 N. length of continuous chip in one revolution is 80 mm.

Calculate coefficient of friction, shear plane angle, velocity of chip along tool face and chip thickness.

8. The following data related to orthogonal cutting of mild steel part :

Cutting speed = 200 m/min; Tool rake angle =  $12^\circ$ ; Width of cut = 1.8 mm; Uncut thickness = 0.2; Coefficient of friction between tool and the chip = 0.55; Shear stress of work material = 390 N/mm<sup>2</sup>. Calculate (i) Shear angle, (ii) The cutting and thrust forces.

Where the desirable characteristics of a cutting tool material ? Explain how these are satisfied in the case of high speed steel tools.



9. For HSS tool  $VT^{0.13} = C_1$ , for Carbide tool  $VT^{0.2} = C_2$ , at cutting speed 24 m/min, the tool life was 170 mins, in each case. Compare their lives at 30 m/min. The following equation for tool-life is given for a turning operation  $VT^{0.14} \times f^{0.78} \times d^{0.38} = C$   $T = 1$  hr when  $V = 28$  m/min  $f = 0.3$  mm/rev,  $d = 2.6$  mm.

Calculate the tool life if  $V$ ,  $f$  and  $d$  increased by 25% individually also taken together.

In orthogonal turning of a low carbon steel bar of dia 150 mm with uncoated carbide tool, the cutting velocity is 90 m/min. The feed is 0.24 mm/rev and the depth of cut is 2 mm. The chip thickness obtained. If the orthogonal rake angle is zero and the principal cutting edge angle is  $90^\circ$ . Calculate the shear angle.

10. Discuss mechanism of metal removal for abrasive jet machining. Write the applications of different types of abrasive used in AJM.

Explain how would you make use of the Faraday's law of electrolysis for computing the material removal rate and the tool feed required during Electro-chemical machining.

11. How does EDM machine employing relaxation circuit compare with pulse generator. Explain the function of abrasive slurry used in USM process. What are the important characteristics of the abrasive used in USM. Name at least 3 common types of abrasive used in USM.

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