

Internal Assessment Test - II

Sub: Machine Tools & Operations						Code:	15ME45B		
Date:	09 / 05 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	IV	Branch:	MECH
Answer Any FIVE full Questions									
							Marks	OBE	
								CO	RBT
1	A)	Describe different types of Tool motions in machining process				[4]	CO2	L1	
	B)	Briefly explain the desirable properties of cutting tool material				[6]	CO3	L2	
2		Derive the equations for the following machining parameters for turning operations spindle speed, cutting speed, cutting time, depth of cut, feed rate and material removal rate.				[10]	CO2	L3	
3		A mild steel bar of 63mm diameter and 200 mm long is to be turned to 60 mm diameter with the help of a HSS tool. Determine the cutting speed and time of machining if the approach length is set at 5mm and feed is set at 0.2mm/rev.				[10]	CO2	L3	
4		Estimate the time required to machine a cast iron surface 250 mm long and 150 mm wide on a shaper with cutting to return ratio of 3:2. Use a cutting speed of feed of 21mm/min, a feed of 2mm stroke and a clearance of 25 mm. the available ram strokes on the shaper are 28,40,60 & 90 strokes/min. also, determine MRR assuming depth of cut as 4mm.				[10]	CO2	L3	
5	A)	Briefly explain the elements of single point tool with a neat sketch				[6]	CO3	L2	
	B)	Write short notes on the following cutting tool materials: (a) HSS (b) CBN				[4]	CO3	L1	
6		With a neat sketch, briefly explain the following for a single point cutting tool, (a) Back rake angle (b) End clearance angle (c) Side cutting edge angle (d) Nose radius				[10]	CO3	L1	
7		Derive the equations for the following machining parameters for slab milling operations spindle speed, cutting speed, cutting time, depth of cut, feed rate and material removal rate.				[10]	CO2	L3	

# Machine Tools & Operations

## Scheme of Evaluation

### Internal Assessment - 2

Sub code - 15ME45B

1)

- A) Definition of machine tool 2  
Types of Tool motions  
1) Primary motion or Cutting motion 2  
2) Auxiliary motion 2

B)

- Properties of cutting tool  
1) Hot hardness 1  
2) Toughness and impact strength 1  
3) Coefficient of thermal expansion 1  
4) wear resistance 1  
5) Chemically stability 1  
6) Cost 1

2)

- 1) Spindle speed - It is expressed in RPM and it is denoted by letter  $\underline{N}$  1  
2) Cutting speed - It is the relative speed at which the tool passes through 1

the w/p material and removes the metal.  
It is expressed in. m/min.

If  $V$  is the cutting speed,  $N$

$N$  is the spindle speed.

$D$  is the diameter of the w/p.

Then

$$V = \frac{\pi DN}{1000} \quad \text{m/min}$$

$$V = \frac{V_s}{\pi DN} \quad \text{mm/min.}$$

### 3) Cutting time ( $T_c$ )

It is the time taken to cut per pass and is denoted by ( $T_c$ )

If  $L$  is the length to be turned.

$$T_c = \frac{L}{fN} \quad \text{min.}$$

### 4) Depth of cut

It indicates how much the tool digs into the w/p during each pass and is denoted by letter ' $d$ ' and is measured in mm.

### 5) Feed Rate -

The relative speed. at which the tool is linearly traversed over the w/p to remove the material.



### b) Material Removal Rate

It is the total volume of material being removed per unit time.

$$MRR = \text{cutting speed} \times f \times \text{depth of cut}$$

$$MRR = \pi D N f t \quad \text{mm}^3/\text{min.}$$

3)

Given

$$D_1 = 63 \text{ mm} \quad D_2 = 60 \text{ mm}$$

$$t = \frac{D_1 - D_2}{2} = \frac{63 - 60}{2} = 1.5 \text{ mm.}$$

$$\text{Length of job} = 200 \text{ mm} = L_j$$

$$f = 0.2 \text{ mm/rev}$$

$$\text{Length of approach} = 5 \text{ mm} = L_{app}$$

Let us assume. ~~speed~~ <sup>spindle speed.</sup>  $N = 200 \text{ rpm}$

Machining speed.

or  
Cutting speed  $= V = \frac{\pi D N}{1000} \text{ m/min}$

$$= \frac{\pi \times 63 \times 200}{1000}$$

$$V = 39.58 \text{ m/min}$$

$$\text{Cutting time} = T_c = \frac{L}{f N}$$

$$= \frac{L_j + L_{app}}{f N} = \frac{200 + 5}{0.2 \times 200}$$

$$= 5.125 \text{ min}$$

4) Given

$$L_j = 250 \text{ mm}$$

$$b = 150 \text{ mm}$$

$$m = \frac{2}{3} = 0.667$$

$$V = 21 \text{ m/min}$$

$$f = 2 \text{ mm/stroke}$$

$$C = 25 \text{ mm}$$

$$t = 4 \text{ mm}$$

$$\begin{aligned} \text{Total length of stroke} &= L_j + 2C \\ &= 250 + (2 \times 25) \\ L &= 300 \text{ mm} \end{aligned}$$

we, know

$$V = \frac{N_s L (1+m)}{1000}$$

$$\therefore N_s = \frac{V \times 1000}{L(1+m)} = \frac{21 \times 1000}{300(1+0.667)}$$

$$N_s = 41.9 \text{ strokes/min}$$

$$N_s \approx \underline{42 \text{ strokes/min}}$$

Nearest available ram strokes is 40 strokes/min which is very near to the calculated value.

$$\Rightarrow \underline{N_s = 40 \text{ strokes/min}}$$

Thus

$$\text{Machining time} = T_c = \frac{b}{N_s f} \text{ min}$$

$$T_c = \frac{150}{40 \times 2}$$

$$\underline{T_c = 1.875 \text{ min}}$$

## Material Removal Rate (MRR)

$$MRR = f \cdot N_s \cdot L \cdot (1+m)$$

$$= 2 \times 4 \times 40 \times 300 (1+0.667)$$

$$MRR = \underline{160032 \text{ mm}^3/\text{min.}}$$

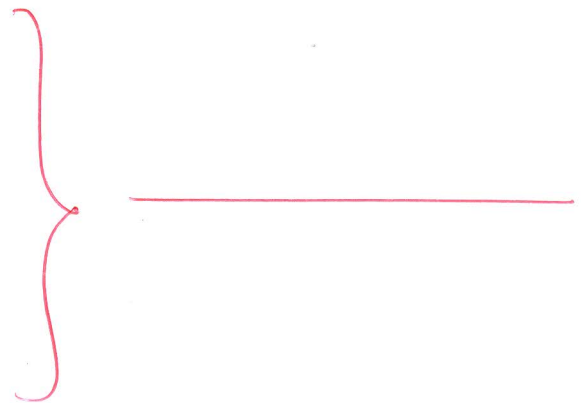
3

5)

A) \* sketch of single point cutting tool

2

- \* Flank
- \* Heel
- \* Base
- \* Face
- \* cutting edges.



4

B)

Brief explanation of HSS & CBN

2+2

6)

\* 2D sketch of single point cutting tool

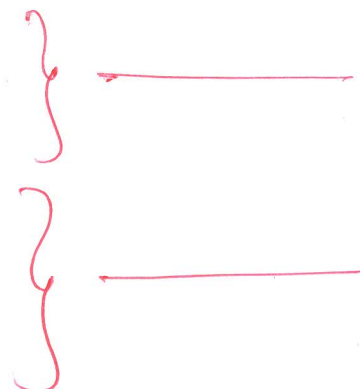
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\* Back rake angle

\* End clearance angle

\* Side cutting edge

\* Nose radius



3

3

7)

## Slab milling parameters.

- 1) Spindle speed - Sp. Rotational motion of arbor and is denoted by letter 'N' is measured in rpm.
- 2) Cutting speed - It is the linear velocity of any point on the periphery of the cutting edge. It is expressed in m/min.

$$V = \frac{\pi DN}{1000} \text{ m/min.}$$

where

D = dia. of w/p.

N = speed of the spindle.

- 3) Feed Rate - It is the rate with which the w/p moves under the cutter while milling. It is expressed as mm/tooth of cutter ( $f_t$ ) or mm/rev of cutter ( $f_r$ ) or mm/min ( $f_m$ ).

$$f_m = f_t \times Z \times N \text{ mm/min}$$

- 4) Depth of cut - It is the thickness of the metal removed from the w/p in one pass of the cutter on the w/p. It is expressed in mm.



## Machining time.

It is the total time taken to mill a given surface on a w/p.

A milling cutter does not make a complete cut when it first comes in contact with the w/p.

$$T_m = \frac{L + L_A + C_1 + C_2}{f_m}$$

where

$L_A$  = length of tool approach

$C_1$  &  $C_2$  = are the clearances on both sides of the w/p.

$$L_A = \sqrt{t(D-t)}$$

## Material Removal Rate (MRR)

$$MRR = \frac{b \times t \times f_m}{1000} \text{ mm}^3/\text{min}$$

where

$b$  = width of cut, mm

$t$  = depth of cut, mm.

$f_m$  = feed rate mm/min.