# B.Tech
## Fifth Semester Examination,
# Manufacturing Tech (ME-309-E)

**Note :** Attempt any *five* questions.

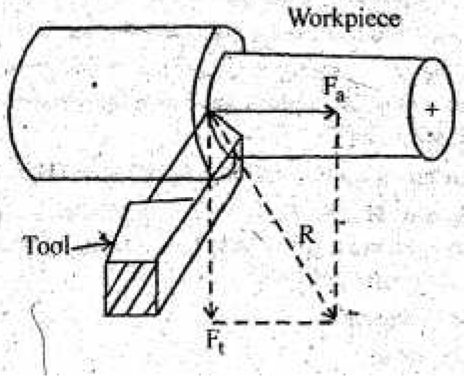
**Q. 1. (a) Differentiate orthogonal and oblique cutting processes with the help of neat sketches.**

**Ans. Difference between Orthogonal & Oblique with :**

| Aspect | Orthogonal | Oblique |
|---|---|---|
| (i) Inclination of cutting edge of tool. | Perpendicular to direction of tool travel | Inclined at angle with normal to direction of tool travel. |
| (ii) Chip movement | Chip flows over the tool face & direction of chip flow velocity is normal to cutting edge. | Chip flows on tool face making an angle with the normal on the cutting edge. |
| (iii) Number of component of cutting force acting on the tool. | Only 2 components of cutting force act on the tool. | 3 component of force act at cutting edge. |
| (iv) Maximum chip thickness occurrence. | Maximum chip thickness occurs at its middle. | Maximum chip thickness may not occur at middle |
| (v) Tool life | Less. | More. |

**Q. 1. (b) Discuss the disposition of three forces on a single point tool during metal cutting. Also discuss the various factors affecting these forces.**

**Ans.** Force on a single point tool during metal cutting.



Orthogonal cutting $R = \sqrt{F_a^2 + F_t^2}$

Oblique cutting $R = \sqrt{F_a^2 + F_r^2 + F_t^2}$

Where, $F_a$ = Axial (feed) force

$F_r$ = Radial force

$F_t$ = Tangential force

(i) Force $F_a$ acts in horizontal plane parallel to work axis.

(ii) Force $F_r$ acts on horizontal plane along a radius of the work.

(iii) Force $F_t$ acts in vertical plane tangent to cutting surface.

(iv) $F_t$ is always the largest of 3 components. It develops torque on the work piece.

**Q. 2. (a) What are the essential characteristics of tool materials? Discuss.**

**Ans.** Essential characteristics of Tool Material :

(i) The material must remain harder than work materials at elevated temperature.

(ii) The material must withstand excessive wear even the relative handness of tool-work material changes.

(iii) The material must have sufficient strength & ductility to withstand shocks & vibrations & to prevent breakage.

(iv) The coefficient of friction at the chip tool interface must remain low for minimum wear & reasonable surface finish.

(v) The cost & easencers of fabrication should be within reasonable limits.

**Q. 2. (b) What is the basic action of cutting fluid? Explain.**

**Ans.** Basic action of cutting fluid :

**(i) Cooling Action :** At the contact between the chip & tool, cooling can reduce the chip temperature & thus, affect directly the friction force between the chip & tool.

Cooling is mainly indirect via conduction through the chip.

**(ii) Lubrication Action :** Lubrication reduces friction between surfaces which are in relative motion.

At any rate, the force holding the parts together control the intimacy of contact & thus has direct influence on frictional force. When a normal force are quite low, the viscosity of an interventing layer of fluid can be the major factor in regulating friction.

**Q. 2. (c) Explain the manufacturing method of High Speed Steel (HSS) tools.**

**Ans. Manufacturing Method of H.S.S. Tools :** High speed steels are obtained by alloying tungsten, chromium, vanadium, cobalt & molybdenum with steel. This alloying produces metal which remain hard at temperature at which normal steel becomes quite soft.

(a) 18–4–1 H.S.S. = 18% tungsten

4% chromium

1% vanadium

0.6–0.7% carbon

**(b) Cobalt High Speed Steel :** Also called super H.S.S. cobalt is added 2 to 15% to increase hot hardness

& wear resistance.

**Q. 3. (a) What is effect of following factors on tool life :**

**(i) Cutting fluids** **(ii) Cutting speed**

**(iii) Feed and depth of cut** **(iv) Cutting tool material**

**Ans.** Effect of following factors on tool life :

**(i) Cutting Fluids :** A fluid's cooling & lubrication properties are critical in decreasing tool wear & extending tool life.

**(ii) Cutting Speed :** When the cutting speed increases the tool life decreases

$$V_T^n = C \text{ constant}$$

**(iii) Feed and Depth of Cut :** When the feed & depth of cut increases the tool life decreases.

**(iv) Cutting Tool Material :** Under the same condition, the tool material affect tool life. For example, carbides have higher tool life than HSS.

Working material also affects tool life. The physical, microstructure, constituent phaser of the hardness of the material makes a large difference in actual tool life values.

Lower the rigidity of system, higher is the chance of tool failure.

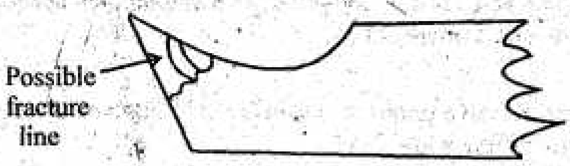
**Q. 3. (b) What is crater wear? How is it caused? How can it be controlled? Discuss.**

**Ans. Crater Wear :** Crater wear occurs on the rake face of tool in the form of small crater or depression. It changes the chip tool interface geometry.

**Formation of Crater Wear :**

Formation of crater is due to abrading action of chip as it passes over the tool face.

Diffusion plays an important role in the development of crater wear in which movement of atoms across the tool-chip interface takes place.




*Crater Wear*

**Methods to Control :** (i) It is largely temperature dependent phenomenon & the temperature in the rake face is much higher than that in flank face.

(ii) The temperature at chip tool interface may be order of 1000°C.

**Q. 4. Differentiate the following :**

**(i) Gear generating and forming,**

**(ii) Gear burnishing and buffing,**

**(iii) Gear shaping and shaving.**

**Ans. (i) Gear Generating and Forming :**

**Gear Generating :**

(i) The term generating in gear cutting stands for development of involute curve by straight cutting edge of cutter, which produces a series of facets of blank so as to form the involute profile.

(ii) Generating methods for producing gear teeth make use of certain relative motion between the work gear & cutter during the machining.

(iii) Generating method for producing gear are faster & suited for production of large quantities.

Methods include the use of :

(i) Gear shapes & gear hobbers for spur & helical gear.

(ii) Spiral bevel & hybrid generators.

Common generating processes used for generating the gear teeth are :

(i) Gear shaper process.

(ii) Hobbing process

(iii) Rack planing process.

**Gear Forming :**

(i) The forming process involves finish machining of gears teeth to predetermined profile by means of form cutter or single point reciprocating form tools.

(ii) Milling machines are capable of cutting practically every type of gear by employing an universal index mechanism & a form cutter.

(iii) The cutter has required toothed profile on it. This cutter may be operated on a vertical or horizontal type of milling machine.

(iv) It is used only when gears cut by more accurate method cannot readily be obtained,

**(ii) Gear Burnishing and Buffing :**

**Gear Burnishing :**

(i) It is used for improving the surface finish & uniformity of gear after cutting & prior to hardening.

(ii) The unhardened work gear is rolled with ample application of lubricant in mesh with one or several burnishing gears with teeth that are hard, smooth & highly accurate.

(iii) The method is applicable for only for gears not requiring high accuracy, as well as for gears not subject to heat treatment processes.

**Buffing :**

(i) In this process the abrasive grains in a suitable carrying medium such as grease are applied at suitable interval to buffing wheel.

(ii) Negligible amount of material is removed in buffing while a very high lusture is generated on buffeed surface.

(iii) The dimensional accuracy is not affected by buffing operation.

**(iii) Gear Shaping and Shaving :**

**Gear Shaping :**

(i) Gear shaping is used for cutting spur & herringbone gear, ratchets, splines, sockets gear segments etc. of almost any pitch & diameter & internal or external gear.

(ii) One shaping cutter can cut all spur gear of same pitch. Gear face width upto 300 mm can be made.

**Gear Shaving :**

(i) Gear shaving is a finish process that removes small amount of metal from the flanks of gear tooth.

(ii) Gear sharing may correct small errors in tooth spacing, helix angle, tooth profile & concentricity.

(iii) Shaving improves the finish on toothed surface & can eliminate tooth-end load concentration, reduce gear noise & increase load carrying capacity.

(iv) Shaving has bean successfully used in finishing gears of diametral pitch from 18082.

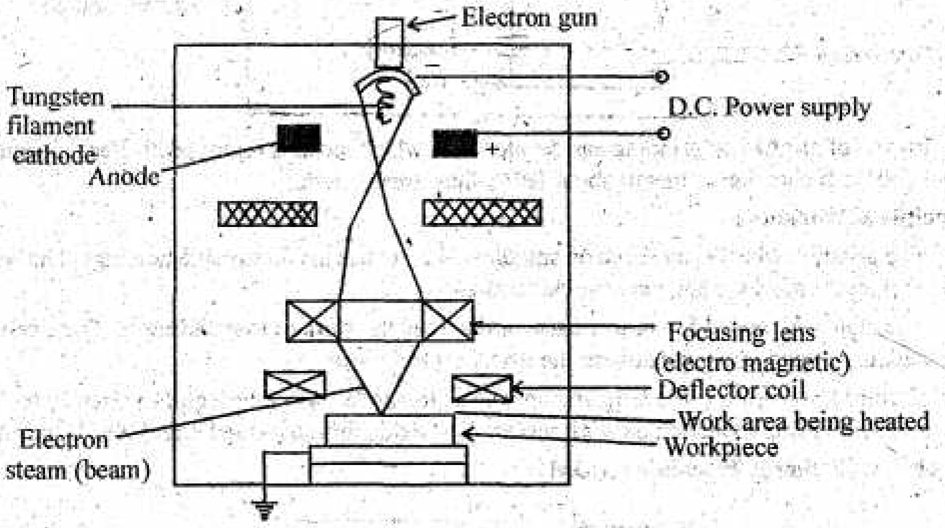
**Q. 5. With the help of neat sketches, discuss the working principles of following unconventional machining processes :**

**(i) Electron beam machining (EBM)**

**(ii) Electrochemical grinding (ECG) and**

**(iii) Electric discharge machining (EDM).**

**Ans. (i) Electron Beam Machining (EBM) :**




EBM is process of machining materials with the use of high velocity beam of electrons.

**Principle :** In this process the material is removed by help of high velocity focused stream of electrons which are focused magnetically upon a small area.

**Characteristics of EBM :**

**(a) Workpiece Material :** All material

**(b) Material Removal :** High speed of electron impinge on surface & K.E. of electron produces intense heat to melt the metal.

**(c) Voltage :** 150 KV

**(d) Medium :** Vaccuum.

$F_a$ due to feed motion is about 35–55% of $F_t$.

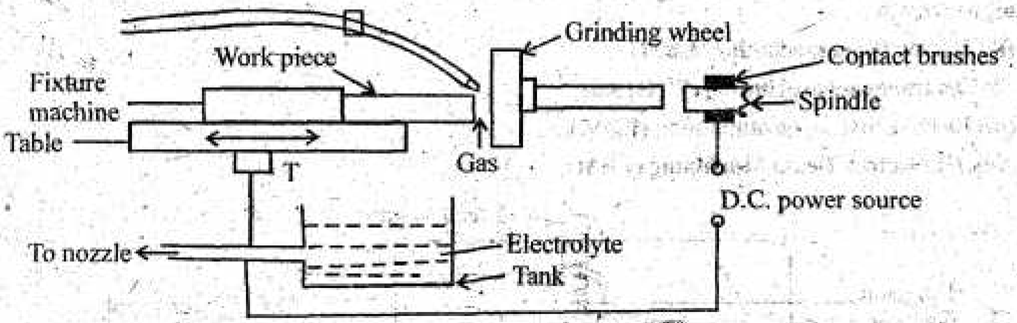
$F_r$ which tends to push the tool back out of work is about 25–30% of $F_t$.

Various factors which affect these forces :

(i) Material being machined
(ii) Rate of feed
(iii) Depth of cut
(iv) Tool angles
(v) Cutting speed

(vi) Coolant used etc.

**(ii) Electrochemical Grinding (ECG) :**




The process of electrolyte grinding has developed in which metal is removed by electro-chemical deposition (about 90%) & abrasion of metal (about 10%), thus, wear is less.

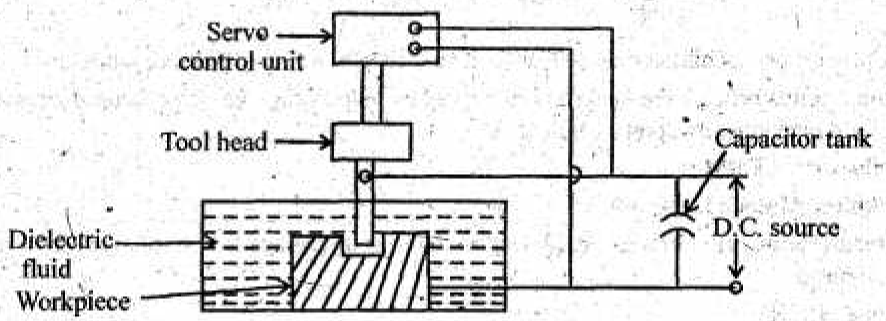
**Principle & Working :**

(i) The grinding wheel is mounted on spindle which rotates inside suitable bearings. The workpiece is held on the machine table in suitable fixtures.

(ii) The table can moved forward & backward to feed the work or to withdraw it. The electrolyte from tank is pumped into gap between the wheel & workpiece.

(iii) Current flows from cathode (grinding wheel) to anode (W/P) through the electrolyte. This led to electrochemical oxidation on work surface. The oxide film so formed is removed by grinding wheel.

**(iii) Electro Discharge Machining (EDM) :**




**Principle & Working :**

(i) It involves controlled erosion of electrically conducting materials by the initiation of rapid & repetitive electrical discharge between the tool (cathode) & workpiece (anode) separated by a dielectric fluid medium.

(ii) A suitable gap between the tool & workpiece is maintained to cause the spark discharge.

**Characteristics of EDM :**

**(a) Tool Material** = Cu, Brass & graphite

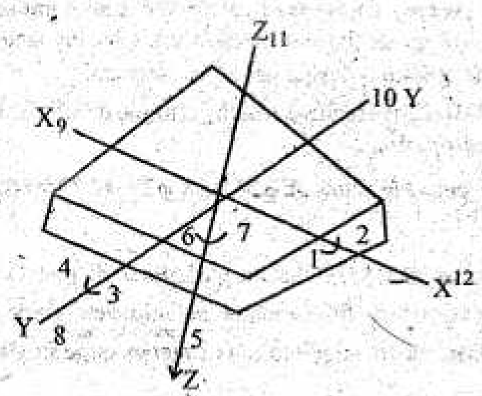
**(b) Workpiece Material :** Conducting material & alloy

**(c) Process Parameter :** Voltage capacitance, spark gap & melting temperature of w/p.

**(d) Material Removal :** Melting & vapourisation.

**Q. 6. (a) Discuss location principles and three locating devices to be used in jigs and fixtures.**

**Ans. Location Principles :**




(i) A workpiece, theoretically suspended & free in space is free to move in any direction.

(ii) It is said to have 12 modes or degree of freedom. It may move in either of 2 opposed directions of the three mutually perpendicular axes X, Y & Z.

(a) 3-2-1 principle of location.

(b) Principle of least points

(c) Principle of extreme position.

**3-2-1 Principle of Location :**

In this method the workpiece is located by means of 6 pins which restricts the workpiece in nine of its degree of freedom.

(a) The workpiece is made to rest on three pins A, B & C inserted in base of body. It restricts the rotational movement along X, Y & also downward movement 1, 2, 3, 4, 5 shown in fig. have been inserted.

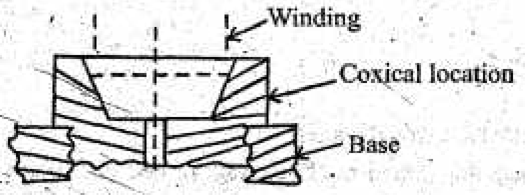
(b) Insertion of 2 more pin D & F restricts the rotational movement of z-axis & movement towards left i.e., 6, 7, 8 have been restricted.

(c) Insertion of one pin F stops the movement 9. Thus, six locating pin restricts 9 degree of freedom.

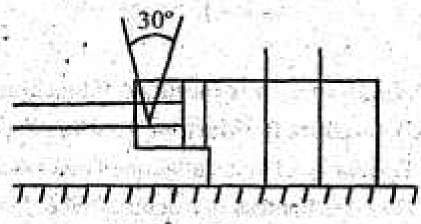
**Various Locating Devices :**

**(i) Cylindrical Locators or Location Pin :** Locating pin are used if reamed or finely finished holes are available for positioning purposes.

**(ii) Conical Locators :** They are used to locate the workpiece from tapered hole or shaft.




*(i) Conical Recess*




*(ii) Fixed V-locator*

**(iii) V-Locator :** A workpiece is located from external cylindrical surfaces by means of V-block.

Wide V-blocks are used for locating finish machines datum surfaces & narrow ones for rough surfaces.

**Q. 6. (b) What is fool-proofing? How is it maintained in the design of jigs and fixtures? Discuss.**

**Ans. Fool-Proofing in Jig & Fixture :** The variation of product configuration requires design & development of newer jig & fixtures designed of jigs & fixtures is dependent on many factor which lead to many design for the same component & hence the optimum design has to be selected.

This paper provides a diagraph & matrix method which is simple & efficient methodologies to select the optimum jig & fixtures i.e., called fool-proofing.

**Q. 7. (a) What is the difference between a hole of φ25 and φ25 H7 ? List the cutting tools to be used for the machining of these two holes.**

**Ans.** ϕ25 means holes of diameter 25 & 25H7 that means holes of diameter 25 and H7 represent clearance or transition fits with H7 depending upon their fundamental deviation and grade of tolerance.

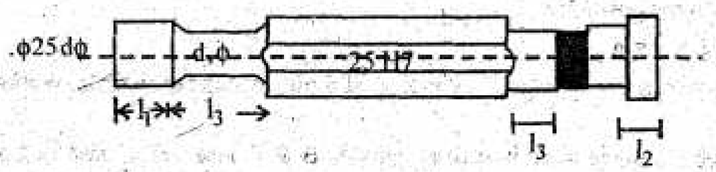
For many engineering application, the fits required can be met by quite small selection from the full range available.

**Q. 7. (b) Sketch two plug gauges with full dimensions for inspecting above mentioned two holes.**

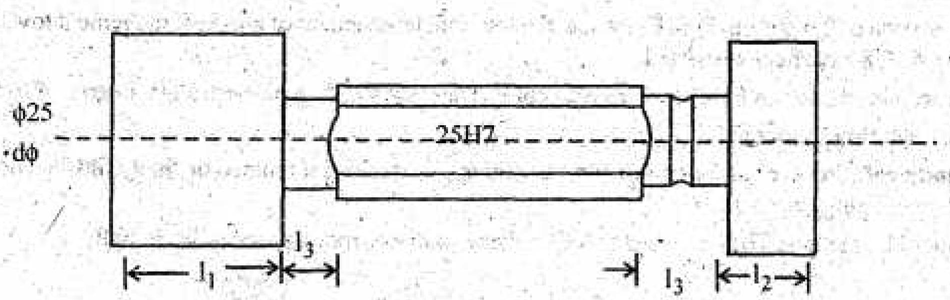
**Ans. Plug Gauge :** Gauges used for checking the holes are called 'plug gauges'. The 'Go' plug gauge is the size of the low limit of the hole while 'No-Go' plug gauge is the size of the high limit of hole.

**Types of Plug Gauge :**

**(i) Solid Type :**




**(ii) Fastened Type :**




**Q. 7. (c) Discuss the procedure of machine tool testing.**

**Ans. Procedure for Machine Tool Testing :**

(i) Test for level of installation of machine in horizontal & vertical planes.

(ii) Test for flatness of machine bed & for straightness & parallelism of bed ways or bed surfaces.

(iii) Test for perpendicularly of guideways to other guideway of bearing surface.

(iv) Test for true running of main spindle & its axial movements.