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INSTITUTE OF
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Internal Assesment Test - II

Sub:	Machine Tools & Operations							Code:	17ME45B
Date:	16 / 04 / 2019	Duration:	90 mins	Max Marks:	50	Sem:	IV	Branch:	MECH (A & B)

Answer ALL FIVE Questions. Assume appropriate data where ever necessary.

		Marks	OBE CO	OBE RBT
1	Explain the different motions involved in machining. List the desirable properties of a cutting tool material.	[6+4]	CO2	L2
2	Explain with neat sketch any 4 operations that are carried out on a drilling machine.	[10]	CO2	L2
3	Explain with a neat sketch the indexing mechanism on a milling machine. List the different operations that can be carried out on a grinding machine.	[7+3]	CO2	L2
4	Estimate the machining time required for machining a 5mm thick layer from a workpiece of 200X400X50mm MS material. The available stroke rates are 10,20,40 and 80 strokes per minute. The feed is considered to be 0.28 mm/stroke. The depth of cut is given as 1mm during each cut. Consider the cutting speed of 30m/min. Also determine MRR.	[10]	CO3	L3
5	It is required to grind a bar of length 210mm and diameter 40mm on a cylindrical grinding machine. The machining allowance is 0.2 mm. The wheel diameter is 600 mm and its width is 63mm. Determine the machining time for a cutting speed of 35 m/min and depth of cut of 0.005mm.	[10]	CO3	L3

Machine Tools and Operations

IAT 2 Solution (April 2019)

1. The material from a job is removed due to the relative motion between the job and tool. So it is absolutely necessary to have some form of relative motion between the tool and job. These relative motions are classified into two main categories, they are :-

   1. **Working Motion**
      a. **Cutting Motion** :- This is the relative motion between the tool and job because of which the material is removed from the job, you can see this in fig 2.1, the rotation of the work in turning and the rotation of tool in milling are the examples of cutting motion.
      b. **Feed Motion** :- Feed motion is provided to be able to move the job or tool with respect to each other so that the entire job can be machined.
   2. **Auxiliary Motions**
      a. **Indexing motion** :- This motion is given in a milling machine where the spherical gear blank is divided into equal parts and then rotated so that equidistant gear teeth can be cut.
      b. **Relieving motion** :- This motion is given to the tool or work when the operation is done and the relative motion between the tool and work has to be stopped. This motion is in the opposite direction to feed motion.

Ideal properties of tool material

a. **High hardness**:- If the tool has to remove material from the work, it needs to be harder than the work. This will ensure minimum wear of the tool and thus lesser number of times it has to be re-sharpened or replaced.
b. **High hot hardness** :- As discussed in the previous point, hardness at room temperature is just not sufficient, because the operating temperature of the tool is well above room temp. Therefore the tool material needs to have higher hardness at higher temp, called higher hot hardness.
c. **Chemical Stability** :- We do not want the tool to reac with the work especially at higher working temperatures, hence the tool has to be chemically stable.
d. **Anti-Welding** :- During welding there is a huge amount of pressure and temperature involved at the contact point of the tool and work, the tool should not weld itself to the work at these extreme conditions.
e. **Less Diffusivity** : -As we know, diffusivity of a material increases exponentially with temperature, hence the diffusivity of the tool has to be less during the high temperatures of machining, this avoids any atoms from the tool to diffuse into the work and contaminate it.
f. **High melting point** :- At the higher machining temperatures, the tool should not soften and loose its hardness, therefore the melting point has to be higher.
g. **High thermal conductivity** :- The tool should help dissipate heat from the machined area, this helps in cooling the work.
h. **Low co-efficient of thermal expansion** :- The tool material should have Low co-efficient of thermal expansion because we do not want the tool to deform when subjected to higher temperatures.

present to remove material (or) chips from inside the hole during the drilling operation.

Drilling operations:-

Some of the operation carried out on a drilling machine are:-

(i) Drilling.
(ii) Boring.
(iii) Reaming.
(iv) Tapping.
(v) Counter sinking
(vi) Counter boring.

(i) Drilling operation:-

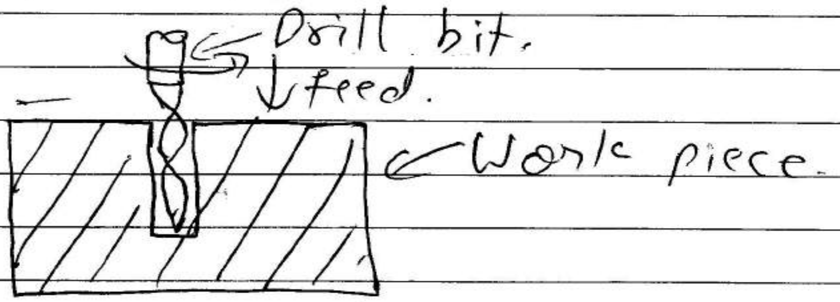


Fig 3.7. drilling operation

As explained earlier. drilling is done to produce a hole of required size. The drill bit is fixed to the chuck of the drilling machine and is made to rotate ~~about~~ along the drill axis. Then this rotating drill bit is moved closer to the workpiece until it makes contact with it. Then the feed which is parallel to the ~~workpiece~~ drill axis is given to the ~~workpiece~~ drill bit. Because of the relative motion between the ~~&~~ drill bit and workpiece material from the workpiece is removed. The depth of feed depends on the depth of hole required. The diameter of the hole will be equal to the diameter of the workpiece. All this while the workpiece is held firmly in the vice.

(ii) Boring:-

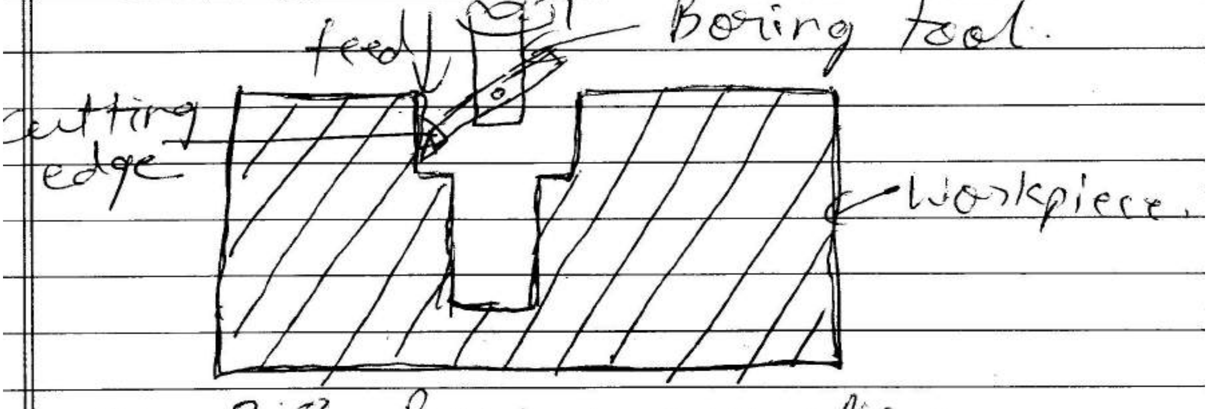


Fig 3.8. Boring operation

Boring operation is done to increase the diameter of previously drilled hole. The boring tool has an adjustable cutting edge. The length of this cutting edge can be varied according to the requirement. The tool rotates along the drill axis and the feed is parallel to the axis. This operation is usually used when the drill bit of a required diameter is not available and hence this can be used instead.

(iii) Reaming :-

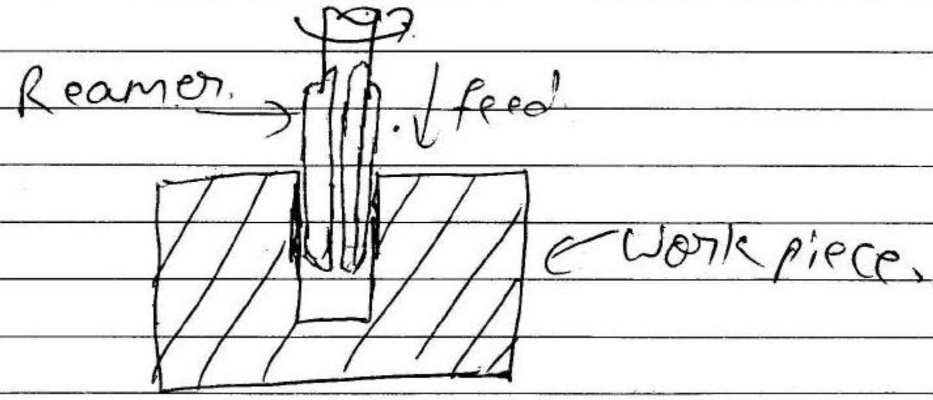


Fig. 3.9. Reaming

Reaming is an operation carried out for finishing a pre-drilled hole. The reamer rotates along the drill axis and the feed is parallel to the axis. The reamer has cutting edges running the entire length of the tool. This tool removes only small amounts of material but it gives a good surface finish to the inner walls of the previously drilled hole.

(iv) Tapping :-

Tapping operation is done to

cut threads on the inner walls of the hole. The tap rotates along

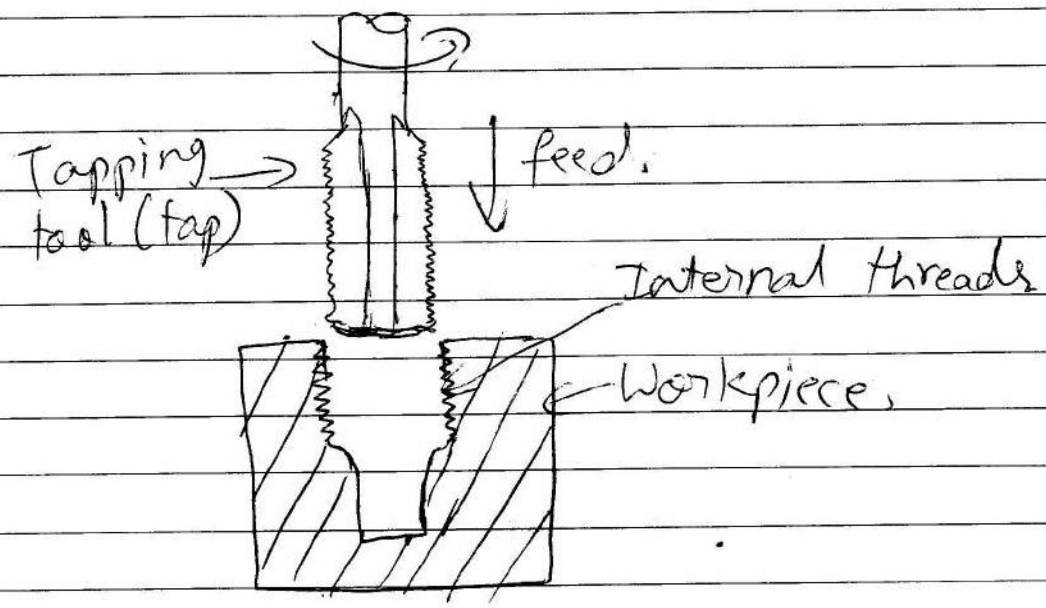


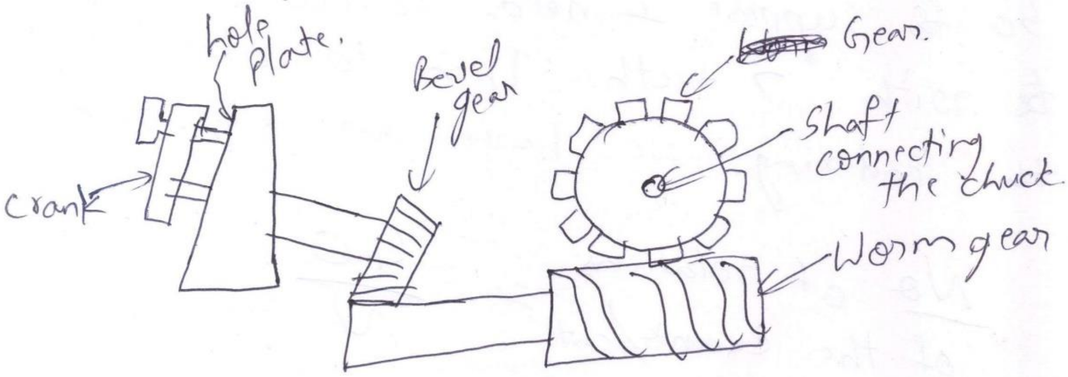
Fig 3.10. Tapping

The drill axis and the feed is parallel to the axis. ~~The~~ Initially a hole of diameter just smaller than the actual diameter required. The tap used should have the same pitch as the pitch of the thread required in the hole. As the tap enters the hole, it cuts threads on the inner walls of the hole.

(v) Counter Sinking :-

Counter sinking is done to obtain a tapered ~~hole~~ at the begining of the previously drilled hole.

3. Indexing Mechanism :-



The above diagram shows a schematic representation of the indexing mechanism. It consists of a crank which rotates around a hole plate. The crank is connected to a bevel gear which inturn rotates the shaft which holds the worm gear. This worm gear is matted to a gear. One rotation of the crank rotates the gear at the end of the mechanism by $\frac{1}{40^{th}}$ of a rotation.

The gear at the end of the mechanism has a shaft passing through it which is connected to the chuck.

The indexing hole plate has 49 holes.

around its circumference.
So ~~fo~~ suppose I need to cut a gear ~~fo~~ with 7 teeth. Then to calculate the indexing we have an equation.

$$\frac{\text{No of rotations of the crank/cut}}{} = \frac{40}{N}$$

N = No of teeth required

$$\Rightarrow \frac{\text{Crank rotations}}{\text{cut}} = \frac{40}{7}$$

$$= 5\frac{5}{7}.$$

~~But~~ This means that you have to rotate the crank 5 full times and $\frac{5}{7}$ times of the next rotation between each cut. but we will not know what $\frac{5}{7}$ of a rotation means, therefore,

$$\frac{5}{7} \times \frac{7}{7} = \frac{35}{49}.$$

So you have to complete 5 full rotations and rotate the crank by 35 holes on the sixth rotation between each cut.

List of operations done on a grinding m/c :-

→ Taper Grinding.
→ Surface Grinding
→ Way Grinding
→ Gear Teeth Grinding.
→ Thread Grinding.

4. Given :-

$b = 200mm$
$L_{job} = 400 mm$
thickness $= 50mm$
~~A~~ $S = 10, 20, 40 + 80$ strokes/min.
$f = 0.28mm/stroke.$
$d = 1mm.$
$V = 30m/min.$
$T = ?$
$MRR = ?$

$$T = \frac{b}{sf}.$$

$$V = \frac{sL(1+R)}{1000}$$

~~L = 30 + 400 + 30 = 460 mm~~

Assume $R = \frac{2}{3} = 0.667$.

$$30 = \frac{S(400)(1.667)}{1000}$$

$$\Rightarrow S = \frac{1000 \times 30}{400 \times 1.667}$$

$$\Rightarrow S = \frac{30000}{666.8} \Rightarrow S = 44.99.$$

$$\Rightarrow \boxed{S = 40 \text{ strokes/min}}$$

$$\Rightarrow T = \frac{200}{40 \times 0.28} = 17.85 \text{ min}$$

for 5 mm $T = 17.85 \times 5$.

$$\Rightarrow \boxed{T = 89.25 \text{ min}}$$

$$MRR = f \times d \times S \times L(1+R) \text{ mm}^3/\text{min}$$

$$= 0.28 \times 1 \times 40 \times 400 (1+0.667)$$

$$\boxed{MRR = 7468.16 \text{ mm}^3/\text{min}}$$

5. Given

$L_{job} = 210mm$

$D_w = 40mm$

M/c allowance = 0.2 mm

$D_g = 600mm$

$B_g = 63mm$

$V = 35 m/min$

$d = 0.005 mm$

$$T = \frac{ikL}{N_g F}$$

$L = L_{job} + 2(0.5B_g)$

$= 210 + 2(0.5 \times 63)$

$\Rightarrow L = 273mm.$

$$V = \frac{\pi D_w N_g}{1000} \text{ m/min}$$

$$N_g = \frac{1000 \times V}{\pi D_w} = \frac{35 \times 1000}{\pi \times 40}$$

$N_g = 278.5$ rpm

$F = f B_g.$

Assume $f = 0.3$

$\Rightarrow F = 0.3 \times 63$

$F = 18.9$ mm/rev.

$$i = \frac{0.2}{0.005} = 40 \text{ passes}$$

$$T = \frac{40 \times 1.4 \times 273}{278.5 \times 18.9}$$

$$T = 2.9 \text{ min}$$