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.

Q.1. A) Attempt any three :

a) Give classification of non-traditional machining processes.

(Detail classification : 04 marks)

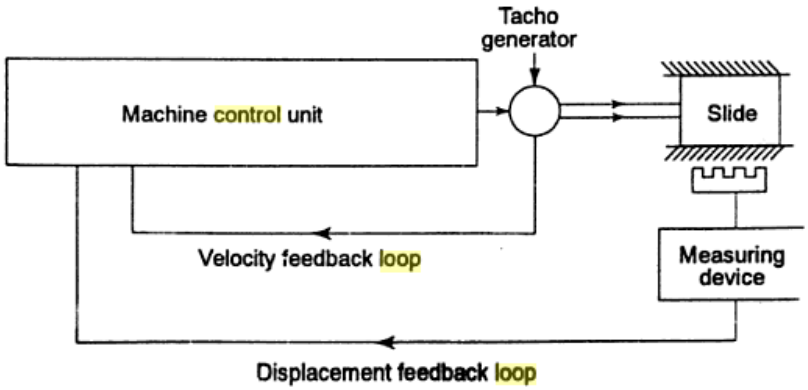
Ans. Classification of non-traditional machining processes

1. Mechanical
   (a) Abrasive Jet Machining (AJM)
   (b) Ultrasonic Machining (USM)
2. Chemical
   Chemical Machining (CHM)
3. Electro-Chemical
   (a) Electro-Chemical Machining (ECM)
   (b) Electro-Chemical Grinding (ECG)
4. Thermo-electric.
   (a) Ion-beam Machining (IBM)
   (b) Plasma Arc Machining (PAM)

(c) Electrical Discharge Machining (EDM)
(d) Electron-Beam Machining (EBM)
(e) Laser-Beam Machining (LBM)

b) With neat sketch explain closed loop control system. (sketch-02 marks & explationation-02 marks)

Ans. In a closed-loop control system the actual output from the system i.e. actual displacement of the machine slide, is compared with the input signal. The closed loop control systems are characterized by the presence of feed-back devices in the system. In the closed loop control system the displacement can be achieved to a very high degree of accuracy because a measuring or monitoring device is used to determine the displacement of the slide. The feedback from monitoring device is then compared with the input signal and the slide position is regulated by the servo system until it agrees with the desired position. Fig. below shows a closed loop control system with a provision for feedback for the displacement of position of machining slide. In order to measure the speed of the motor and compare the actual speed with the programmed speed, a velocity feedback system is added to the system.



Block diagram of a closed-loop system

c) State advantages of gear hobbing. (1 mark for each point)

Ans. Advantages of gear hobbing are:

1. It's a versatile process. It can cover a variety of work including spur, helical, worms and worm wheels, splines and serrations, and a variety of special forms.
2. The indexing is continuous and there is no intermittent motion to give rise to errors.
3. There is no loss of time due to non-cutting on the return stroke.
4. It is also possible to generate internal gears.
5. The rate of production is high as compare to other generating processes.

6. The process is applicable for small as well as large scale production.

d) Compare between burnishing and polishing.

(1 mark for each point)Any for from following

Burnishing :

1. Process is carried out with the help of a hard tool (punch and/or dir, rollers and balls etc.).
2. Smooth and shiny surface is obtained by contact and rubbing the surface against the tool(hard and highly polished)Rollers.Burning improves surface finish by removing scratches, tool marks.
3. It improves the fatigue life of the component due to cold working.
4. Typical applications include hydraulic system components, seals, valves, spindles and fillets on shafts..
5. Burnishing is used to improve mechanical properties of surfaces as well as shape and surface finish.
6. This process is used on various flat, cylindrical or conical surfaces.

Polishing :

1. Process is carried out with the help of soft or resilient wheels or belts. These wheels are made of canvass, felt or wool.
2. Smooth and lustrous surface is obtained by the simultaneous action of the tool (wheel/belt) and abrasive particles pastes. The process is carried out by using very fine minerals. very little or no material removal during the process. Visual appearance is the primary purpose.
3. Force per unit area for polishing is the lightest of all processes
4. It does not improves the fatigue life of the component.
5. Typical applications include cutlery and small hand tools like screw drivers, axes, wrenches, internal works on tools & dies, bicycle parts, golf club heads, jet engine turbine blades, sole plates for electric irons. Fountain pen parts etc.,
6. Polishing operation is employed for removing scratches of tool marks.
7. Irrespective of shape it is used for accuracy and surface finish. For mass production automatic machines are used.

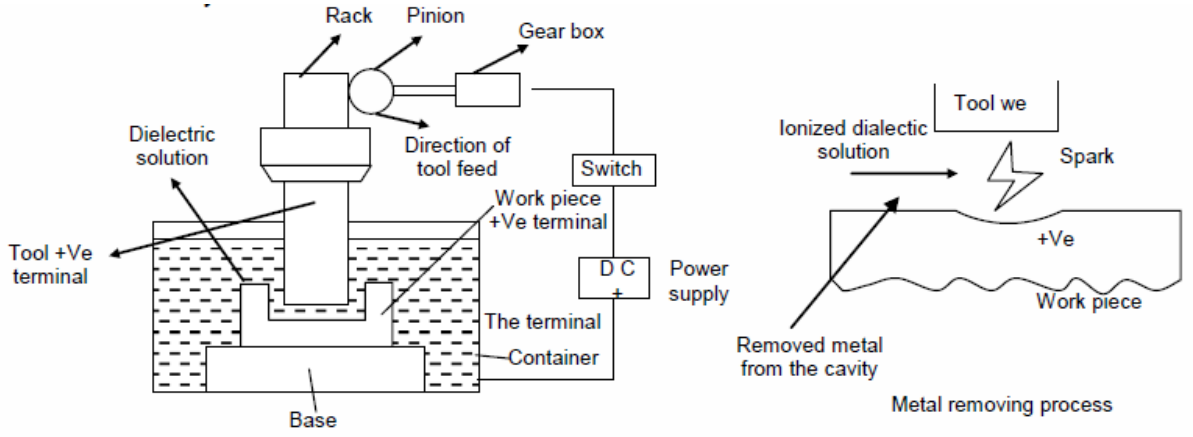
Q.1. B) Attempt any one:

a) Draw neat labeled diagram of EDM and explain the process w.r.t. its principle, applications and limitations. (Diagram-2 marks, Principle-2 mark, Apllications-1 mark, Limitatons-1 mark)

Working Principle of Electric Discharge Machining

Electric discharge machining process is carried out in presence of dielectric fluid which creates path for discharge. When potential difference is created across the two surfaces of die electric fluid, it gets ionized. An electric spark/discharge is generated across the two terminals. The potential difference is developed by a pulsating direct current power supply connected across the two terminals. One of the terminal is positive terminal given to workpiece and tool is made negative terminal. Two third of the total heat generated is generated at positive terminal so workpiece is generally given positive polarity. The discharge develops at the location where two terminals are very close. So tool helps in focusing the discharge or intensity of generated heat at the point of metal removal.

Application of focused heat raise the temperature of workpiece locally at a point, this way two metal is melted and evaporated.



Line Diagram Indicating Working Principle and Process Details of EDM

Application of Electric Discharge Machining

This process is highly economical for machining of very hard material as tool wear is independent of hardness of workpiece material. It is very useful in tool manufacturing. It is also used for broach making, making holes with straight or curved axes, and for making complicated cavities which cannot be produced by conventional machining operations. EDM is widely used for die making as complex cavities are to be made in the die making. However, it is capable to do all operations that can be done by conventional machining.

Limitations of EDM Process

There are some limitations of EDM process as listed below :

(a) This process cannot be applied on very large sized workpieces as size of workpiece is constrained by the size of set up.

(b) Electrically non-conducting materials cannot be processed by EDM.

(c) Due to the application of very high temperature at the machining zone, there are chances of distortion of workpiece in case of this sections.

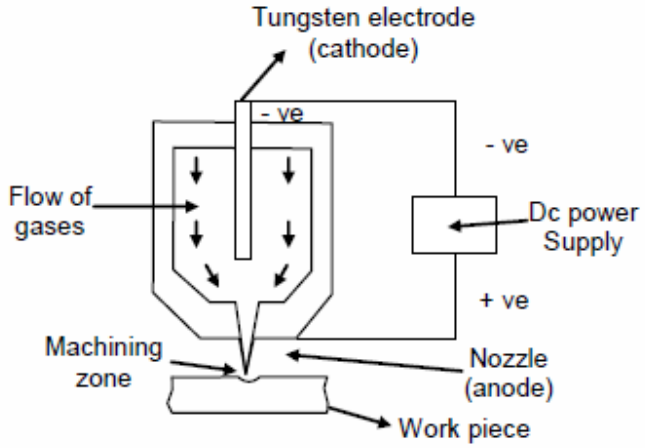
(d) EDM process is not capable to produce sharp corners.

(e) MRR achieved in EDM process is considerably lower than the MRR in case of conventional machining process so it cannot be taken as an alternative to conventional machining processes at all.

b) Draw neat labeled sketch of PAM. Explain its working. Also state its advantages and applications. (Diagram-2 marks, Working-2 marks, Apllications-1 mark, Advantages-1 mark)

Working Principle of PAM

In this process gases are heated and charged to plasma state. Plasma state is the superheated and electrically ionized gases at approximately 5000°C. These gases are directed on the workpiece in the form of high velocity stream. Working principle and process details are shown in Figure



Gases are used to create plasma like, nitrogen, argon, hydrogen or mixture of these gases. The plasma gun consists of a tungsten electrode fitted in the chamber. The electrode is given negative polarity and nozzle of the gun is given positive polarity. Supply of gases is maintained into the gun. A strong arc is established between the two terminals anode and cathode. There is a collision between molecules of gas and electrons of the established arc. As a result of this collision gas molecules get ionized and heat is evolved. This hot and ionized gas called plasma is directed to the workpiece with high velocity. The established arc is controlled by the supply rate of gases.

Power supply (DC) is used to develop two terminals in the plasma gun. A tungsten electrode is inserted to the gun and made cathode and nozzle of the gun is made anode. Heavy potential difference is applied across the electrodes to develop plasma state of gases.

As we know that hot gases continuously comes out of nozzle so there are chances of its over heating. A water jacket is used to surround the nozzle to avoid its overheating.

There is no direct visible tool used in PAM. Focused spray of ho0t, plasma state gases works as a cutting tool.

Workpiece of different materials can be processed by PAM process. These materials are aluminium, magnesium, stainless steels and carbon and alloy steels. All those material which can be processed by LBM can also be processed by PAM process.

Applications of PAM

The chief application of this process is profile cutting as controlling movement of spray focus point is easy in case of PAM process. This is also recommended for smaller machining of difficult to machining materials.

Advantages of PAM Process

Advantages of PAM are given below :

(a) It gives faster production rate.

(b) Very hard and brittle metals can be machined.

(c) Small cavities can be machined with good dimensional accuracy.

Q.2. Attempt any four :

a) State difference between dialectic fluid and electrolyte. (1 mark for each point)

Ans.

Dielectric	Electrolyte
1. It is used as conducting medium in EDM process.	1. It used as conducting medium in ECM process.
2. It act as conductor and insulator both.	2. It always provide passage for supply of electricity.
3. Tool wear takes place in the dielectric fluid.	3. The electrolyte selected is such that there is no wear of tool.
4. It may or may not be corrosive in nature.	4. It should be non corrosive in nature.

b) Give any two applications of AJM, LBM, WEDM and WJM.

Ans. **Any two applications from the following for each process (1/2 mark for each application)**

Abrasive Jet Machining (AJM) :

(i) Removing flash and parting lines from injection moulded parts.
(ii) Deburring and polishing plastic, nylon and teflon components.
(iii) Cleaning metallic mould cavities which otherwise may be inaccessible.
(iv) Cutting thin sectioned fragile components made of glass, refractories, ceramics, mica, etc.
(v) Producing high quality surface.
(vi) Removing glue and paint from paintings and leather objects.
(vii) Reproducing designs on a glass surface with the help of masks made of rubber, copper, etc.
(viii) Frosting interior surfaces of glass tubes.
(ix) Etching markings on glass cylinders.

Laser-Beam Machining (LBM):

Laser can be used in wide range of manufacturing applications

- Material removal – drilling, cutting and tre-panning
- Welding
- Cladding
- Alloying

Drilling micro-sized holes using laser in difficult – to – machine materials is the most dominant application in industry. In laser drilling the laser beam is focused over the desired spot size. For thin sheets pulse laser can be used. For thicker ones continuous laser may be used.

Wire cut Electrical Discharge Machining (WEDM) :

The process is used in the following areas:

- Aerospace, Medical, Electronics and Semiconductor applications
- Tool & Die making industries.
- For cutting the hard Extrusion Dies
- In making Fixtures, Gauges & Cams
- Cutting of Gears, Strippers, Punches and Dies
- Manufacturing hard Electrodes.
- Manufacturing micro-tooling for Micro-EDM, Micro-USM and such other micro- machining applications.

Water Jet Machining (WJM) :

Application

- Paint removal
- Cleaning
- Cutting soft materials
- Cutting frozen meat
- Textile, Leather industry
- Mass Immunization
- Surgery
- Peening
- Cutting
- Pocket Milling
- Drilling
- Turning
- Nuclear Plant Dismantling

c) Explain absolute and incremental part programming.

(02 marks for explationation of each programming)

When studying a part print in order to program a part, one of the first things a programmer will notice is how the part is dimensioned. Carefully study the part in Figure. The distance from the left edge of the part to hole 1 is 1.25. From hole 1 to hole 2, the distance is 1.50. The distance from hole 2 to hole 3 is 1.50, and 1.62 from hole 3 to hole 4. This is known as ***incremental dimensioning***. It is also referred to as ***delta*** dimensioning. The word *delta* is derived from a Greek letter that means the difference between two quantities. In Figure 13–1, each dimension is given incrementally from the last position to the next position.

Incremental programming works according to the same principle; it positions the work or cutter from the point where it currently is to the next point programmed. Calculations are made from the tool's present location to the next position where it is going. The use of plus or minus signs takes on a new meaning when used in the in-

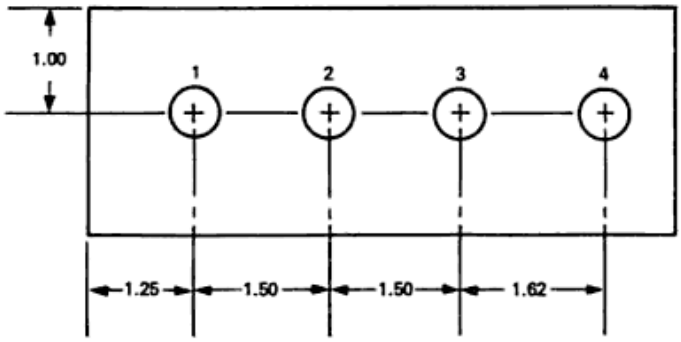


FIGURE 2-1
Incremental dimensioning.

cremental mode. A positive X move does not refer to a specific rectangular quadrant, but directs the tool to move to the right along the X-axis from its current position. A negative X move directs the tool to the left. Similarly, a positive Y move positions the cutter up from the present location, and a negative Y is a command to move down. A positive Z directs the cutter away from the workpiece, while a negative Z is a move toward or into the workpiece.

Looking closely at the workpiece in Figure 2-2 you will see how closely it resembles the one shown in Figure 2-1. The difference is the way the actual part is dimensioned. This part is dimensioned in a manner known as ***absolute*** or ***baseline dimensioning*** because all positions are given as distances from the same zero location or reference point. All dimensions are calculated from one zero point, as indicated in Figure 2-2.

Absolute programming operates similarly to absolute dimensioning. All positions are figured from the same zero or reference point. All positional moves come from the same reference or "datum edge" at all times, as opposed to an incremental system, where each new move is an incremental distance from the last.

One advantage of absolute systems over incremental systems concerns positioning errors. If a positioning error occurs in an incremental system, all the rest of the positions are affected and all remaining moves will be wrong. This is because each new position is an incremental move from the last. When a positioning error occurs

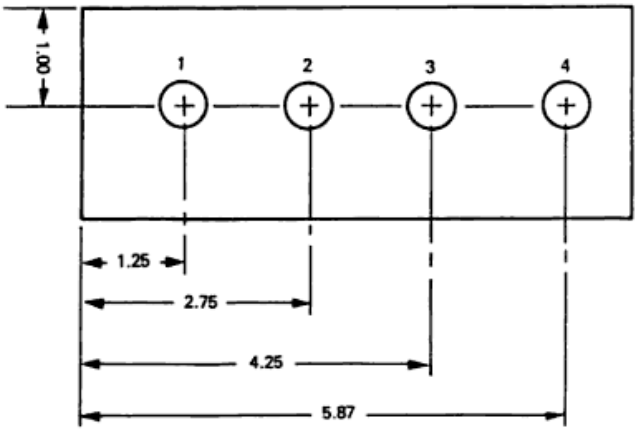
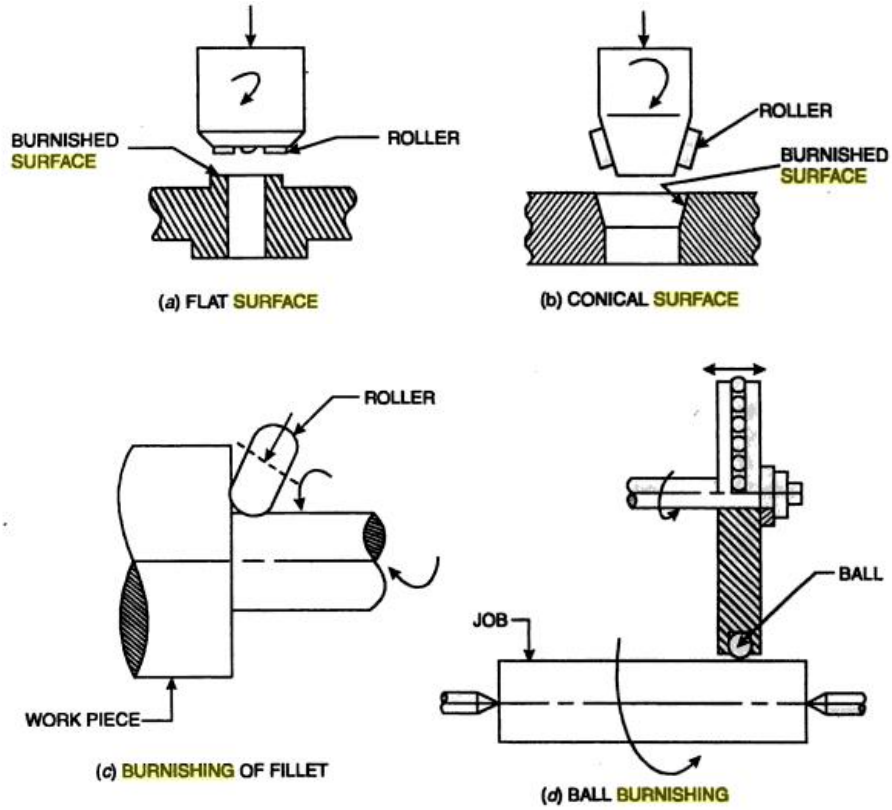


FIGURE 1–2
Absolute dimensioning.

in an absolute N/C system, one particular position or location will be wrong but remaining positions are not affected. This is because all dimensions and each remaining positional move are always based from the same zero or reference point. This is not to say, however, that absolute dimensioning and programming is better than incremental dimensioning or programming. This philosophy started in the early days of N/C when purchasers were forced to choose between either an absolute or an incremental system. This resulted in part drawings having to be dimensioned (absolute or incremental) to suit the type of N/C system being used to machine the part. If the part drawing was not or would not be dimensioned to match the N/C system being used to machine the part, the programmer was forced to do all the math and convert dimensions from one system to another. This process was very error-prone.

d) Explain what is burnishing. (sketch-02 marks & explationation-02 marks)

Burnishing: Burnishing operation is the process of getting a smooth and shiny surface by contact and rubbing of the surface against the walls of a hard tool [punch and/or die, rollers and balls etc.). It is a finishing and strengthening process. Burnishing is basically a cold surface plastic deformation process. Cold working of surfaces improves the surface finish and induces surface compressive residual stresses, thus improving the fatigue life of the component.



Flat, cylindrical or conical surfaces (both internal and external) are burnished with hardened steel or cemented carbide rollers or with steel balls mounted in a holder, fig.

Fillets and grooves are burnished by rollers rounded to a radius, fig. Where strengthening is the aim of the treatment, the burnishing pressure is to be increased. However, this condition results in somewhat lower machining accuracy. Hole burnishing is performed with multi-roller tools on drill presses, turret lathes, horizontal borers, unit built machines and automatic lathes. Burnishing raises the hardness of the surface by 20 to 50% and its wear resistance by 1.5 to 2 times. Internal surfaces are also burnished with the help of balls, the process being called as "ball burnishing" or "Ballizing". Smooth balls or mandrels slightly larger than the bore diameter are pushed through the length of the hole

Typical product applications of roller burnishing include: Hydraulic system components, Seals, valves, spindles and fillets on shafts.

e) State advantages and applications of broaching machines.

(Advantages – 2 marks, applications – 2 marks)

Ans. Advantages of broaching machines:

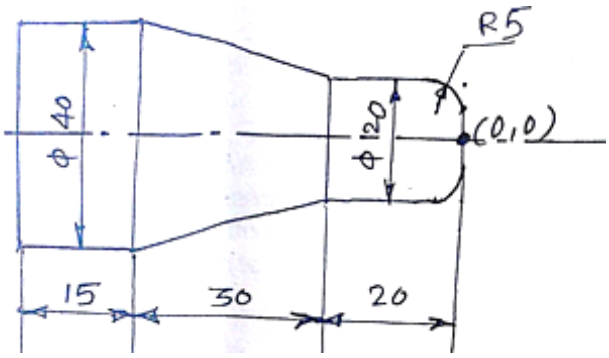
1. Higher production rate with unskilled worker.
2. Longer tool life since each broach takes a smaller cut.

3. Roughing and finishing operations can be performed on a single tool with a single pass.
4. Cutting fluid can be easily applied.

Applications of broaching machines:

1. In automotive industry for gears, steering gear levers, cylinder blocks, connecting rods, bearings, pistons, carburettors etc.
2. Machining irregularly shaped holes of considerable length very economically for both small lot jobs as well as for mass production.
3. Keyways, straight and spiral splined holes, square, hexagonal and other odd shaped holes are produced very efficiently.
4. Forming the teeth In small internal gears, in cutting suitable grooves or splines in castings, forgings.

Q 3 a) Part programming for CNC Lathe Job
(Correct program: 06 marks, proper codes & symbols: 02 marks)
Note: Simple part program or Canned cycle should be given due marks. Canned cycles for turning may have G codes like G70, G71, G76, G81, G82, etc. as they vary for different control systems.



O100
N10 G90 G94;
N20 T01 G54;
N30 S1200 M03 M08 F150 ;
N40 G00 X41 Z1.0;
N50 G71 P100 Q200 D0.2 I 0.1 K0.1; (Instead of I& K, U & W may be used for finish allowance)
N100 G01 X0 Z0;
G01 X10 Z0;
G02 X20 Z-5 R5;
G01 Z-20;

G01 X40 Z-50;
G01 Z-65;
N200 G00 X42;
G00 Z10;
M05;
M09;
M02

Q 3 b) Part programming for CNC Milling Job
(Correct program: 06 marks, proper codes & symbols: 02 marks)
Note: Simple part program or Canned cycle should be given due marks. Only the contour path programming should be considered for assessment as diameter of cutter and dimensions of job are far wide to write whole surface finish program. Marks should be given for such program.

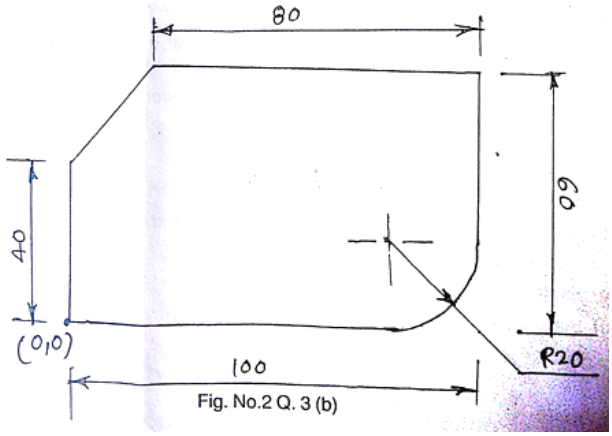


Fig. No.2 Q. 3 (b)

Main Prog
O111
N10 G90 G94;
N20 T01 G54 G42;
N30 S800 M03 M08 F120 ;
N40 G00 X0 Y0 Z0;
N50 M98 L111 P8; (0.5 DEPTH OF CUT x 8 REPITATIONS = 4 MM DEPTH)
G00 Z10;
G40;
M05;
M09;
M02

Sub-prog
L111

N05 G91 G01 Z-0.5;
N10 G90 G01 Y40;
N20 G01 X20 Y60;
N30 G01 X100;
N40 G01 Y20;
N50 G02 X80 Y0 R20;
N60 X0;
N70 G00 X0 Y0 Z0;
N80 M99

Q 3 c i) WEDM (State parameters: 02 marks, Explanation: 02 marks)

The following are the controlling parameters

i) Discharge current
ii) Pulse duration
iii) Pulse frequency
iv)Wire dia & speed
v) Dielectric flow

i) Discharge current : The wire being small in diameter and cannot carry current more than 30 A. Material Removal Rate increases with increase in current.

ii) Pulse duration : Increase in pulse duration results in more removal of material and reduces surface roughness.

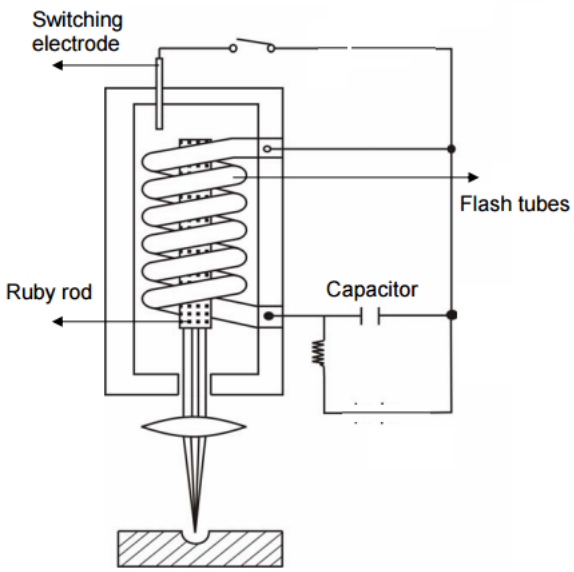
iii) Pulse frequency : The pulse frequency is about 1MHz. MRR increases with increase in pulse frequency. This results in reduced creater size or better surface finish.

iv) Wire diameter and wire speed : The wire diameter should be uniform throughout the operation. If wire diameter is not uniform, it will affect the intensity of spark and hence the MRR. The wire speed is in the range of 2.5 to 150 mm/sec.

v) Wire tension : The appropriate wire tension should be maintained in order to keep the wire straight. A series of tension rollers is provided to keep the required tension. The wire tension is 50% - 60% of its tensile strength.

vi) Dielectric flow : The supply of dielectric fluid should be continuous and enough to allow the sparking.

Q 3 c ii) LBM (Sketch: 02 marks, Explanation: 02 marks)



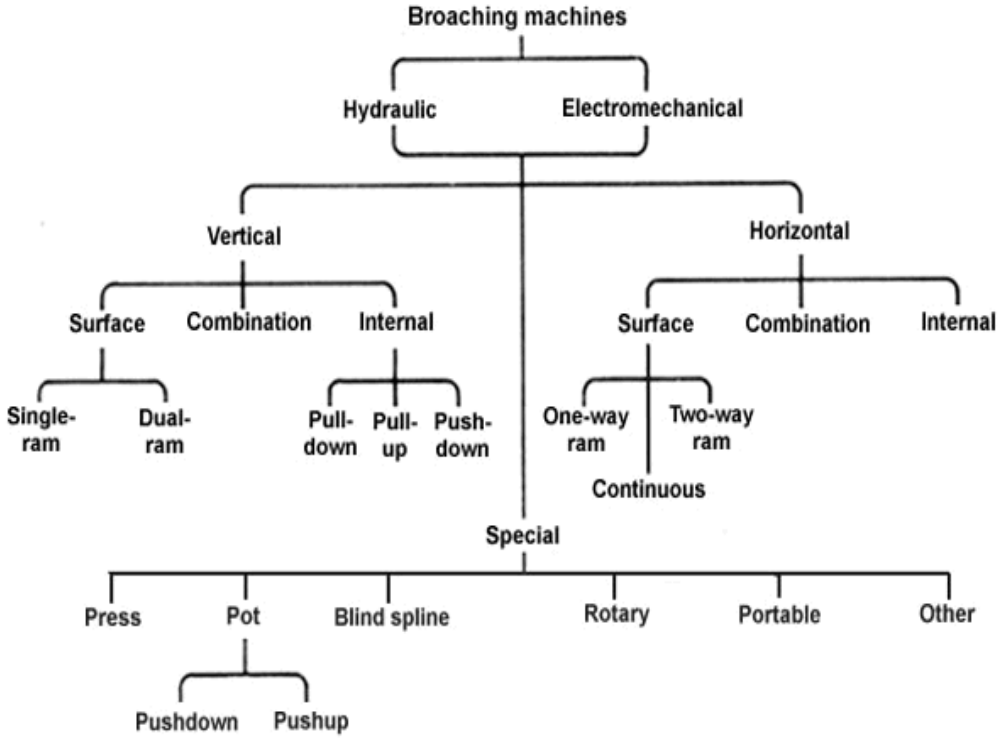
Laser beam machining (LBM) is an unconventional machining process in which a laser is directed towards the work piece for machining. Since the rays of a laser beam are monochromatic and parallel it can be focused to a very small diameter and can produce energy as high as 100 MW of energy for a square millimeter of area.

It consists laser rod in the form of cylindrical crystal with 10 mm diameter and 150 mm long, its ends are well finished with close tolerances. It also has coil flash tube which is placed around ruby rod.

It is especially suited to making accurately placed holes. It can be used to perform precision micro-machining on all microelectronic substrates such as ceramic, silicon, diamond, and graphite.

Examples of microelectronic micro-machining include cutting, scribing & drilling all substrates, trimming any hybrid resistors, patterning displays of glass or plastic and trace cutting on semiconductor wafers and chips. A pulsed ruby laser is normally used for developing a high power.

Q 4 A a) Classification of Broaching machines (Detail classification: 04 marks)



Q 4 A b) Horizontal Broaching machines (List: 02 marks, Function: 02 marks)

Various parts of Horizontal Broaching machine are:

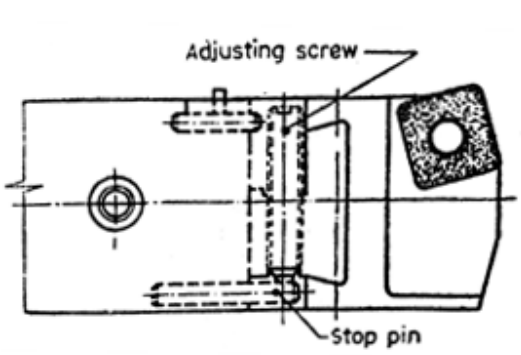
i) Power Head
ii) Hydraulic cylinder
iii) Tool holder
iv) Machine Bed
v) Supporting face plate
vi) Supporting table
vii) Broach tool

Functions:

i) Power Head : it provides arrangement for getting required power to run the system.
ii) Machine Bed: it is support to all machine members, absorb / percolate vibrations
iii) Tool Holder: It's a device to hold the tool correctly in position in order to maintain precision & accuracy in all jobs

iv) Supporting Table: It gives enough support to the job. It provides stability (support firmly) to the job while operation is going on.

Q 4 A c) Sketch of 02 boring tools (02 marks each)



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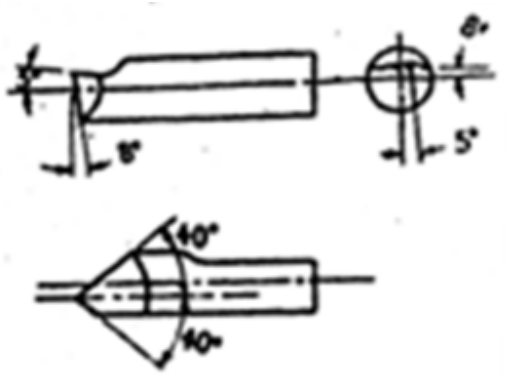
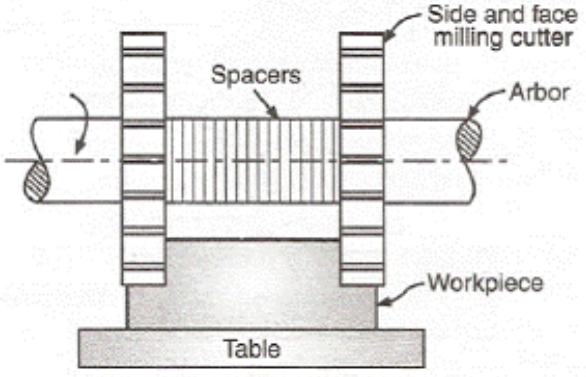


Figure Boring tool

Q 4 A d) Straddle milling (Sketch: 02 marks, Explanation: 02 marks)



Straddle milling

Straddle milling is operation of machining two parallel vertical surface of work piece simultaneously.

This operation is done when it is necessary to machine opposite sides of duplicate parts so that machined surfaces are perfectly parallel to each other.

For straddle milling, on the arbor of plain or universal milling machine, side milling cutters having teeth on sides, as well as on periphery are mounted.

The distance between the two cutters is correctly adjusted by using suitable spacing collers.

It is commonly used to produce square or hexagonal surfaces, such as bolts, nuts, guides etc.

Q 4 B a) Difference in Capstan & Turret (Any 6 points: 06 marks)

	Capstan Lathe	Turret Lathe
1.	Capstan lathe is limited to the manufacture of work from bar fed during the empty spindle held in a collect and the standard machines contain a condition for fixing a jaw chuck to the spindle nose thus that bars, castings and forging might be held.	Spindle nose of the this machine is threaded outwardly for screwing faceplate force plate, lathe chuck or any other work holding device proper to the job stock. Inside hole is tapered to get the lathe center and proper collect for bar holding.
2.	Tailstock does not give for center support of bar stock and rising of shank tools. Tail stock hold up is not required as short piece bar stock is use for work production.	Tailstock is moreover give for center hold up of the bar stock and rising of shank tools. Tail stock be able to bolted at the great right hand of the bed or among carriage with turret slide.
3.	Capstan head move about on the capstan slide in the move familiar by the stop while the whole unit left over bolted on the right hand side of the bed ways.	Turret head rise on the ram slide move longitudinally in the move familiar by the stop screws. Whole unit be able to slide on the bed ways and after that locked at the necessary location.
4.	Lead-screw does not give and thread is produced by using the threading head mount on capstan held.	Lead screw gives for cutting particular and multi-start threads on a preferred length of work by single point tool of thread cutting. Thread head can moreover be use for the normal threads.
5.	Capstan lathe is give by the stop rolls to decide the longitudinal and cross movement of the tools at their cycle.	Turret is too given by the stop rolls to determine the longitudinal and cross movement of the tools at their cycle.
6.	The carriage is give with front tool post (single-way or four-way) with rear tool post moreover.	The carriage is give by the turret tool-post and rear tool post used for holding tools.
7.	Capstan lathe is use of the mass production of small size equal part.	Turret lathe is use intended for the mass production of large size equal parts.
8.	Feed rod give for longitudinal feed.	Feed rod is not give for longitudinal feed.

Q 4 B b) Comparison of Up milling & Down milling (Any 6 points: 06 marks)

	Up Milling	Down Milling
1.	There is propensity to lift workpiece so extra clamping forces are required to fix job on table.	Forces are enough on job to press down. Thus clamping difficulty is not so much.
2.	Cutter turns against direction in which the work is being fed.	Cutter turns in similar direction as to in which the work is being fed.
3.	It use of cutting fluid is complicated.	It use of cutting fluid is simple.
4.	Cutting force vary as of zero to maximum.	Cutting forces vary as of maximum to zero.
5.	Job tool movement is in opposite way.	Job tool movement is in the similar direction.
6.	Chip thickness differs as of minimum to maximum.	Chip thickness varies as of maximum to minimum.
7.	It surface finish is improved.	It surface finish is improved, if it is free as of backlash error.
8.	It is feasible.	It is unfeasible.

Q. 5 a) Knee Type Horizontal milling machine (Sketch 03 Marks, labeling 01 mark)

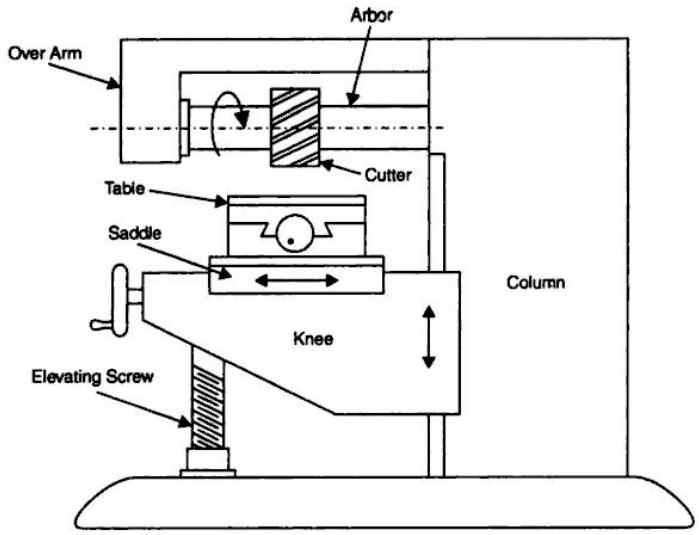


Fig. 8.1(a) Horizontal Milling Machine

b) (Description 04 marks) – (Diagram preferred but not essential)

Plain Indexing: - In plain indexing the dividing head spindle is moved by turning the index crank. As the shaft carrying the crank has a single threaded worm which meshes with the worm gear having 40 teeth, 40 turns of the crank are necessary to rotate the index head spindle though one revolution. To facilitate indexing to fractions of a turn, index plates are used to cover practically all numbers. Index plates with circles of holes are as follows:-

Plate No. 1 – 15, 16, 17, 18, 19, 20
Plates No. 2 – 21, 23, 27, 29, 31, 33.
Plate No. 3 – 37, 39, 41, 43, 47, 49.

With the three index plate supplied , simple indexing can be used for all divisions upto 50, even numbers upto 100 except 96. The formula for index crank movement is given below:-

Index Crank Movement = 40/ N where, N= number of divisions required.

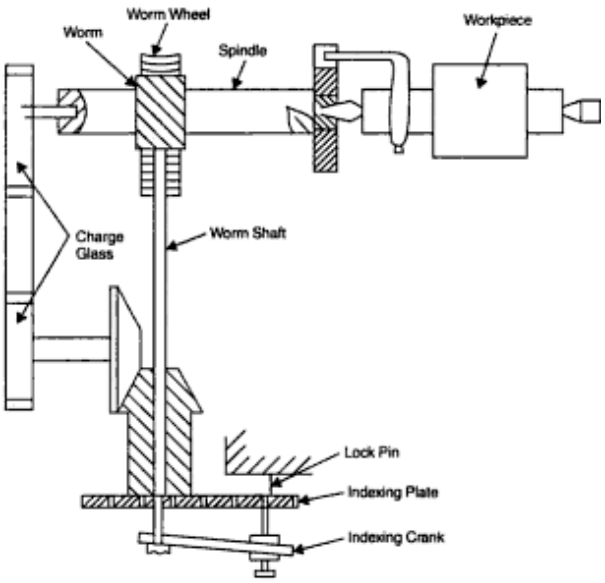
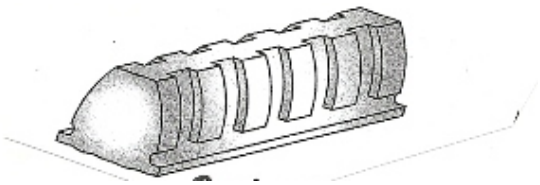


Fig. 8.21 Working Mechanism of a Universal Dividing Head

c) Gear shaving process- (Sketch 02 Mark , Explanation 02 mark)

Gear shaving process can be linear or rotary. In the linear type rack type cutter is used. While rotary method employs a pinion cutter. The cutter teeth are serrated to form a series of cutting edges. To obtained relative sliding action between the tooth profile the work gear and shaving cutter are set up in the gear shaving machine with cross axes. Due to the sliding action very small amount of material from the gear tooth is removed and finished profile surface is obtained.



Gear shaving tool with serration

d) lapping Process:- (advantages 02 marks , application 02 marks any two each)

Advantages :-

1) Close Dimensional tolerances can be obtained (in the range of ± 0.0004 mm).
2) Use to produce geometrically true surfaces.
3) the surface finish can be as smooth as 0.025 to 0.1 μm
4) Low pressure ,low speed abrading process to refine the surface finish

Applications:-
Piston rings, bearing races and cups, tappets and shafts.

f) Grinding wheel selection factors:- (04 marks any 04 points)
1. Material to be ground and its hardness
2. Amount of stock to be removed. And finish required.
3. Area of contact(Grinding contact)
4Whether the grinding is to be done wet or dry.
5 Grinding wheel speed.
6 Severity of the grinding operation
7. Type of grinding machine.
8. Condition of the grinding machine.
9. Skill of the operator.

Q. 6
a) Classification of grinding machine:- (04 Marks)
I) Rough Grinders:-

1) Floor Stand & Bench Grinders

2) Portable & Flexible Shaft Grinders

3) Swing Frame Grinders

4) Abrasive Belt Grinders

II) Precision Grinders :-

1) **Cylindrical Grinders**
   a) Centre type Plain b) Centre type universal c) Centreless
   b) **Internal Grinders:-** a) Chucking b) Planetory c) Centreless
   c) Surface Grinders
   a) **Reciprocating Table :-** i) Horizontal spindle ii) Vertical spindle.
   b) **Rotating Table :-** i) Horizontal spindle ii) Vertical spindle.

d) Special Grinding machines.

b) Grinding Wheel specification (04 marks)

1) **W** - Manufacturers symbol .It is optional prefix.

2) **A** - Type of abrasives e.g Aluminum Oxide, Alumina AL2O3 (A),Silicon Carbide(c)

3) **46** - Grain size .Its types are

Coarse:10,12,14,16,20,24

Medium:30,35,46,54,60

Fine:80,100,120,150,180

Very fine:220,140,280,320,400,500,600

4) **K** -Grade . The grades are Soft, Medium and hard. The grade scale is denoted by letters . soft grade is denoted by capital letters A to I . Medium by J to R, and hard grades are denoted by S to Z.

5) **5** Structure: The structure is of two types i) Dense: 1,2,3,4,5,6,7,8 2)Open:9,10,11,12,13,14,15

6) **V** Type of Bond. There are various types of bonds Vitrified (V)or ceramic ,Resinoid(B),Rubber (R) Shellac (E),Silicate(S),Oxychloride(O)

7) 17 – Manufacturer abrasive type symbol. It is optional suffix.

c) Preventive Maintenance :- (04 marks for explanation)

Preventive maintenance may be defined as the set of systematic inspection procedure and maintenance activities carried out to keep equipment in the optimum operating state, minimum faults and prevent breakdowns. Preventive maintenance is undertaken to prevent breakdowns of equipment in the near future thus minimizing the total interruption of production. The preventive maintenance management is designed with the following goals and objectives:-

1) To produce and supply products at an optimum cost which assures reliability.
2) To improve productivity and provide greater plant safety.
3) To develop well chalked out and systematic inspection procedure and maintenance activities for all equipments in plant to minimize downtime.
4) Preventive maintenance

Preventive maintenance helps in prolonging the life of the equipment and reduction in un expected breakdowns. On the other hand it insures the accuracy of the equipment thus maintaining the quality and continuity of production.

d) Repair Cycle analysis:- (definition 01 mark, Explanation 03 marks)

Defenition. The repetitive performance of maintenance activities(Inspection.minor,medium,majoir repair)in between two overhauling is called repair cycle.

Repair Cycle analysis helps for maintenance planning and it gives idea about

1.Number of maintenance staff needed.

2. Number of small/minor repairs

3.Number of majoir repairswhich are importantand need more time and cost.

4.Number of Spare parts and their quantity.

5.To prepare budget of maintenance section by calculating annual repair cost per machine.

Repair cycle analysis can be carried out for number of similar machinesand it can be compared for taking the decisions whether the machine tool is fit for use or it should be scrapped.

In the repair cycle, the activities consists are

Three Inspections

One minor repairand two major repairs in between two consecutive overhauls.

It can be represented as O-I1-R1-R2-I2-R2-O

Or(B1)Inspection –I , (B2)Small Repair –S, (B3) Medium Repair – M , (B4) Complete overhaul – C.

e) Chain maintenance practice :- (any four points 01 mark each)

a)Proper lubrication and servicing of chain.

b)Checking for chain adjustments.

c)Checking for chain elongation, wear out, sprocket alignment, condition of lubricants, lubrication system, drip rate of lubricant. Lubrication pump condition.

d)Remove accumulation of dirt or foreign materials

e)Chain and sprocket wheel should be protected by cover.

f) Maintenance Record:- (Explanation 02 marks , chart 02 marks any 02)

Maintenance records are the various documents of maintenance activities carried out by staff of the maintenance section. These documents are used for improvements as well as to get the history of maintenance of a particular machine or equipment.

Preventive Maintenance Chart

1. Company Name :_____
2. Department /Section :_____
3. Name of machine : Lathe (HMT) Maintenance staff :

Sr. No	Machine Part	Check for	Status required	Status observed	Action	Remark

Break down Maintenance Chart

1. Company Name :_____
2. Department /Section :_____
3. Name of machine : Lathe (HMT) Maintenance staff :

Sr. No	Name of Defective Part	Action taken	Repair details	Break down			
				Date	Time	Date	Time

Machine History Card

1. Company Name :_____
2. Department /Section :_____
3. Name of machine : Lathe (HMT)

Sr. No	Date	Nature of fault	Action taken	Lost Hours	Lost Hrs	Lost in Quantity	Remarks	Sign