

B.Tech.

Fifth Semester Examination

Manufacturing Technology-II (ME-309-F)

Note : Attempt any *FIVE* questions.

Q.1. During orthogonal turning operation, the following data was obtained :

Cutting force	= 130 kg
Feed force	= 50 kg
Rake angle	= 10 degrees
Feed	= 0.2 mm/rev.
Width of cut	= 2 mm
Chip thickness	= 0.5 mm
Cutting speed	= 110 mm/min.

Determine the following :

- | | |
|--------------------------|--------------------|
| (i) Chip thickness ratio | (ii) Shear angle |
| (iii) Shear stress | (iv) Shear energy. |

Ans. (i) In the absence of any dots on the machining constant, we shall be merchant's fission solution to find out the shear plane angle, so, from equation

$$2\phi + \lambda - \alpha = 90^\circ$$

Where,

$$\lambda = \tan^{-1} \mu = \tan^{-1} 0.5$$

$$= 26.57^\circ$$

$$\alpha = 10^\circ,$$

Thus,

$$\phi = \frac{90 + 10 - 26.57}{2} = \text{degrees} = 36.7^\circ$$

(ii) Using equation, we have

$$F(s) = \frac{2 \times 0.2 \times 400}{\sin 36.70^\circ} = 262.3 \text{ N}$$

$$R = \frac{262.3}{\cos(36.7^\circ + 26.57^\circ - 10^\circ)} \text{ N}$$
$$= 438.6 \text{ N}$$

Now, that R has been determined, F_C and F_T can be calculated, using equation (4.10) as

$$F_C = R_{\cos}(26.57^\circ - 10^\circ)$$
$$= 420 \text{ N}$$

$$F_T = R_{\sin}(26.57^\circ - 10^\circ)$$
$$= 125 \text{ N}$$

Shear angle is 86.7°

Drip Thickness ratio is 438.6 : 1

Q. 2. Discuss the method of manufacturing, properties and applications of following cutting tool materials :

(i) **Carbides** (ii) **Ceramics** and (iii) **Cubic Boron Nitride (CBN).**

Ans. (i) Carbides : The basic ingredient of most carbides is tungsten carbide. Carbide suitable for steel machining consists of 82% tungsten carbide, 10% titanium carbide & 8% cobalt. Carbides have very high hardness over a wide range of temperatures and have relatively high thermal conductivity.

They have strong tendency to form pressure welds at low cutting speeds and hence they should be operated at high speeds considerably in excess of those used for HSS tools.

(ii) Ceramics : Even though the carbides can make the process of cutting highly productive, they are very expensive; ceramic is an inexpensive tool material and in many cases, they are efficient substitutes for connected carbides. Their main constituent is aluminium oxide.

Ceramic tool can cut almost any metal & withstand high heat, but they are very brittle & will not take shock. Ceramic tools can give externally five finishes to the surface of a material. It can be operated at speed twice that of carbides. The red hardness of the order of 1200°C is in ceramic.

(iii) Cubic Boron Nitride (CBN) : Diamond being a form of a carbon is not thermally very stable & at high temperature readily react with iron. Cubic boron nitride has been developed as an alternative to diamond, for machining ferrous materials. CBN consists of nitrogen & boron, with a special structural configuration similar to diamond.

CBN is the second hardest material known; has red hardness upto 1000°C .

1. Shaping & Planning : In shaping & planning, the surface obtained is plane. In shaping, the cutting tool is given a reciprocating motion & after every cutting stroke, the work is fed perpendicularly in order to provide a layer of the uncut material to the tool. Since here the cutting is not continuous, the machining is known as an intermittent cutting operation.

2. Turning : This is a very basic operation & produces a cylindrical surface. Of course, by face turning, a flat surface can also be obtained. The machine tool used for this type of operation is known as lathe.

3. Drilling : This is used for making a hole in a solid body.

4. Milling : A versatile machining operation, it can produce various types of surfaces. In plain slab milling operations, the tool is mostly known as a milling cutter, possesses a number of cutting edges.

5. Grinding : In grinding the cutting tools are the sharp edges of the abrasive grains of the grinding wheel. These grains are very large in number & have a random orientation & distribution.

Q. 3. What are the different causes of tool wear? How and where do flank and crater wear occur respectively? How do they progress and how these two types of wear can be measured? Discuss in detail.

Ans. It is well known that whenever a solid surface slides over another, a resistance force, commonly referred as the friction force, develops. The friction phenomenon was first scientifically studied by Amontons & Coulomb. Since this phenomenon is extremely complicated, we shall be restricted on it to a very elementary level.

Let us consider 2 solid surfaces in contact. When a solid surface slides over another, both the surfaces are subjected to a gradual loss of material. A fraction of the material loss from one surface may be transferred to the other body, whereas the same gets removed in the form of small (wear) particles. This process of gradual loss or transfer of material from a body is known as wear.

The three major mechanisms of wear, relevant to the manufacturing processes are :

- Abrasion
- Adesion
- Diffusion.

Crater Wear : Crater wear occurs on the rake face of cutting tool & it occurs at a distance from the cutting edge.

Crater wear is a result of rubbing between the chip & the rake face of tool. As the crater wear progresses, the cutting edge becomes weaker & it may lead to the chipping of cutting edge.

Crater wear can be reduced by using chip breakers.

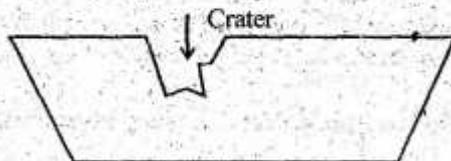


Fig. (a) Crater Formations & Wear

Flank Wear : Flank wear occurs on the face of the tool; flank wear is due to the continuous contact between the newly machined work's shoulder surface & the flank face of the tool because of the depth of cut.

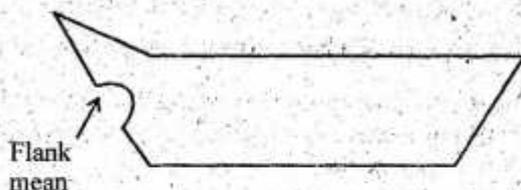


Fig. (b) Flank Wear

Q. 4. What do you understand by gear generation? Discuss the following methods of gear manufacturing :

- (i) gear hobbing and (ii) gear shaping.

Ans. Milling is perhaps the most versatile meaning operations & most of the shapes can be generated by this operation. It is especially more in dispensable for machining the parts without rather at symmetry

$$AB \& AC \sin \beta \text{ or}$$

$$t_{1 \max} \approx \frac{f}{N^2} \sin \beta$$

$$\cos \beta = \frac{OT}{OA} = (\beta - d)/(D/2)$$

$$\sin \beta = [1 - \cos^2 \beta]^{1/2} = \left[1 - \left(1 - \frac{2d}{D} \right)^2 \right]^{1/2}$$

$$\approx 2 \sqrt{\frac{d}{D}}$$

$$f_{1 \max} = \frac{2f}{N^2} \sqrt{\frac{d}{D}}$$

Gear Hobbing : Any involute gear of a given pitch will mesh with a rack of same pitch. One form of cutting gears utilizes a rack as a cutter. If it is given a reciprocating motion similar to a cutting on a follows shaper,

involute teeth will be generated on the gear as it is rotated intermittently in mesh with the rack cutter.

The hobbing system of manufacturing gears is somewhat similar to the principle just described. A rack is developed into a cylinder, the teeth forming threads and having a lead as in a large screw.

Hobbing, may be defined as a generating process consisting of rotating and advancing a fluted steel worm cutter part on revolving blank. This cutting action is where the teeth on a worm gear are being cut to full depth by a rotating hob.

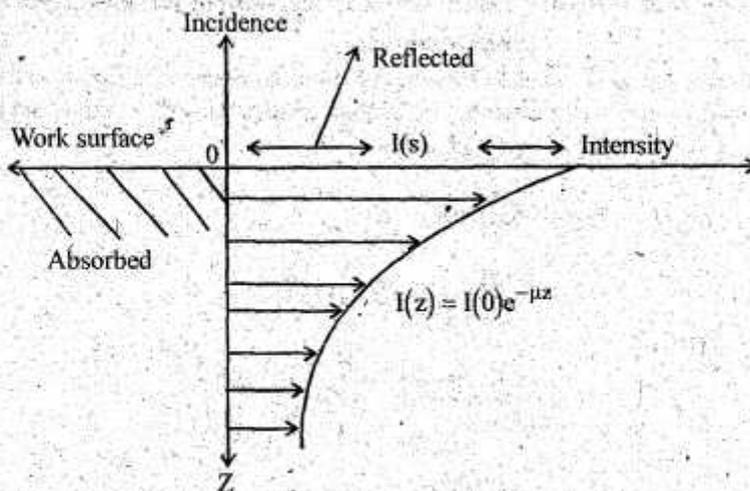
Gear Shaping : Gear shaping method is commonly used for cutting a space gear. Such a cutter used in a milling machine is formed according to the shape of the tooth space to be removed. Theoretically, there should be a different shaped cutter for each size gear of a given pitch as there is a slight change in the curvature of the involute. However, one cutter can be used for several gears having different numbers of teeth without much sacrifice in their.

Q. 5. Discuss the principle, machine set-up, process characteristics, advantages and disadvantages of Laser Beam machining (LBM).

Ans. Like a beam of high velocity e_1 a laser beam is also capable of producing very high-power density. Laser is a highly coherent beam of electromagnetic radiation with wavelength varying from 0.1 to $70\mu\text{m}$. However, the power requirement for a machining operation restricts the effectively usable wavelength range of $0.4 - 0.6\mu\text{m}$. Because of the fact that they says of a laser beam are perfectly parallel & monochromatic, it can be focussed to a very small diameter & can produce a power density as high as 10^7 w / mm^2 .

Mechanism of LBM : Machining by a laser beam is achieved through the following phases :

- (i) Interaction of laser beam with work material.
- (ii) Heat conduction & temperature rising.
- (iii) Melting, vaporization & ablation.



Laser beam falling on works surface & variation of intensity below surface :

$$\frac{\partial^2 \theta(z,t)}{\partial z^2} = \frac{1}{2} \frac{\partial \theta(z,t)}{\partial t} = 0$$

i.e., $z = 0$

$$\frac{\partial \theta}{\partial z} = -\frac{1}{K} H(t)$$

$$\theta(z, t) = \frac{1}{K} \sqrt{\frac{\alpha}{\pi}} \int_0^t \frac{H(t-\tau)}{\sqrt{\tau}} \exp\left(-\frac{z^2}{4\alpha\tau}\right) d\tau$$

$$\theta(z, t) = \frac{2H}{K} \left[\sqrt{\frac{\alpha t}{\pi}} \exp\left(-\frac{z^2}{4\alpha t}\right) - \frac{z}{2} \operatorname{erfc}\left(\frac{z}{2\sqrt{\alpha t}}\right) \right]$$

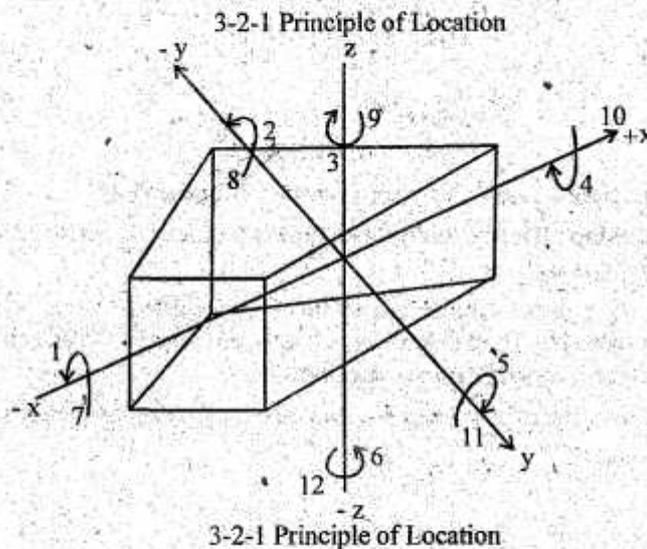
$$\theta(0, t) = \frac{2H}{K} \left(\frac{\alpha t}{\pi}\right)^{1/2}$$

If θ_m is the melting temperature of the material, the time required for the surface to reach this temperature is t_m then,

$$t_m = \frac{\pi}{\alpha} \left(\frac{\theta_m K}{2H}\right)^2$$

Q. 6. (a) What is 3-2-1 principle of location? Discuss with neat sketches.

Ans.



Geometric dimensioning and tolerances practices establish datums, usually in three planes X, Y, Z axis. Datums may be planes, lines, points, cylinders and axis of cylinders.

Location for tool design begins with this relationship. The primary datum, assumed to be horizontal is located by three pins or three isolated flat surfaces or by a flat plate, which is an infinite number of pins. The pins must be solid & stable, otherwise floating will prevent interchangeability.

The second datum surface, which is perpendicular to the horizontal plane, is located by 2 pins. The third datum surface is controlled by one pin. This is called 3-2-1 principle of location.

Q. 6. (b) Why bushes are used in drill jigs? What is the material? Discuss.

Ans. Bushes guides the tool and the drill. A bushing is a hardened steel tube and there are many varieties. The inside diameter of the bush has a tight tolerance to guide the drill jig or seamer. Fasteners hold the tool part together & may include sulws, belts, nuts, dowels, roll pins, keys & adhesives.

Once the part is positioned against locators & damped & the machine tool & the cutting tool are ready the tool is guided into the part.

Q. 6. (c) Discuss the working of Box type of jig with neat sketch.

Ans. Milling operations are joined with box jigs, fixtures & table attachments. These attachments are used for special design.

Box jigs uses are index head for cutting gears. An index head or dividing head is a complex set of gears housed in a box. The geared shaft rotates work through a predetermined number of degrees or a fraction of resolution. A gear cutter is shaping the gear teeth. This method of gear production is limited to school shops for instructional purposes.

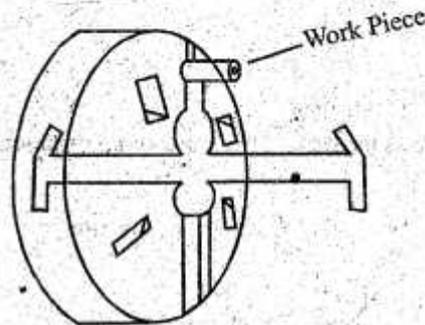


Fig. Box Type Jig

Q. 7. With suitable examples, discuss 'Product cycle in manufacturing'.

Ans. (i) Tolerance Stacking : It is practically impossible to produce any part to exact dimension irrespective of the methods of manufacturing.

Since, we cannot manufacture any component exactly to the specified dimension, the designer provides some diviation from the desired size. The desired size is known an basic size. The permissive deviation of a dimension from the desired size is called tolerance stacking.

(ii) Operation Selection : The term operation, selection includes the parameters such as :

- Cutting speed
- Feed &
- Depth of cut

Cutting Speed : It is the distance travelled by the work surface in a unit time with reference to the cutting edge of the tool.

Feed : Feed is the distance advanced by the tool for each revolution of work. Feed is usually expressed in mm/rev.

Depth of Cut : Depth of cut is measured as perpendicular distance between the machines surface and the unmachined (uncut) surface on the previously machined surface of the workpiece. Depth of cut it is expressed is mm.

(iii) **Product Cycle in Manufacturing** : Product cycle implies the order in which the operations are to be carried out in order to complete manufacturing of a job. When more than one operation is needed to be carried out on a component one has to do the operations in a particular sequence to correctly produce the component. This is very much similar to dressing up.

Example to mean the tri, one has to wear shirt first. A possible sequence of cycle for component could be :

- 1 - Turning
- 2 - Facing
- 3 - Knurling.

Q. 8. (a) Discuss any two acceptance tests for machine.

(i) **Magnetic Particle Inspection Test**

(ii) **Radiographic Inspection Test.**

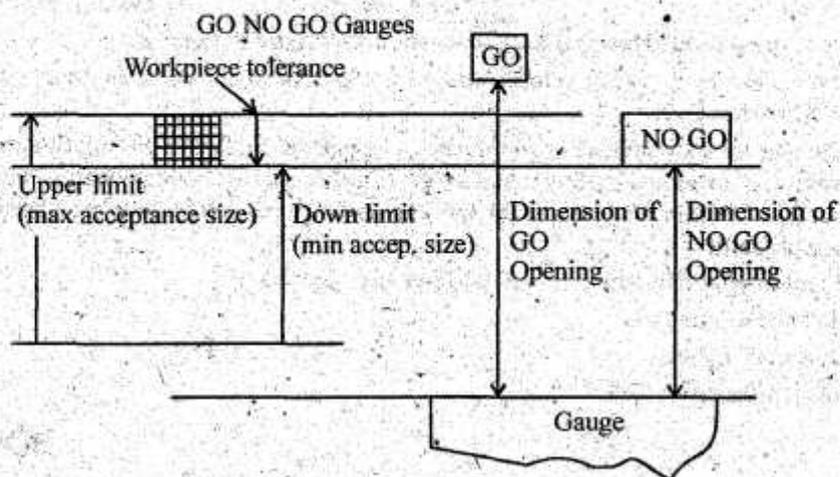
Ans. (i) Magnetic Particle Inspection Test : In magnetic particle inspection, an intense magnetic field is set up in the part to be inspected, cracks, voids & material discontinuities cause the lines of magnetic flux to be distorted & they break through the surface. In some tools, hardness measurements cannot be correlated with strength, but certain magnetized properties do correlate with strength & other physical characteristics of the metal.

(ii) **Radiographic Inspection Test** : It is accomplished by exposing a part to either X-rays, gamma rays or radioisotopes & viewing the image created by the radiation on a fluorescent screen or film to examine a piece of steel 5 in thick with X-ray requires a machine of more than 1000 KVA capacity.

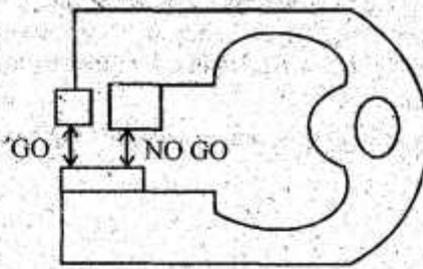
Various fluorescent penetrations can find surface defects in almost any material. The penetrants are normally oil based & may be applied by dipping spraying & brushing.

Q. 8. (b) Sketch Go and No Go gauges for a hole of diameter 20 H 7.

Ans. GO NO GO Gauges :



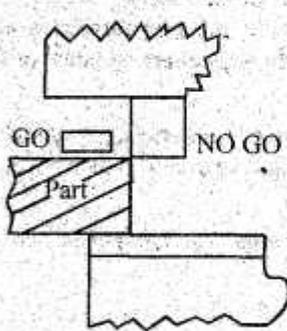
(a) GO-NO GO Dimensions



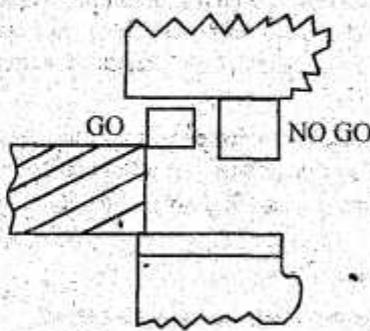
(b) The Gauge Diameter = 20 HZ

Three Illustrations are possible :

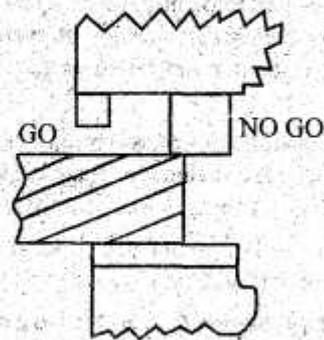
- (a) Good part
- (b) Oversized part
- (c) Undesired part



(a) Good Part



(b) Oversized Part



(c) Undesired Part

Q. 8. (c) What is spirit level? How is it used in machine tool testing? Discuss.

Ans. Spirit level is the level needed in tool workpiece chip zone in metal cutting testing operations to improve the machining performance.

Basically, a coolant is used to test the cutting zone. The type of coolant or cutting fluid used depends upon this type of workpiece material & tool material. Water is an excellent coolant; however it causes rusting of workpiece & machine components and for lubricant hierarchical soluble oils are added to water to improve cutting fluid properties.

The machine tool turning fails when it ceases to function satisfactorily.

The failure may be classified as :

- Catastrophic failure
- Gradual/progressive wear.