SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**

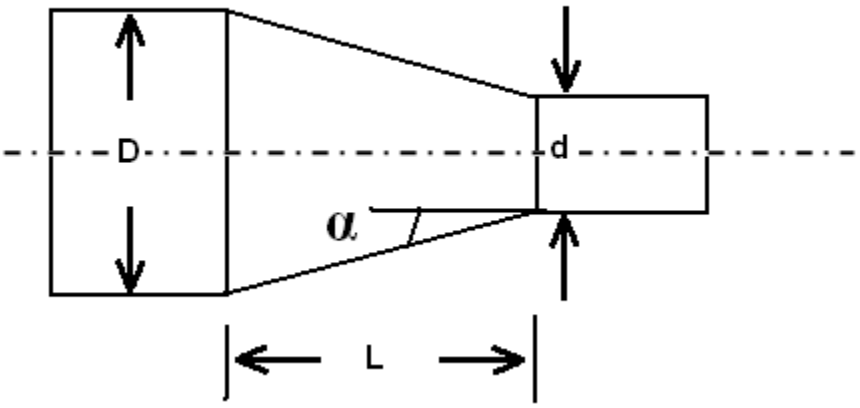
Q.1 a) Attempt any one four of the following.

i) How taper angle is calculated for taper turning on Lathe?

(02 marks for correct answer)

Ans:- Taper angle:-

In case of taper turning on lathe following method is used to calculate taper angle.



From figure shown above taper angle is given by

$$\alpha = tan^{-1}\left(\frac{D-d}{2L}\right)$$

where,

D = Bigger diameter of tapered work piece in mm.

d = Smaller diameter

L = Length of the tapered portion in mm,

α = angle of taper = half taper angle

ii) What is thermosetting plastic? (02 marks for correct answer)

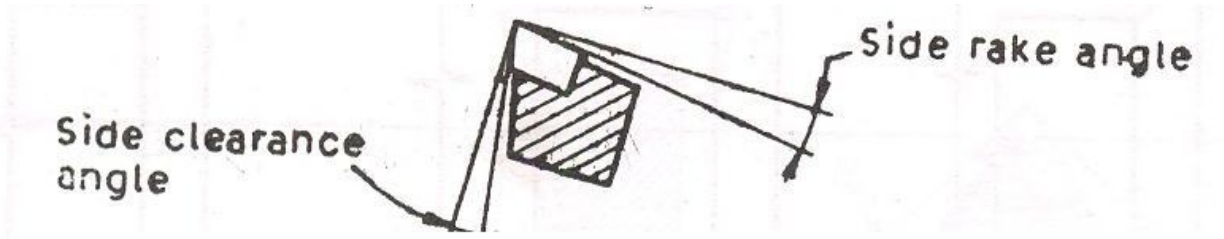
Ans:-

Thermosetting Plastic:

Those plastics which are hardened by heat, effecting a non-reversible chemical change are called thermosetting. In other words we can say that they acquire a permanent shape when heated and pressed and cannot be softened by reheating. They are also known as heat-setting or thermosets.

iii) Define side rake angle of single point cutting tool (02 marks for def.)

Ans:-



Side rake angle:

Definition: It is a rake angle. Side rake angle indicates that the same plane that forms the face or top of tool has been ground back at an angle sloping from the side cutting edge.

iv) What is deep hole drilling? (02 marks for appropriate answer)

Ans:

Deep hole drilling:

Deep hole drilling is a process when length to diameter ratio of required hole is larger such wholes are called as deep hole and the process is called as deep hole drilling process .For

deep holes having larger length to diameter ratio twist drills cannot be used, chips cannot come out easily and coolant cannot reach to the tip of the tool. Such drills are required to be done in rifle barrels, break cylinder, crank shaft,etc. Deep holes are made by using gun drills which are hollow and high pressure coolant forces out chips through them using deep hole drilling machine.

v) Enlist the different gear finishing processes? (any 04, 02 marks)

Gear finishing processes :

1 .Gear shaving

2. Roll finishing

3. Gear burnishing

4 .Gear grinding

5. Gear lapping

6. Gear honing.

vi) What is polishing?

Ans:

Polishing:

Polishing is a surface finishing operation performed by a polishing wheel for the purpose of removing negligible amount of metal to take out scratches, tool marks, pits and other defects from rough surfaces. **(01 mark)**

Applications:

1) For polishing geared shaft
2) For polishing machine shafts
3) For polishing inner side of cylinder of IC engine
4) For polishing bearing balls, automobile components **(any 02, 01 mark)**

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**

Que.1. B) Attempt any three of the following? (02 marks for classi. 02 marks for point to point)

i) How CNC machines are classified? Describe point to point control system?

Ans:

Classification of CNC machines is as follows

1) Classification based on feedback control

   a) Open loop control system
   b) Closed loop control system

2) Classification based on control system feature

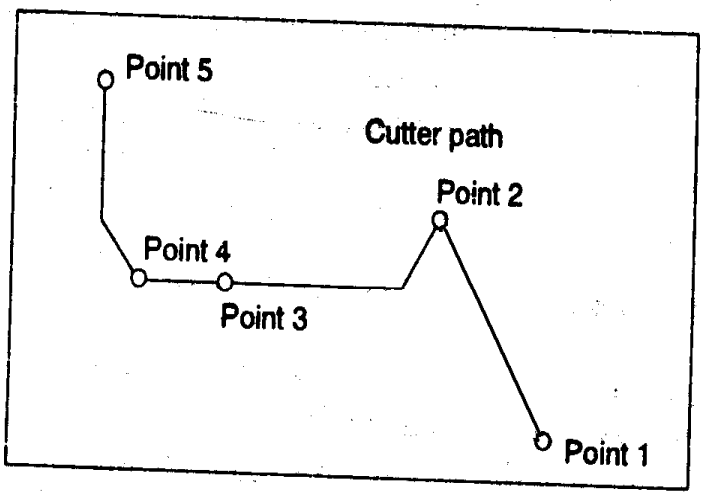
   a) Point-to-point control system

   b) Straight line control system

   c) Continuous path or contouring control system

Point-to-point control system:

Point-to- point control is one where accurate positional control is required only to place the machine slides in fixed position and the machine tool slide is required to reach a particular fixed coordinate point in the shortest possible time. The machining operations are performed at specific points and there is no machining while the machine table/slides move from one point to the next. no machining takes place until the machine slides have reached the programmed coordinate point and slide movement ceases. Since there is no machining when the machine slides move from one point to other point, all the slide movements are made in rapid traverse to save time. Also the path of movement is the not important but care must be taken to ensure that the cutting tool should not hit the work piece while moving from one position to the next.



Point-to-point system

The movement along the different axis may be sequential or simultaneous and each axis is controlled independently. The simultaneous movement along the axis results in reduced cycle time. Point-to-point system is suitable for drilling, boring, tapping, punch presses and jig boring machines.an example of machining by Point-to-point control system is shown in fig.

ii) Find the time required to turn a work piece from 80mm diameter to 60mm diameter, having a length of 260mm.The cutting speed is 40 m/min and the feed rate is 0.5 mm/rev. The radial depth of cut should not exceed 2mm.

Ans.:-

Given data:

Diameter of work piece before machining =D=80mm

Diameter of work piece after machining =d=60mm

Length of work piece=L=260mm

Cutting speed=V=40m/min

Feed rate=0.5mm/rev

Max. radial depyh of cut=2mm

Solution:

Let,

RPM of work piece =N

Cutting speed=V = πDN/1000 m/min.

40 = π x 80 x N / 1000

N =40x 1000/ π x 80 =40000/ (3.14x80)

N = 159.23 RPM. Say 160 RPM **(02 marks)**

Machining time for turning= L/ (S X N) min.

Where,

S = feed of the work piece per revolution mm/rev.

L = length of the work piece in mm.

N= RPM

Machining time for turning=260/(0.5X160)

=3.25 min

No. of cuts required to reduce dia. From 80 mm to 60mm considering depth of cut 2 mm = 5cuts

Total time required for turning = 3.25X5

= 16.25 minutes **(02 marks)**

iii) How grinding machines are classified? (04 marks for appropriate answer)

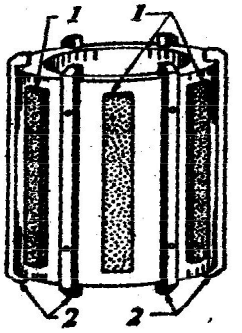
Ans: According to the quality of surface finish

Grinding machine

Rough grinder	precision grinder
Floor stands and benches	a) Cylindrical grinder
Portable & flexible shaft grinder	-Centre type (plain)
Swing frame grinder	-Centre type (universal)
Abrasive belt grinder	-Centre less
	b) Internal grinder
	- Chucking
	- Planetary
	- Centre less
	c) Surface grinder
	- reciprocating table
	- Horizontal spindle
	- Vertical spindle
	d) Rotating table
	-universal
	-Special
	e) Tool & cutter grinder
	- Universal
	-Special
	f) Special Grinding machines

iv) Explain the Honing process with neat sketch? (02 marks for sketch, 02 marks for explanation)

Ans.: -



Honing tool-head for holes
1. Stones, 2. Guides

Honing is grinding or abrading process mostly for finishing round holes by means of bonded abrasives stones, called hones. Honing is therefore a cutting operation and has been used to remove as much as 3 mm of stock but is normally confined to amounts less than 0.25 mm. So honing is primarily used to correct some out of roundness, taper, tool marks and axial distortion. Honing stones are made from common abrasives and bonding materials, often impregnated with sulphur, resin, or wax to improve cutting action and lengthen tool life. Materials hones range from plastics, silver, aluminum, brass and cast iron to hard steel and cemented carbides. This method is mostly used for finishing automobile crankshaft journal.

When honing is done manually the tool is rotated and the work piece is passed over the tool. For precision honing, the tool is given a slow reciprocating motion as it rotates. Honing stones may be loosely held in holders, cemented into metal shells which are clamped into holders, cemented directly in around the holder while others are interlocking so that they present a continuous surface to the bore. A typical honing tool head is shown in figure. The honing tool may be so made that a floating action between a work and tool prevails and any pressure exerted in the tool may be transmitted equally to all sides. Coolants are essential to the operation of this process to flush away small chips and to keep temperature uniform.

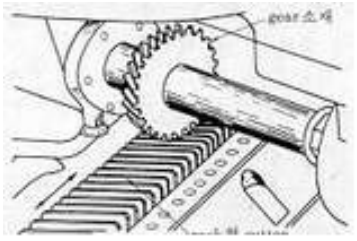
Honing is done on general purpose machine such as lathe, drill press, portable drills, as an expedient. But more economical results can be obtained by honing machines for production work. There aret wo types of honing machines: Horizontal and vertical. A honing machine rotates and reciprocates the hone inside holes being finished. The two motions produce round straight holes that have a very fine surface finish of random scratches. Vertical honing machines are probably common. Horizontal honing machines are often used for guns and large holes.

v) Explain with neat sketch rack cutter gear generating process?

(02 marks for sketch, 02 marks for explanation)

Ans:

The rack cutter generating process is called gear shaping process. In this method the generating cutters has the form of a basic rack for the gear to be generated. The cutting action is similar to a shaping machine. The cutter reciprocates rapidly and removes metal only during cutting stroke. The blank is rotated slowly but uniformly about its axis, and between each cutting stroke of the cutter, cutter advances along its length at a speed equal to the rolling speed of mating pitch lines. When the cutter and blank have rolled a distance equal to 1 pitch of the blank the motion of blank is arrested, the cutter is withdrawal blank to give relief to the cutting edges and the cutter is returned to its starting position. Blank is next indexed and next cut is started following the same procedure. The helical gears are cut by swivelling the cutter slide to the required helix angle. The cutter now reciprocates in a path set by the helix angle while the rotary moment of the blank is continued.



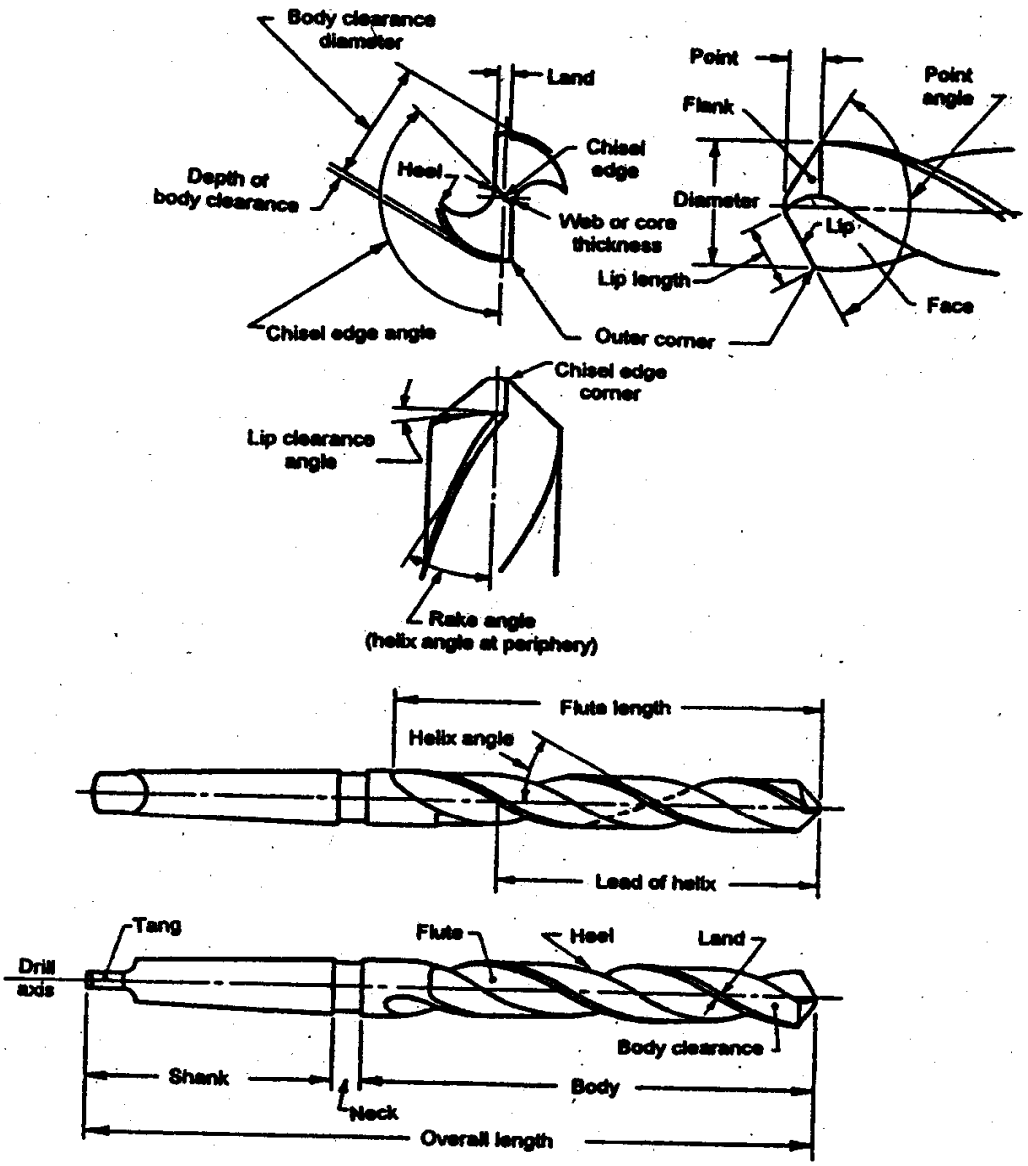
Que. 2. (any 04 parameters with sketch should be given full marks)

a) Draw a neat sketch of twist drills showing its nomenclature on it?

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**

Ans.:- The following are the different elements of twist drills.



Twist drill nomenclature

- Body:- It is the part of drill which starts from bottom cutting edge to the commencement of the shank.
- Face:- It is a portion of flute surface adjacent to lip.
- Flute:- It is grooved in the body to provide lip. It helps to extract out the current chips and permits the coolant to flow towards the tip of the drill.
- Land: - It is cylindrically ground surface on the leading edges of drill flutes.
- Flank: - It is the surface on the drill point which extends behind the lip to the next flute.
- Chisel Edge: It is the edge formed by the intersection of flanks.
- Heel: It is the edge formed by the intersection of flute surface and the body clearance.
- Lip: It is the edge formed by intersection of flank and face.
- Web: It is the central portion between roots of flutes.
- Shank: It is the portion of drill to hold and drive it into the work piece.
- Axis: It is the longitudinal centre line of drill.
- Tang: It is the flattened end of a tapered shank which fits into drift slot of spindle or socket or drill holder.

Drill Angles:

The following are the different angles of drill.

1. Helix Angle or Rake Angle: It is the angle formed by the leading edge of the land with a plane having the axis of the drill. Smaller the rake angle,greater will be the torque required to drive and feed the drill. The angle varies from $30^0$to 45^0.
2. Lip Clearance Angle: It is the angle formed by the flank and a plane at right angle to the drill axis.
3. Chisel edge angle: It is the angle between the chisel edge and the lip if seen from the tang side of the drill. Its value range from 120^0 to 135^0.
4. Point Angle: It is the angle between the two lips projected upon parallel plane to the drill axis and parallel to the cutting lips. For cutting mild steel, its value is 118^0.

b) (02 marks for types, 02 marks for word address format)

The following are the three programme formats being used for part programming:

(1) Fixed block format
(2) Tab sequential format
(3) Word address format

The numerical control systems are designed to understand and work with one type of programme format but control systems which can understand and work with more than one type of format are also being used in CNC Machines.

(1) Word address format:

In the word address format, each data is preceded and identified by its address letter. For example, X identifies the x-coordinate; F identifies the feed rate and so on. In a word remains unchanged, it need not be repeated in the next block. A typical instruction block in word address format will be as follows:

N010 X0000 Y0000 F 200 S 0800 T 010.01 M 30 EOB

N – SEQUENCE NUMBER
G – PREPERATORY FUNCTION
X – X –COORDINATE
Y- Y –COODINATE
F- FEED RATE
S- SPINDLE SPEED
T –TOOL NUMBER
M- MISCELLANEOUS FUNCTION
EOB – END OF BLOCK

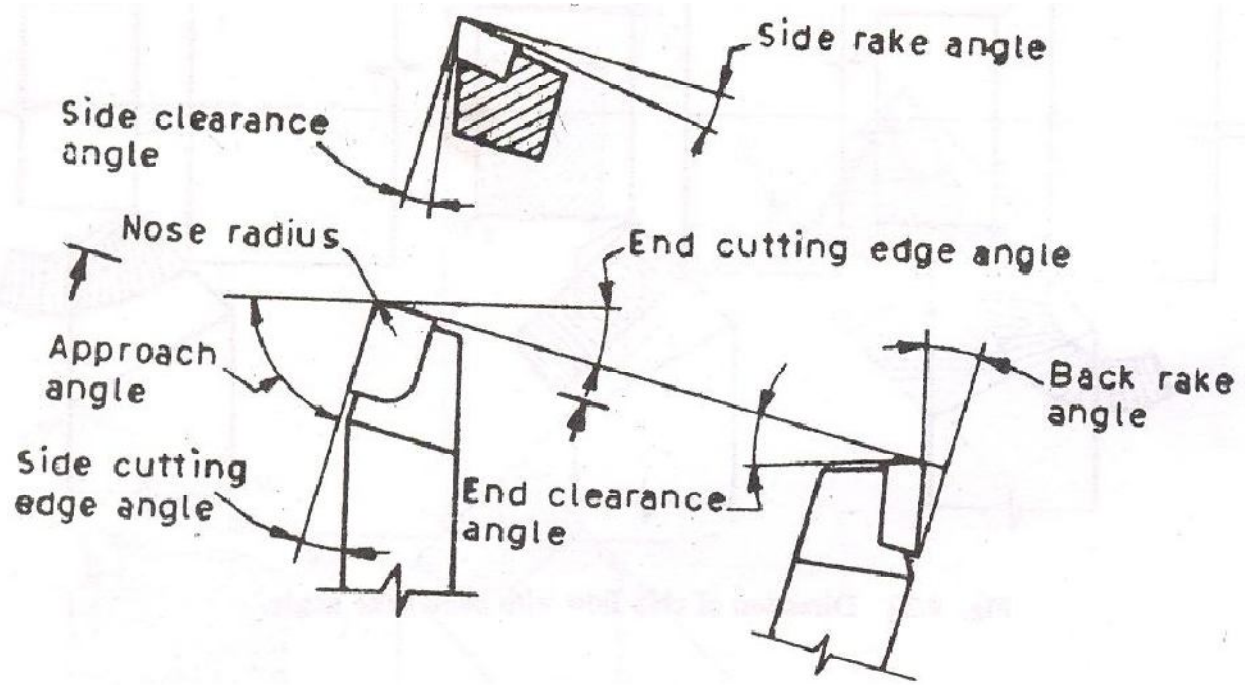
c) What is Tool signature explain with example? (02 marks for def. 02 marks for example)

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**

Ans:

Tool Signature:



The tool signature or tool designation is used to denote a standardised system of specifying the principal tool angles of a single point cutting tool. Some common systems used for tool designation or tool nomenclature are the following-

1. **American or(ASA) System.** It defines the principle angles like side rake, back rack, nose, etc. without any reference to their location with regard to cutting edge . As such ,this system of nomenclature does not give any indication of the tool behavior with regard to the flow of chip during the cutting operation the three reference planes adopted for designating different tool angles are similar to those used in conventional machine drawing i.e , x-x,y-y and z-z the last one containing the base of tool and the two plane being normal to this plane as well as mutually perpendicular . Thus, this system is a coordinate system of tool nomenclature.
2. **British system**: This system, according to B-S1886-1952, defines the maximum rake. The various tool parameters in this system are indicated if the order of Back rake, Side

rake ,End relief angle, Side relief angle, End cutting angle ,Side cutting edge angle and Nose radius.

3. **Continental systems:** This category of tool nomenclature systems includes the German or DIN System (DIN-6581), Russian Systems (OCT-BKC 6897and 6898) and Czechoslovakian System (CSN-1226).The various tool parameters in these systems are specified with reference to the tool reference to the tool reference planes.
4. **International system:** It is an internationally adopted system, developed recently. It incorporates the salient features of tool nomenclature of different systems in it.

Example: A tool with 8, 10, 6, 6 , 6 , 10, 0.2, signature in A.S.A system is having following specification.

Back rake (α_y) =8^0

Side rake (α_x)=10^0

End relief angle (β_y) =6^0

Side relief angle (β_x) =6^0

End cutting edge angle (φe) = 6^0

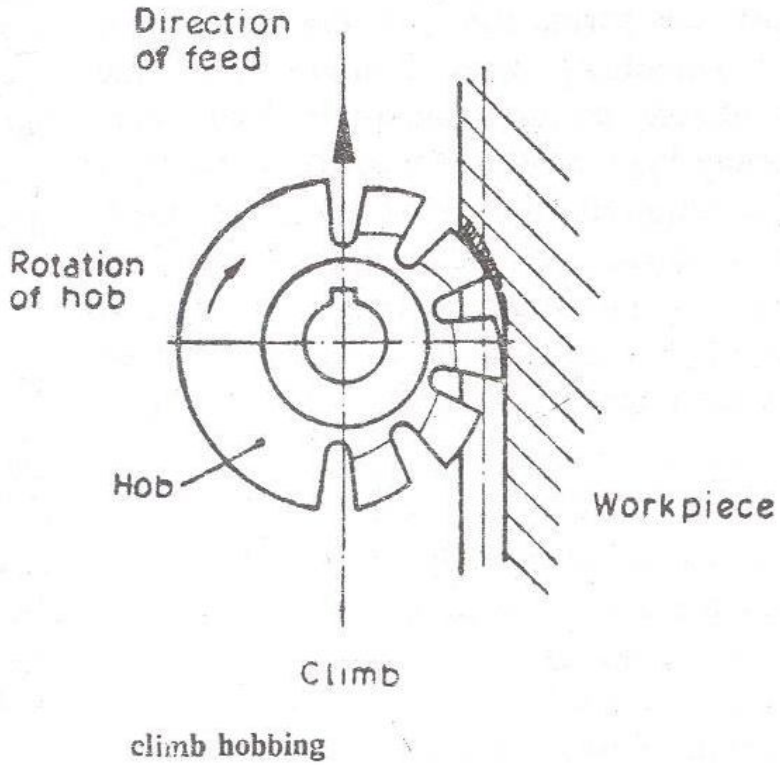
Side cutting edge angle (φs) = 10^0

Nose radius = 0.2mm

d) Explain with neat sketch climb hobbing technique? (02 marks for sketch, 02 marks for explanation)

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**



climb hobbing

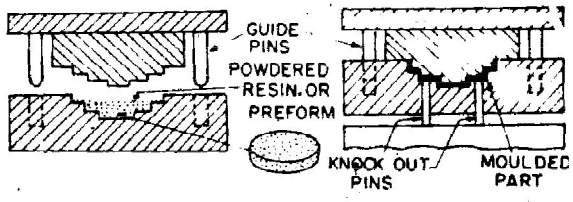
Climb Hobbing:

This type of feeding method is mainly used for cutting spur and helical gears, .It involves moving the hob towards the gear blank or the blank towards the hob to bring the two in such a relative position that the required tooth depth is obtained. This is followed by feeding the rotating hob along the face of the blank parallel to the axis of the latter. This feeding can be from below the blank upwards or from above the blank downwards . The former method is known as Climb hobbing and the latter as Conventional hobbing . In either case, the gear blank continues to rotate about its vertical axis in its set position

e) Explain the procedure of compression moulding with neat sketch? (02 marks for sketch, 02 marks for explanation)

Ans.:-

Compression moulding:



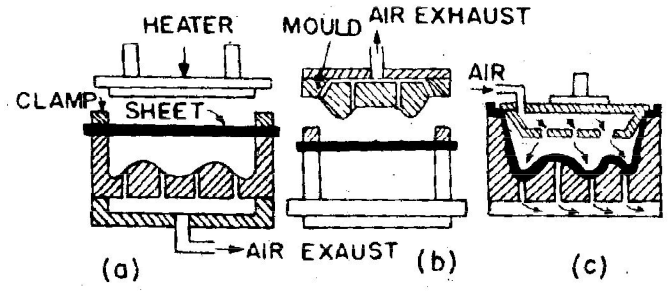
Open mould before compression Mould closed

Most of the thermosetting plastics and a few thermoplastic plastic can be moulded through this process. The process consists of a placing a correct amount of plastic compound in a heated mould. A punch called force, compresses the compound from top into the required shape and density. The mould is kept closed for sufficient time to allow the chemical change (polymerisation) to complete, so that the product is sufficiently hardened. Although loose compound can be used, but for faster production a previously cold compressed tablet, called perform, is used.

f) Explain vacuum forming process with neat sketch and give examples?

(02 marks for sketch, 02 marks for explanation)

Ans.:- Vacuum forming:



Vacuum forming methods.

Intricate shapes are easily formed by the application of pressure or vacuum on the plastic sheet draped over the mould. The operation consist of stretching the sheet over the mould cavity to form a seal, heating it by suitable means and then drawing the air out of the space between the sheet and the mould. A few typical vacuum forming examples are illustrated in figure.At (a) only vacuum is used for drawing the heated sheet in the mould .At (b) the formed mould presses down the heated sheet, forming it partially, followed by pulling the vacuum through the mould to complete the forming .At (c) a cored plug is used to push the heated sheet into the mould, followed by applying air pressure through the plug to complete the process.

Q. 3 a) A rectangular work piece size of 60 × 30 × 200 mm long is to be milled to reduce the height by 10mm. the face cutter diameter is 100mm, the spindle rpm is 120, and the feed rate is 6mm/min. the depth of cut in single pass is not to be exceeded over 2mm. find the time taken to complete the job.

Given N = 120 rpm.

F = 6 mm / min.

D = 100 mm.

L = 200 mm.

Depth of cut d = 2mm

No passes required to mill 10mm height = 5

Total tool travel length = length of work + Approach length

Approach length $A = \frac{D}{2} - C$

Where A = approach length

D =dia. of cutter

$$C = \sqrt{\left(\frac{D}{2}\right)^2 - \left(\frac{B}{2}\right)^2}$$

B= width of work piece

Putting Value $A = \frac{D}{2} - \sqrt{\left(\frac{D}{2}\right)^2 - \left(\frac{B}{2}\right)^2}$

$$A = \frac{100}{2} - \sqrt{\left(\frac{100}{2}\right)^2 - \left(\frac{60}{2}\right)^2}$$

A = 50 – 40

A= 10 mm

$Total\ Tool\ travel\ Length\ L = 200 + 10 = 210\ mm$ **(02 marks)**

Time taken for one cut $T = \frac{L}{f} \times \frac{1}{N}$

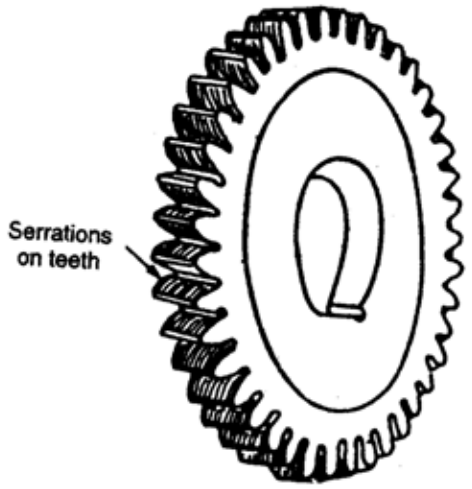
$$T = \frac{210}{6} \times \frac{1}{120} = 0.2916\ min.$$

= Say 0.3 min.

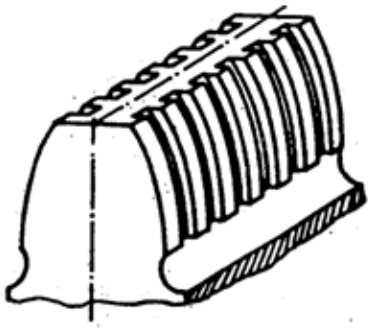
Time take for five cuts = 5 × 0.3

= 1.5 min. **(02 marks)**

Q. 3 b) Explain Gear Shaving and Gear lapping process. (02 marks mfor each process)



Shaving cutter



Tooth of a gear shaving cutter

Gear Shaving :- Gear shaving involves cutting of very fine chips of size 0.0005 mm to 0.1 mm thick from gear tooth profiles. By the cutting edges of a shaving cutter.

Gear shaving can be rotary or linear. In the linear type, a rack type cutter is used.

The rotary method employs a pinion like cutter shown in fig. the cutter teeth are serrated to form a series of cutting edges to obtain relative sliding motion between the tooth profiles the work gear and shaving cutter are set up in a gear shaving machine with crossed axes.

Gear Lapping :- Gear with a high degree of accuracy and precise meshing of gears profiles can be produced by using gear lapping.

This work gear and lapping gear are run together, the mating teeth being fed with a lapping medium consisting a fine abrasive powder in suspension in kerosene or light oil.

The lapping gear is precisely manufactured fine grained CI gear.

Q. 3 c) Explain the use of universal dividing head. (04 marks for appropriate answer)

This type of dividing head is very useful for the purpose of indexing work and which is used for following purposes.

1) For setting the work in horizontal vertical and inclined positions, relative to the table surface.
2) For turning the work periodically through a given angle to impart indexing movements.
3) For imparting a continuous rotary motion to the workpiece for milling helical grooves.

4) It is in conjunction with a tailstock acts both as a holding as well as supporting device for the work during the operation.

Q. 3 d) What is CNC machine? What are the advantages of using CNC machines?

(02 marks for CNC , 02 marks for adv.)

CNC machine is a form of programmable automation in which the process is controlled by numbers, letters & symbols. The numbers, letters & symbols are arranged in proper manner to form one block. The series of block form a programme & control is done by computer. Each block carries some specific instructions contain in the programme are read & interepretated by MCU to regulate the different slides of the m/c tool & spindle motions

A separate hardware unit (i.e MCU) is used for each m/c tool & programme is entered into computer through i/p device such as key board stored in the memory parentally. It is very easy to edit & modify a programme. It has facility to show tool path motion.

Tape Reader	NC Programme Storage	Mini Computer	Computer hardware interface and servo systems		Machine Tool

Block diagram of CNC system

Advantage of CNC systems

1) Reduced lead time.
2) Elimination of operator errors.
3) Reduced operator activity.
4) Lower labour cost.
5) Longer tool life.
6) Elimination of special jigs and futures.
7) Flexibility in changes of component design.

8) Reduced inspection.
9) Less scrap.
10) Accurate costing and scheduling.

Q. 3 e) What is preparatory code? States any four. (02 marks for def., 02 marks for stating any four)

The code which used for preparing the m/c tool for function is known as preparatory code. The G code are among those numerical codes by which command data is given to the CNC system in the form of part programme. G codes are also known as preparatory functions.

The G code takes active part in part programme execution and machine operation and are programmed by the letters G followed by two digits as Goo. They are always programmed at the start of the block (after the sequence no.)

The action of the G codes is either 'Modal' or 'Block by block'

Preparatory Codes :-

1) GOO :- Rapid travel
2) GO1 :- Linear Interpolation
3) GO2 :- Circular interpolation in clock wise direction
4) GO3 :- Circular interpolation in counter clock wise direction
5) GO4 :- Dwell cycle
6) G90 :- Absolute programming
7) G91 :- Incremental Programming
8) G94 :- Feed rate in mm/min
9) G95 :- Feed rate in mm/revolution.
10) G70 :- Dimension in inch
11) G71 :- Metric data i/p
12) G8O :- Canned cycle cancled
13) G81- G89 :- Canned cycle

Q. 3 f) What is lapping? How it is done? (02 marks for def. 02 marks for process)

It is an abrading process employed for improving the surface finish by reducing roughness waviness, and other irregularities on the surface it is used on both heat treated and nonmeat treated metal parts.

It is should be used only where accuracy is a vital consideration in addition to the surface finish.

In contrast to grinding and honing, lapping is minimal material removal forces are very light and parts move freely between lap prates.

Finishes are measured in micron and nanometer ranges. The term is also commonly used for processes that produce very fine finishes using loose abrasive grains.

Historically lapping means a process for the ultimate refinement of geometry or surface finish using very fine abrasive to produce extremely accurate components. The process is being replaced by fine grinding.

Lapping is a process where in abrasive particles are mounted into face of a lap, which is further rubbed against the workpiece.

The lapping operation is done with hand or machine very small amount of material up to 0.005 mm is removed.

The lapping action is either rotary or reciprocating. Abrasive material used include emery, corundum, iron, oxide, chromium oxide, mixed with a fluid medium usually oil is used in this operation.

Q. 4 a) What are the abrasives ? Name artificial abrasive used for manufacturing of grinding wheels . (02 marks for def. 02 marks for names)

An abrasive is a substance that is used for grinding and polishing operations. It is hard and tough material. It has many sharp edges, and can be used to cut the other material. Abrasive particiles used for grinding wheels are two types.

1) Natural abrasives 2) Artificial abrasive

The artificial abrasives are manmade manufactured abrasive. These are manufactured electro chemically. The quantities and composition of these components can be easily controlled and their efficiency is better than natural abrasive.

The artificial abrasive mainly used for manufacturing grinding wheel are as follows.

i) Silicon carbide (Sic)

ii) Aluminium oxide (Al_2O_3)

The silicon carbide is made from chemical reaction of core, silica sand and salt at very high temp. it is manufactured in two grades. Green grade silicon carbide, which is normally used for grinding tungsten carbide tools. Other blue-black grade silicon carbide which is used for grinding low tensile strength material such as brass, copper cost iron glass, porcelain and all kinds of stones.

The aluminium oxide is manufactured by refining bauxite. Aliminium oxide is refined to different grades which give black, white, gray or pink colour to the grinding wheel. Aluminium oxide wheels are tough and shock resistant and mainly used for dry grinding materials of high tensile strength.

Q. 4 b) Explain buffing process. Which materials are used for making buffing wheels ?

(02 marks for process, 02 marks for materials)

Buffing is surface finishing operation which is usually performed after polishing to give much higher, brighter, reflective surface to work. The buffing processes consists in applying a very five abrasive with a rotating wheel.

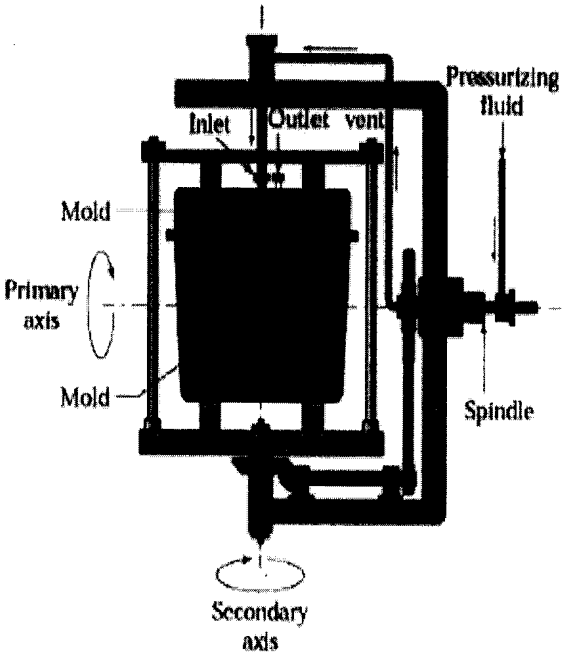
Buffing wheels are made of felts pressed and glued layers of duck or other cloth and also leather. The abrasive is mixed with a binder and is applied either on buffing wheel or on the work. The buffing wheels rotates with a high peripheral speed up to 40m/sec and work is slightly pressed on the wheel. The abrasive consist of iron oxide, chromium oxide, emery etc. the binder is a paste consisting of wax mixed with grease, paraffin and kerosene or turpentine and other liquids.

Buffing is always used to non-feverous metals such as aluminum, copper, brass, zin alloys die casting, stainless steel, chromium and nickle etc.

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**

Q. 4 c) Explain rotational moulding process with neat sketch.(02 marks for sketch, 02 marks for explanation)



The rotational molding

The rotational moulding process is high temperature low pressure plastic forming process that uses heat &biaxial rotation(i.e angular rotation on two axis) to produce hollow one piece part the process does have distinct advantages manufacturing large hollow parts such as oil tank, water tank & many plastic articles is much easier than any other maoulding method it is cheaper than any other type of mould. Very little material is wasted using this process & excess material can be reused making it very economically & environmental viable manufacturing process.

Thermo plastics are thermosets can be formed in to large part by rotational moulding. A thin walled metal mould is made two pieces. It rotates about two perpendicular axes. Premeasured quantity of powdered plastics material is rotated about two axes& heating is provided.

Q. 4 d) Explain any two cutting parameters of drilling operation. (Any two, 04 marks)

1) Cutting Speed :-

Cutting speed in a drilling operation refers to the peripheral speed of a point on the surface of the drill in contact with the work. It is express in m/min

So cutting speed (s) is given by,

$$s = \frac{\pi dN}{1000} rpm$$

Where, d = drill dia. in mm

N = Spindle speed in rpm.

S = Peripheral speed.

The use of cutting speed of drill depends on several factors such as

1) the kind of material being drilled softer the material higher the speed
2) the cutting tool material HSS drill can be operated at about twice the speed of high carbon steel drill.

2) Feed :-

It is the distance a drill moves, parallel to axis into the work in each revolution of the spindle. It is expressed in mm per revolution. Also feed can be expressed as feed in mm per minute, if the total distance moved by the drill into work parallel to its axis in one minute is considered.

Feed in mm/min = feed in mm/rev × N.

The amount of feed as in the cutting speed is dependent upon several machining conditions such as

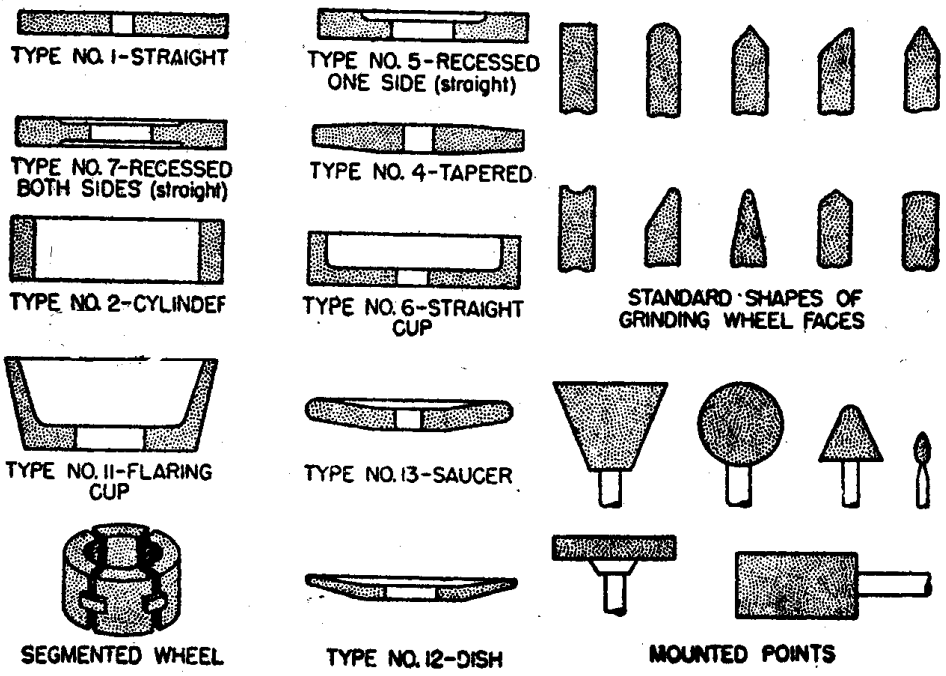
1. Material being cut e.g. hard, tough, soft etc.
2. Rigidity of the job & machine
3. Depth of hole
4. Type of finish desired
5. Power available
6. Range of feeds available

3) Depth of cut :-

In drilling operation the depth of cut is measured at right angles to the axis of the drill. i.e. the direction of feed. It is generally taken as one half of the drill dia.

$$Depth\ of\ cut = \frac{drill\ dia}{2}\ mm$$

Q. 4 e) Sketch and state the uses of any four types of grinding wheels. (Any Four , 01 mark each))



Standard grinding wheel shapes

Grinding wheels are made in many different shapes and sizes to adapt them for use in different types of grinding machines and on different classes of work.

They fall into the following groups :

1) Straight side grinding wheels.
2) Cylinder wheels.
3) Cup wheels.

4) Dish wheels.

1) **Straight Wheels :-** Generally used for cylindrical, centre less and surface grinding operations.
2) **Tapered face straight Wheel :-** Primarily used for grinding thread, gear teeth etc.
3) **Cylinder or wheel ring :-** It is used for producing flat surfaces, the grinding being done with the end face of the wheel.
4) **Cup wheel :-** It is used for grinding flat surfaces by traversing the work past the end or face of the wheel.
5) **Dish wheel :-** It is also used for tool room work.
6) **Segmented wheels :-** These are used chiefly on vertical spindle, rotary and reciprocating. Table surface grinders and way grinders.

Q. 4 f) What is burnishing? State it's purpose and explain the burnishing operation.

(01 mark for def. ,01 mark for purpose, 02 marks for explanation)

It is a super finishing cold working process, performed to improve surface finish, dimensional accuracy and to impart work hardening without removal of material. It can be performed on ductile or malleable material for external as well as internal surfaces. The surface may be cylindrical, tapered, spherical or circular flat.

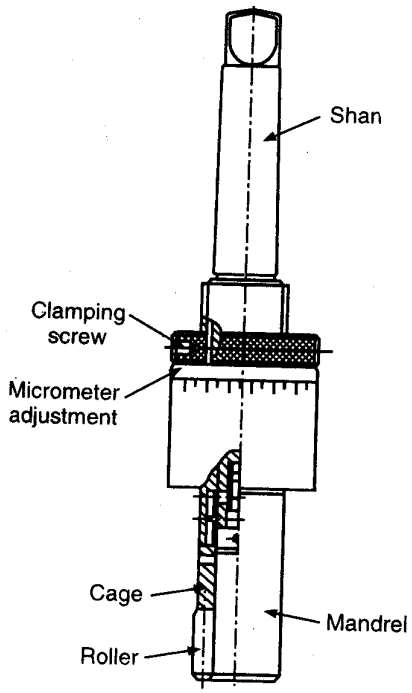
This process is used instead of reaming process but mostly it is used after reaming or boring. A roller burnishing tool in which hardened rollers are free to rotate on the mandrel. The rollers are held in cage. A micrometer adjustment provision is made to adjust the diameter of tool. The tapered shank is used to fit the burnishing tool into spindle of machine. The tool is fed in the hole which rotating and lubrication is done to prevent heating up of tool and workpiece.

In roller burnishing, the surface of the work piece is cold worked by a hard and highly polished roller. This process is used on various flat cylindrical or conical surfaces.

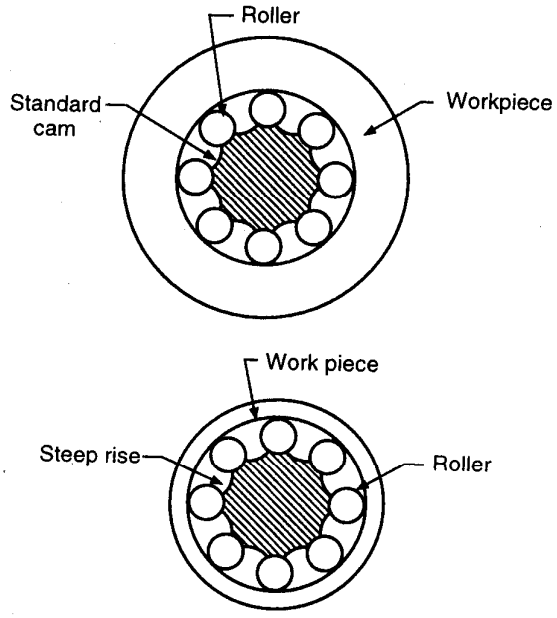
Roller burnishing is used to improve the mechanical properties of surfaces, as well as shape and surface finish of the workpiece.

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**



Burnishing tool



Cross-section of burnishing peening tools using standard and steep-rise cams

Q.5 Attempt any TWO of the following: **Marks- 16**

a) What are the fixed cycles in programming? Explain the use of any two with suitable example. (2 marks for fixed cycle, 3 marks each for examples)

Canned cycle or fixed cycle may be defined as a set of instructions stored in the system memory to perform a fixed sequence of operations. The canned cycles can be brought into action with a single command which reduces the programming time and efforts. Canned cycles are used for repetitive and commonly used machining operations.

Commonly available canned / fixed cycles for lathe operations are:

i) Cycle for rough turning
ii) Cycle for Cycle for facing
iii) Cycle for finish turning
iv) Cycle for threading

Commonly available canned / fixed cycles for milling machines or machining centre operations are:

i) Drilling Cycle
ii) Boring cycle
iii) Threading cycle
iv) Pocket milling
v) PCD or bolt hole drilling cycle.

Deep hole drilling Cycle or peck drilling cycle :- when the depth of hole is more it is desirable to withdraw the drill from the hole at regular intervals to avoid clogging due to chips. By using peck drilling cycle the drill is retracted upto reference plane at rapid feed rate every time after drilling a hole to a specified incremental depth. the code available is G83 and the format for the cycle is

G83 Z Q R F ;

Where,

Z – Positions of the Z axis at the bottom of hole i.e depth of hole to be drill

Q- Cut depth, always incremental

R - Position of the reference plane

F - Feed rate in mm/min

Example: To drill a hole of 10 mm diameter and 40 mm depth at a distance of X 20 and Y 30 in a aluminium plate of size 60 X 60 mm.

N1 G90 G94
N2 G54
N3 M03 S800
N4 M08
N5 G01 X 20. Y 30. Z0 F20
N6 G83 Z -20. Q5. R5. F20
N7 G80 G00 Z10.
N8 M09
N9 M30

Drill canned Cycle: by using drilling cycle the complete drilling cycle is completed by giving the information in a single block.

The code for fixed cycle for drilling is G81 the format for the cycle is :

G81 Z R F ;

Where,

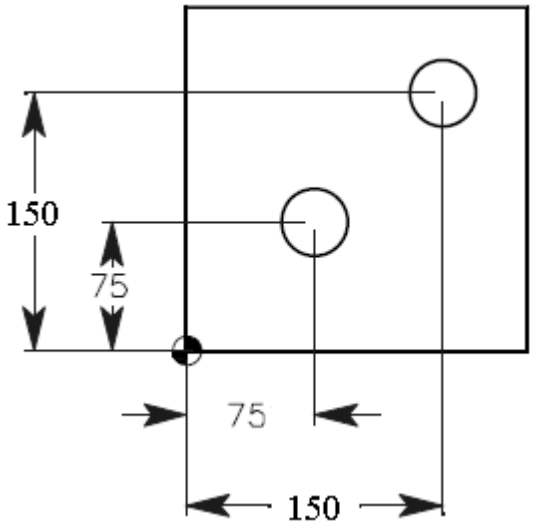
Z – depth

R – reference plane

F- feed rate in mm/min

Example:- To drill a hole of 10 mm dia.and depth of 10mm at the position shown in diagram
G90 G94;
G54;
M03 S1000;
M08;
G01 X 75 Y 75 Z 0 F20 ;
G81 G99 Z10. F 20 R2;
X 150 Y150;

G80 G00 Z10 ;
M09;
M30;

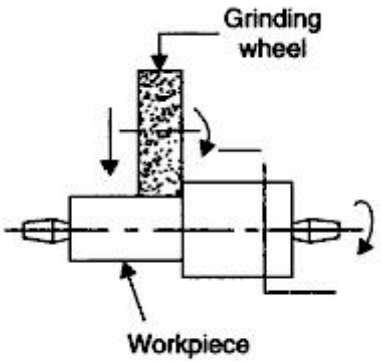


b) Enlist the different types of grinding operations. Explain any two operations with neat sketch.(2 marks for enlist, 3 marks each for any two operations- 2 marks for sketch , 1 mark for explanation))

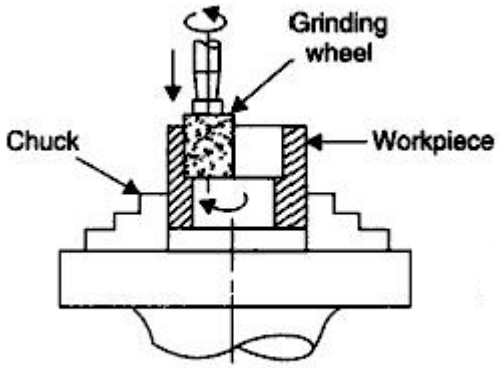
Following are the different grinding operations:

i) Cylindrical Grinding
ii) Surface Grinding
iii) Form Grinding
iv) Centreless Grinding

i) Cylindrical Grinding: the cylindrical grinding is used for producing external and internal cylindrical surfaces. The workpiece is held between the centers is rotate about its own axis whereas the grinding wheel is located similar to the tool post of a centre lathe with an independent power and is driven at a high speed suitable for the grinding operation. Internal cylindrical grinding produces internal holes and tapers.

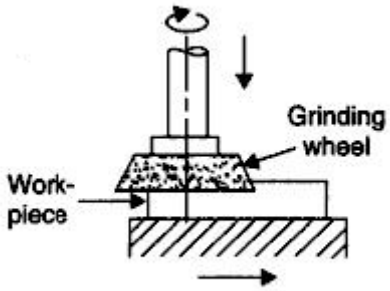


(i) External cylindrical grinding



(ii) Internal cylindrical grinding

ii) Surface Grinding: Generally used for producing flat surfaces. The work may be ground by either the periphery or by the end face of the grinding wheel. The workpiece is reciprocated at a constant speed below or on the end face of the grinding wheel.



Surface grinding

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**

c) What is indexing? State the methods of indexing and explain in brief compound indexing method.(2 marks for Indexing,2 marks for methods and 4 marks for compound indexing)

Indexing is the operation of dividing the periphery of a work piece into any number of equal parts.

Indexing is performed in cutting equally spaced teeth on the gear blank in cutting spur gear, for production of hexagonal and square headed bolts, cutting splines on shaft, fluting drills, taps, and reamers ect.

Methods of indexing are:

1) Simple or Plain Indexing
2) Compound Indexing
3) Angular Indexing
4) Differential Indexing

Compound Indexing: - The indexing method is called compound due to the two separate movements of the index crank in two different hole circles of one index plate to obtain a crank movement which is not obtained by plain indexing. The index plate is normally held stationary by a lock pin which engages with one of the hole circles of the index plate from the back. While indexing, first the crank pin is rotated through t a required number of spaces in one of the hole circle of the index plate and then the crank pin is engaged with the plate. The second movement index movement is now given by removing the rear lock pin and then rotating the plate together with the index crank forward or backward through the calculated number of spaces of another hole circle and then the lock pin is engaged. The effective indexing movement will be the summation of the two movements.

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**

Q.6 Attempt any TWO of the following

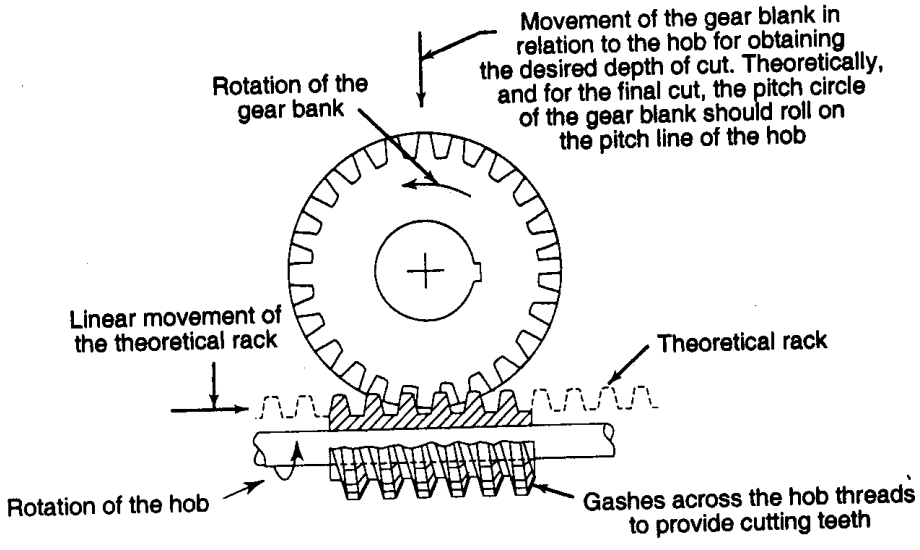
a) Explain with neat sketch gear hobbing. State the advantages and limitations of gear hobbing.

(2 marks each for sketch,explanation,advantages,limitations)

Gear hobbing is a continuous generating process in which the tooth flanks of the constantly moving workpiece are formed by equally spaced cutting edge of the hob. A hob may have one two or more threads of cutting edges. when a gear blank of N teeth is cut with a single thread hob , the blank turns a complete revolution when the hob completes N revolutions.

The workpiece is mounted on a vertical axis and rotate about its axis. The hob is mounted on an inclined axis whose inclination is equal to the helix angle of the hob, this makes the blank teeth in the same plane as that of the gear hob teeth, which is termed as the generating plane. The hob is rotated in synchronization with the rotation of the blank and is slowly moved into the gear blank till the required depth is reached in a plane above the gear blank. Then the hob is fed slowly in the axial direction of the gear blank till the complete tooth face width is achieved.

For hobbing helical gears the hob is swelled by an additional angle of the helix angle of the gear to be made.



Advantages:

i) Gear hobbing is a versatile process it can generate spur gear, helical gear, worm and worm wheels, splines and serrations and variety of special forms.

ii) It is a fast and most economical gear machining process.

iii) The indexing is continuous and there is no intermittent motion to give rise to errors.

iv) There is no loss of time due to non cutting on the return stroke.

v) It is possible to mount more than one gear blank in the work axis to increage the production rate.

Limitations:

i) This process can not be used for machining gears with shoulders and flanges.

ii) Splines and serrations are sometimes required with one tooth blocked or removed is not suitable for hobbing.

iii) It is possible to generate internal gears but the application is very limited and involves a special hob head on the machine and special cutting tools.

b) Prepare a part program to machine workpiece as shown in Fig. No.1 below on CNC lathe. The raw material available is 20 mm dia. Bar. The operatios involved are:
i) Facing ii) Turn to 15 mm dia. Over 15mm length iii) taper turning
(2 marks each for header part, facing, turning and taper turning)

```
O00107
T101;
G90 G94;
G54;
M03 S1000;
M08;
G00 X 20  Z 1 ;
G01 Z – 2 ;
G01 X 0.0;
G00 X 20 0Z 1 ;
G01 X 18 ;
G01 Z -17 ;
G00 X 20 Z 1 ;
G01 X 16 ;
G01 Z -17;
G00 X 20 Z 1 ;
G01 X 15 ;
```

G01 Z -17;
G01 X 20 Z -22 ;
G00 X 20 Z1 ;
M09;
M30;

c) Enlist the various milling operations and explain with neat sketches any two milling operations.(2 marks for enlist, 3 marks each for any two operations- 2 marks for sketch , 1 mark for explanation))

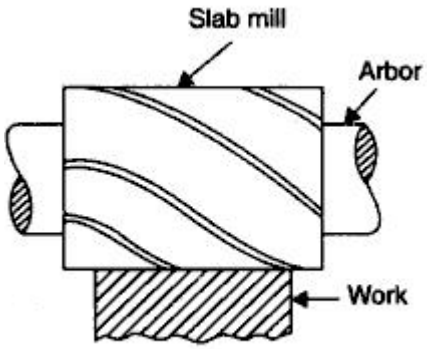
The following are the different milling operations:

1) Plain milling	6) Gang milling	12) Gear cutting
2) Face milling	7) Form milling	13) Helical milling
3) Side milling	8) End Milling	14) Cam milling
4) Straddle milling	9) Saw milling	14) Thread milling
5) Angular milling	10) Milling keyways, grooves and slot	

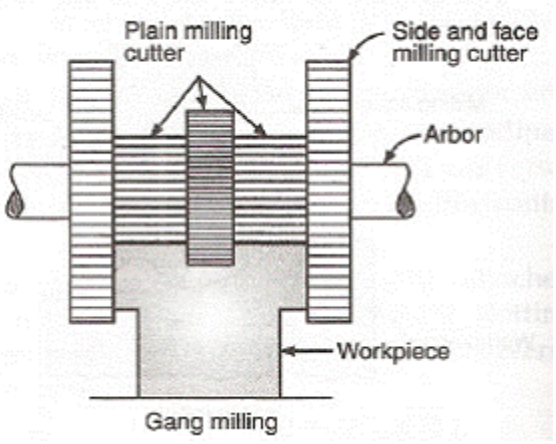
Plain or Slab Milling: The plain milling is the operation of production of a plain, flat, horizontal surfaces parallel to axis of rotation of plain milling cutter. The operation is also called slab milling. To perform the operation the work and the cutter are secured properly on the machine. The depth of cut is adjusted by rotating the vertical feed screw of the table.

SUMMER – 13 EXAMINATION

Subject Code: 12091 **Model Answer**



Plain or slab milling.



Gang milling

Gang Milling: The gang milling is the operation of machining several surfaces of a workpiece simultaneously by feeding the table against a number of cutters having same or different diameters mounted on the arbor of the machine. The method saves much of the machining time and is widely used in repetitive work.