

Important Instructions to examiners:

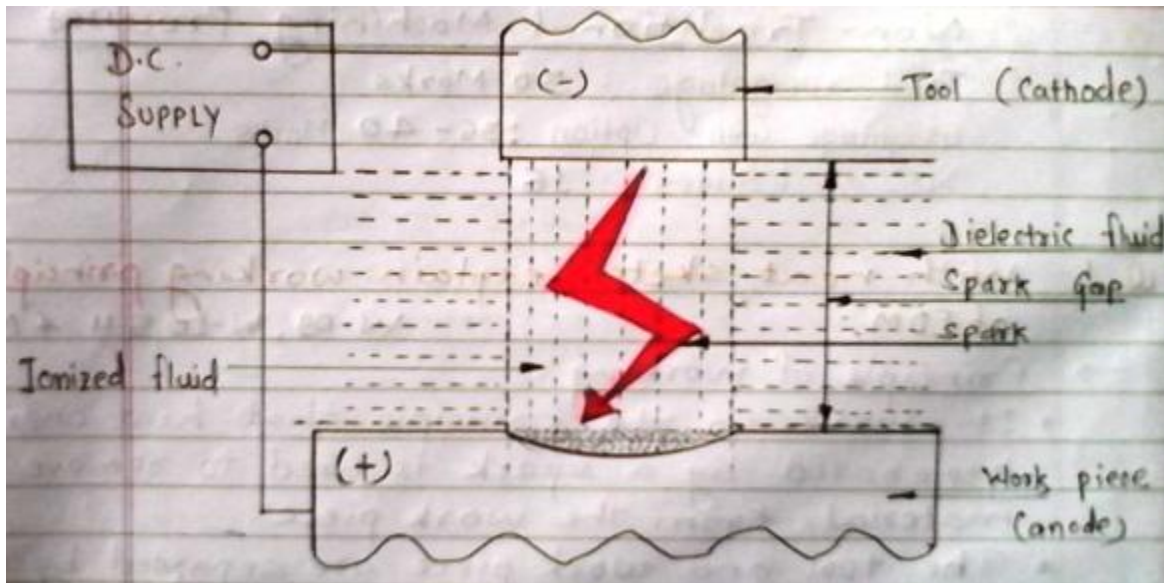
- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling 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.

Q1. A) Answer any Three of the following

- i) State the principle of EDM with a neat sketch explain the process of metal removal

Ans **Principles of EDM**

- Electrical Discharge Machining (EDM) is a controlled metal-removal process that is used to remove metal by means of electric spark erosion. [1 marks]



[1 marks]

Process of metal removal

- In this process an electric spark is used as the cutting tool to cut the work piece to produce the finished part to the desired shape.



- The tool (Cathode) and work piece (Anode) are separated by a small gap(0.01 to 0.5) called as spark gap
 - The workpiece and tool both are immersed in the dielectric fluid.
 - When the supply is made ON thousand of spark are produced per second. The duration of each spark is very short.
 - When spark come in contact with the dielectric fluid in the spark gap, the fluid get ionized. It allows current to flow between the tool and work piece as shown in fig.
 - A very high temperature of around 10000°C is generated in the spark region. As a result, the material gets melted and is removed from the work piece
- [2 marks]**

ii) Give any four applications of PAM.

1. For machining hard to cut metals such as super alloys, stainless steel, particularly during cut-off or rough slitting operations
2. For rough turning of very difficult material
3. For stock cutting, plate beveling, profiling and piercing
4. For removing gates and riser from casting in foundry
5. It cuts hot extrusion to desired lengths.
6. It finds use in the manufacturing of automotive and rail road components

[any 4 4 marks]

iii) Compare closed loop CNC system with open loop CNC system

Parameter	Open loop	Closed loop
Design	Simple	Complex
Feedback	No feedback element	Feedback system is present
Input	The input is directly given to the MCU	The input and feedback signal is given to the comparator which sends the required signal to the MCU
Output	The output may not be as desired	The output given is exactly as desired
Time	Time required for processing is less	Time required for processing is more
Cost	It is cheaper	Expensive

[4 Point 4 marks]

iv) Define part program. Explain the term ‘preparatory function’ and ‘miscellaneous functions, in the context of CNC programming.

Part programming – Part program defined as the way in which the blocks of instructions are planned and written such that after its execution on the CNC machine the required shape is obtained on the work piece in minimum possible time.

OR

- Part program is a set of instructions the machine tool about the processing steps to be performed the manufacture of component.

Preparatory functions are G codes. G codes are designated by the letter G and a two digit numeric value. These codes are the most important functions in CNC programming because they direct the CNC



system to process the coordinate data in a particular manner. Some examples are rapid traverse, circular interpolation, linear interpolation, and drilling.

Miscellaneous function

The M word is used to specify certain miscellaneous function such as spindle starts, spindle stop, coolant ON/OFF etc. The miscellaneous function as are those functions which do not related to the dimensional movement of the machine. These function actually operate some control on the machine. For example M02 which indicate end of program.

[4 marks]

06

B) Answer **any one** of the following

i) What are non- traditional machining processes? Compare traditional and non- traditional machining process.

Non – Traditional machining processes is defined as a group of processes that cut material by utilizing mechanical , thermal ,electrical or chemical energy or combination of these energies but do not use a sharp and hard cutting tools as required for traditional manufacturing process.

[2 marks]

Traditional Machining Processes	Non- Traditional Machining Processes
1. Generally macroscopic chip formation by shear deformation.	1. Material removal may occur with chip formation or even no chip formation may take place.
2. There may be a physical tool present.	2. There may not be a physical tool present.
3. Cutting tool is harder than work piece	3. Cutting tool not harder than work piece
4. Material removal takes place due to application of cutting forces – energy domain can be classified as mechanical	4. Mostly NTM processes do not necessarily use mechanical energy to provide material removal. They use different energy domains to provide machining. For example, in USM, AJM, WJM mechanical energy is used to machine material, whereas in ECM electrochemical dissolution constitutes material removal.
5. Conventional machining involves the direct contact of tool and work –piece	5. Whereas unconventional machining does not require the direct contact of tool and work piece.
6. Lower accuracy and surface finish.	6. Higher accuracy and surface finish.
7. Suitable for every type of material economically	7. Not Suitable for every type of material economically



<p>8. Tool life is less due to high surface contact and wear.</p> <p>9. Higher waste of material due to high wear.</p> <p>10. Noisy operation mostly cause sound pollutions</p> <p>11. Lower capital cost</p> <p>12. Easy set-up of equipment.</p> <p>13. Skilled or un-skilled operator may required</p> <p>14. Generally they are manual to operate.</p> <p>15. They cannot be used to produce prototype parts very efficiently and economically.</p>	<p>8. Tool life is more</p> <p>9. Lower waste of material due to low or no wear.</p> <p>10. Quieter operation mostly no sound pollutions are produced.</p> <p>11. Higher capital cost</p> <p>12. Complex set-up equipment.</p> <p>13. Skilled operator required.</p> <p>14. Generally they are fully automated process.</p> <p>15. Can be used to produce prototype parts very efficiently and economically.</p>
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[any 4 points 4 marks]

ii) What is lasing action? Differentiate between EDM and LBM.

Lasing process describes the basic operation of laser, i.e. generation of coherent beam of light by “light amplification” using “stimulated emission”.

(a) the action of exciting electrons to higher energy levels, i.e., pumping electrons to excited states, (b) the transition of the electrons to lower energy levels, and (c) the emission of high-intensity radiation in a narrow beam with a narrow spectral width.

[2 marks]

EDM	LBM
1.The removal of material takes place by repetitive, short-lived electric sparks between the tool and the workpiece	1.The removal of material takes place by means of an intense monochromatic beam of light called laser which is an electromagnetic radiation
2.High MRR	2.Low MRR
3.Tool wear	3.No tool wear
4.Suitable for complicated components	4.Extremely small holes are machined not suitable for complicated components



5.It cannot be applied to non-conducting materials	5.It is applied on non-conducting materials
6.Moderately low cost	6. High cost
7.Heat affected zone is high	7.Hear affected zone is small
8. Examples like press tools, forging dies, thread cutting, helical profile and curved hole drilling.	8. Examples like welding, micromachining, sheet metal trimming, blanking and engraving.

[any 4 points 4 marks]

Q2 Answer any four of the following

04

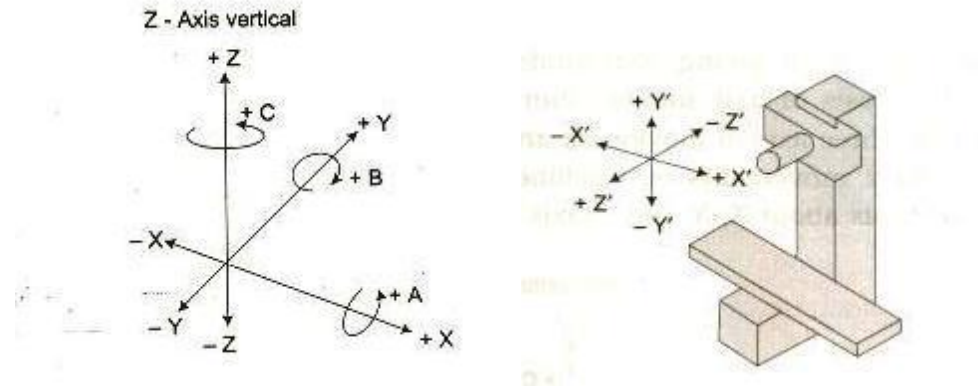
i) What are the advantages of CNC machines?

1. Greater accuracy of job is achieved
2. High Repeatability and improved product quality.
3. Less operator skill is required to run CNC machine.
4. Better machine utilization hence reduced idle time.
5. High production rate as speed, feed , depth of cut are optimum for best quality.
6. Lower tooling cost, per piece in mass production.
7. Jigs and fixtures cost can be reduced.
8. Reduced cycle time.
9. Better tool life and machinability.
10. Less scrap due to consistent accuracy, less error.
11. Excellent reliability as dimension are based on programs.
12. Reduced in-process inventory of parts in process.
13. Design changes are possible. Any change in design is feasible at lowest cost.
14. Productivity can be improved to great extent.
15. Tool setup time can be reduced.
16. Most suitable for continuous and better production.
17. Program can be stored and used again when required.
18. Optimum speed and feed for surface finish can used.

[any 4 points 4 marks]

ii) How are linear and rotary axes identified in CNC machines?

Most of the machine has two or more slideway, disposed at right angles to each other, along which the slides are displace. Each slide can be fitted with a control system and for the purpose of giving commands to the control system the axis have to be identified. The basis of axis identification is the 3-dimensional Cartesian co-ordinate system and the three axis of movement are identified as X, Y and Z axis. The possible linear and rotary movements of the machine slides/ work piece are shown in figure. Rotary movements about X, Y and Z axis are designated as A, B and C respectively.



The main axis of movement and the direction of movement along this axis is identified as follows:

Z- Axis: The Z- axis motion is always the axis of the main spindle of the machine. It does not matter whether the spindle carries the work piece or the cutting tool. If there are several spindle on the machine one spindle is selected as the principal spindle and its axis is considered to be Z-axis. On vertical machines the Z-axis is vertical and on horizontal machines the Z axis is horizontal. Positive Z movement is in the direction that increases the distance between the work-piece and the tool as shown in figure.

X-Axis: The X-axis is always horizontal and parallel to the work holding surface. If the Z-axis is vertical in vertical milling machine, positive X-axis movement is identified as being to the right, when looking from the spindle towards its supporting column.

Y-Axis: The Y-axis is always at right angle to both the X-axis and Z-axis.

A-Axis: It is the axis of rotary motion of a tool along X-axis. Clockwise rotation is consider as positive

B- Axis: It is the axis of rotary motion of a tool along Y-axis. Clockwise rotation is consider as positive

C- Axis: It is the axis of rotary motion of a tool along Z-axis. Clockwise rotation is consider as positive

[4 marks]

iii) Give the classification of broaching machines

A) According to direction of broach travel.

1. Horizontal broaching machine
2. Vertical broaching machine

B) According to Method of operation.

1. Pull broaching machine
2. Push broaching machine
3. Surface broaching machine
4. Continuous broaching machine

C) According to method of drive.

1. Mechanical drive machine
2. Pneumatic drive machine
3. Hydraulic drive machine

D) According to type of operation.

1. External broaching machine
2. Internal broaching machine

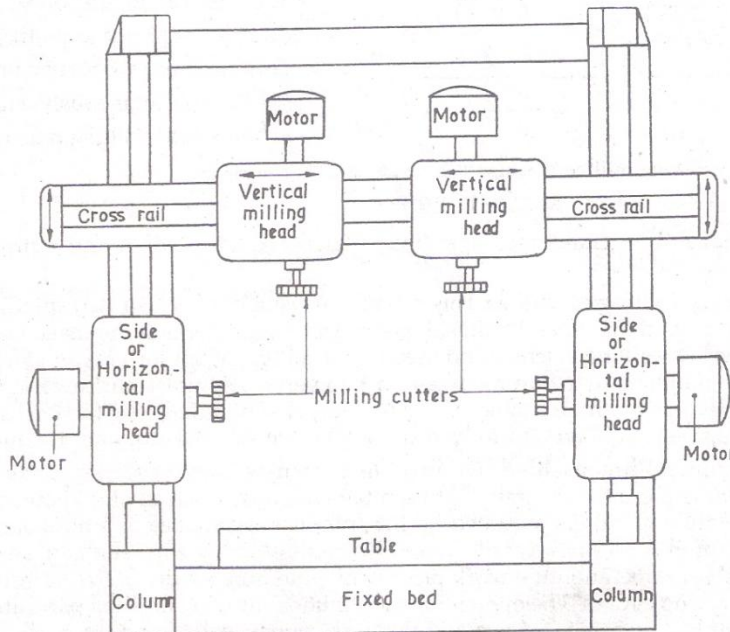
[4 marks]

iv) Compare capstan and turret lathe

S.No	Capstan lathe	Turret lathe
1	It is a light duty machine	It is a heavy duty machine
2	The turret head is mounted on the ram and the ram is mounted on the saddle.	The turret head is directly mounted on the saddle and the saddle slides over the bed ways
3	The saddle will not be moved during machining	The saddle is moved along with the turret head during machining
4	The lengthwise movement of turret is less	The lengthwise movement of turret is more
5	Short work pieces only can be machined.	Long work pieces can be machined
6	It is easy to move the turret head as it slides over the ram	It is difficult to move the turret head along with saddle
7	The turret head cannot be moved crosswise	The turret head can be moved crosswise in some turret lathes
8	As the construction of lathe is not rigid, heavy cut cannot be given	As the construction of lathe is rigid, heavy cut can be given
9	It is used for machining work pieces up to 60mm diameter	It is used for machining work pieces up to 200mm diameter
10	Collet is used to hold the work piece	Jaw chuck is used to hold the work piece

[any 4 points 4 marks]

v) Explain the construction of Plano miller



[2 marks]

A planomiller is shown in fig.

Construction

1. **Bed:** A fixed bed is considered as the base of the machine.
2. **Table :** A table is mounted on the bed. The table has longitudinal movement only.
3. **Column :** Two vertical columns, one on each side of the bed are mounted on the bed.
4. **Cross rail:** A cross rail is fitted on the column. It may be lowered or raised to suit the height of the workpiece.
5. **Milling Head:** Two vertical milling head are fitted on the cross rail which can move towards each other. Two horizontal milling head are mounted on the column which can move vertical over it.
6. **Milling cutter:** Each milling head carries one cutter

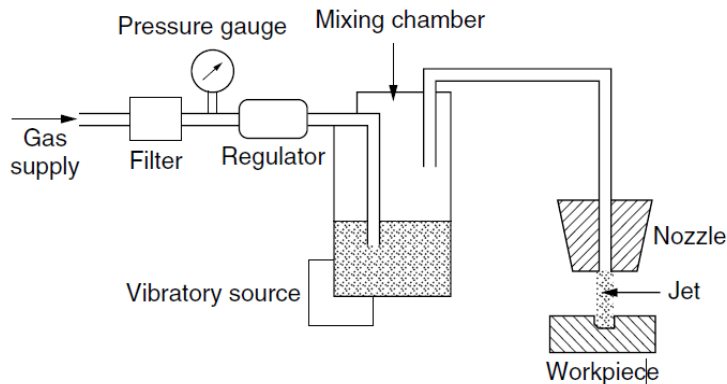
[2 marks]

Q. No. 3 attempt any Two of the following.

i) Abrasive Jet Machining

(Sketch 02 Mark + Explain 03 mark)

In abrasive jet machining (AJM) a focused stream of abrasive grains of Al_2O_3 or SiC carried by high-pressure gas or air at a high velocity is made to impinge on the work surface through a nozzle of 0.3- to 0.5-mm diameter. The work piece material is removed by the mechanical abrasion (MA) action of the high-velocity abrasive particles.



Abrasive Jet Machining

Fig. shows AJM machining system in which a gas (nitrogen, CO_2 , or air) is supplied under a pressure of 2 to 8 kg/cm^2 . After filtration and regulation, the gas is passed through a mixing chamber that contains abrasive particles and vibrates at 50 Hz. From the mixing chamber, the gas, along with the entrained abrasive particles (10–40 μm), passes through a 0.45-mm-diameter tungsten carbide nozzle at a speed of 150 to 300 m/s. The abrasive powder feed rate is controlled by the amplitude of vibrations in the mixing chamber. The nozzle standoff distance is 0.81 mm. The relative motion between the work piece and the nozzle is manually or automatically controlled using cam drives, pantographs, tracer mechanisms, or using computer control according to the cut geometry required. Masks of copper, glass, or rubber may be used to

concentrate the jet stream of abrasive particles to a confined location on the work piece. Intricate and precise shapes can be produced by using masks with corresponding contours. Dust removal equipment is incorporated to protect the environment.

Advantages Any Two

(01 Mark)

1. Because AJM is a cool machining process, it is best suited for machining brittle and heat-sensitive materials like glass, quartz, sapphire, and ceramics.
2. It is not reactive with any work piece material.
3. No tool changes are required.
4. Intricate parts of sharp corners can be machined.

Limitations Any Two

(01 Mark)

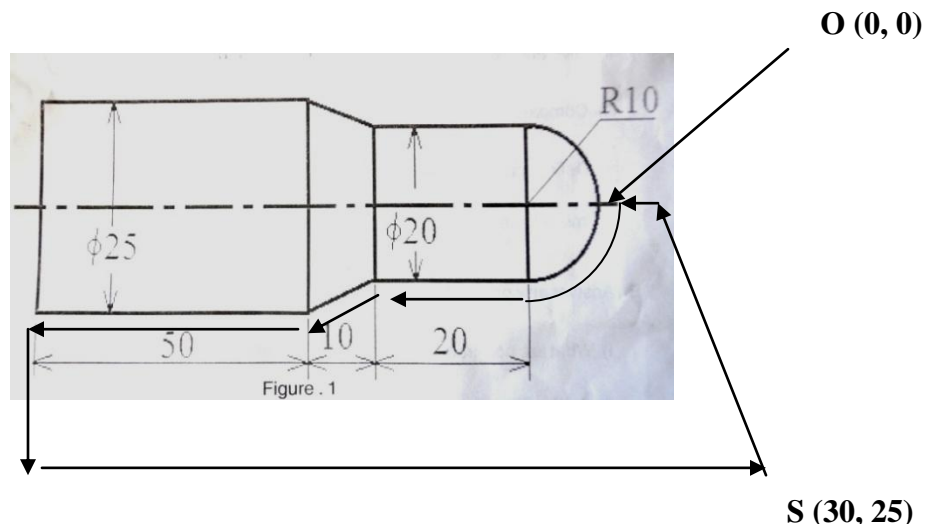
1. The removal rate is slow.
2. Stray cutting can't be avoided (low accuracy of ± 0.1 mm).
3. The tapering effect may occur especially when drilling in metals.
4. The abrasive may get impeded in the work surface.

Applications Any Two

(01 Mark)

1. Drilling holes, cutting slots, cleaning hard surfaces, deburring, polishing, and radiusing
2. Deburring of cross holes, slots, and threads in small precision parts that require a burr-free finish, such as hydraulic valves, aircraft fuel systems, and medical appliances
3. Machining intricate shapes or holes in sensitive, brittle, thin, or difficult-to-machine materials
4. Micro-deburring of hypodermic needles.

ii) Part programming for machining on CNC lathe.





Machine zero - O (0, 0) Starting point - S (30, 25)

Part programme for above component:

N01 G90 G71 G94 EOB

N02 M03 T01 S2000 EOB

N03 M08 EOB

N04 G00 X0 Z1 EOB

N05 G01 Z0 F30 EOB

N06 G 03 X 20 Z-10 EOB

N07 G01 Z-20 EOB

N08 G01 X 25 Z-40 EOB

N09 G01 Z-90 EOB

N10 G00 X30 M09 EOB

N11 G00 Z25 EOB

N12 M30 EOB

iii) Cutting Parameters in Milling:

(02 Marks)

a) Cutting speed: The cutting speed of a milling cutter is its peripheral linear speed resulting from rotation. It is expressed in meters per minute and is given by formula-

$$v = \pi d n / 1000 \text{ m/min where } d \text{ is diameter of cutter in mm \& } n \text{ is cutter r.p.m.}$$

b) Feed: It is defined by the distance the work advances under the cutter. Feed is expressed by – feed per tooth, feed per cutter revolution and feed per minute. They are related with each other by a formula-

$$S_m = n \times S_r = Z \times n \times S_z \text{ where } Z \text{ is no. of teeth, } n \text{ is r.p.m.}$$

c) Depth of cut: It is the thickness of the material removed in one pass of the work under the cutter. It is the peripheral distance measured between the original distance and final surface of the workpiece. It is expressed in mm.

Calculation of Machining Time:

(02 Marks)

The time required to mill a surface for any operation can be calculated from the formula-

$$T = \frac{L}{S_z \times Z \times n} \text{ where } T \text{ - time required to complete the cut in minutes.}$$

L – Length of table travel to complete the cut in mm

Sz – Feed per tooth in mm

Z – No. of teeth in the cutter and n – the r.p.m. of the cutter

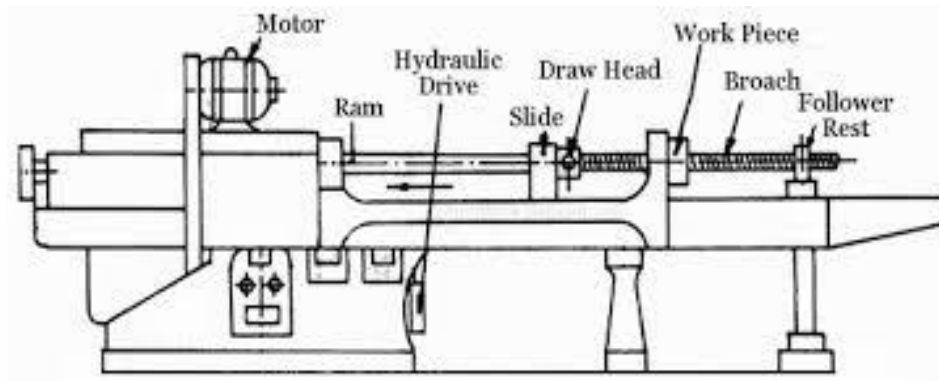
The length of table travel is consists of i) length of work “C” and ii) approach length “A”
Approach “A” is the distance through which the cutter must be moved before the full depth of cut is reached.

Q. No. 4 A) Attempt any three of the following.

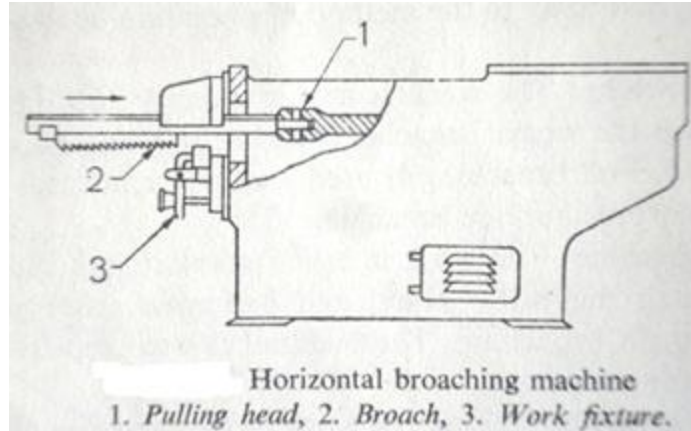
i) Difference between Pull broach and Push broach: (any 4 points 04 Marks)

Sr. No.	Pull Broach	Push broach
01	It is designed to pull through the work piece by a special press.	It is designed to push through the work piece by a special press.
02	Broach is entirely in tension and is long slender.	Because of the tendency to bend under compressive loads, push broach is short and stocky.
03	It has large no. of teeth and more stock can be removed for each pass.	It has fewer teeth on the broach and less material is removed for each pass.
04	Material is removed in thick layers by each tooth only from part of work surface	Holes are machined by push broaches only for sizing.
05	Widely used for external broaching.	Widely used for internal broaching.
06	It has progressive cut teeth.	It is solid type.

ii) Horizontal Broaching Machine: Labeled sketch (Sketch -04 Marks)



OR

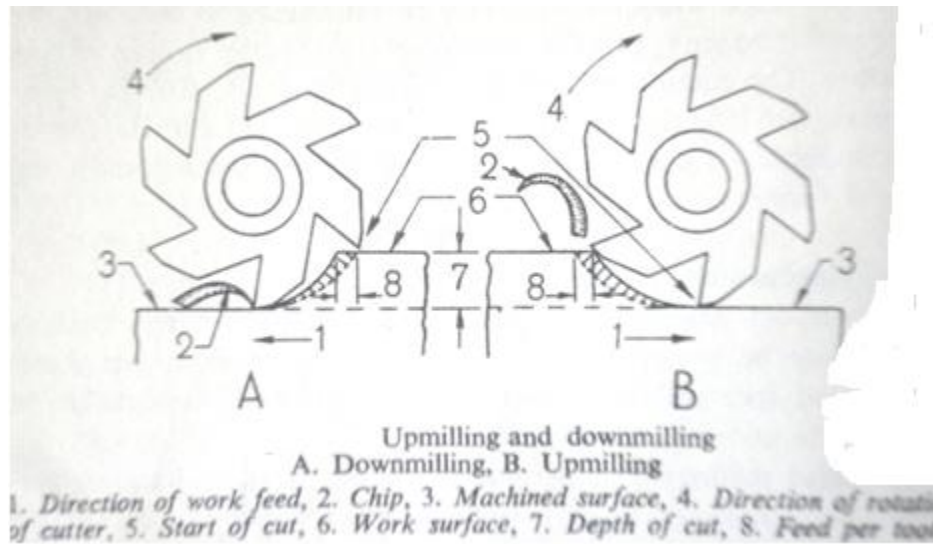


iv) Specifications of Horizontal Boring Machine:

- a) Diameter of machine spindle in mm – 75 to 355 mm
- b) Spindle motor Horse Power
- c) Column height
- d) Size of table or floor plate
- e) Spindle speeds, feeds and length of feeds
- f) Weight of machine and floor space required.
- g) Length of stroke in mm.

iv) Up Milling and Down Milling:

(Sketch 02 Marks Explanation 02 Marks)



Up milling: it is the conventional milling process which is most commonly used. In this, the material is removed by the cutter which is rotating against the direction of travel of the work



piece. As shown in fig., the thickness of the chip in the up milling is minimum at the beginning of the cut and it reaches maximum when the cutter terminates. As the chip thickness per tooth is not uniform, the cutting force in upmilling increases from zero to maximum. The cutting force is directed upwards and it tends to lift the work from the fixture. Due to this, difficulty is experienced in pouring coolant just on the cutting edge from the chip begins. As the cutter progresses, the chip gets accumulated at the cutting zone which spoils the machined surface. The surface milled by up milling is slightly wavy as the cutter teeth do not begin their cut as soon as they touch the work surface.

Down milling: It is also known as climb milling. In this, material is removed by the cutter which is rotated in the same direction of travel of the work piece. As shown in fig., the thickness of the chip is maximum when the tooth begins the cut and it reduces to minimum when the cut terminates. The cutter tooth starts removing the metal immediately on reaching the work piece, without sliding. The cutting force in down milling is maximum when the tooth begins its cut and is minimum when the tooth leaves the work. Here the chips are disposed off easily and do not interfere with the work. Fixture design is easier as the cutting force tries to seat the work firmly in work holding devices. Coolant can be poured directly at the cutting zone. This results in improved surface finish. If there is any backlash in feed screw, it causes vibrations and damages work surface.

Q. No. 4 B) Attempt any one of the following

i) Importance of Maintenance

(02 Marks)

The importance of an effective maintenance program cannot be overlooked because it plays such an important role in the effectiveness of Lean manufacturing. It is required to effectively reduce waste and run an efficient, continuous manufacturing operation, business, or service operation. The main purpose of regular maintenance is to ensure that all equipment required for production is operating at 100% efficiency at all times. Through short daily inspections, cleaning, lubricating, and making minor adjustments, minor problems can be detected and corrected before they become a major problem that can shut down a production line. A good maintenance program requires company-wide participation and support by everyone ranging from the top executive to the shop floor personnel.

Difference between Breakdown maintenance and preventive maintenance.

(04 Marks Any 04 points)

Sr. No.	Breakdown maintenance	Preventive maintenance
1	Breakdown maintenance is basically the “run it till it breaks” maintenance mode. No actions or efforts are taken to maintain the equipment	Actions performed on a time- or machine-run-based schedule that detect, preclude, or mitigate degradation of a component.
2	Increased cost due to unplanned downtime of equipment.	Reduced equipment or process failure.
3	Increased labor cost, especially if overtime is needed.	Less labor cost because of planned maintenance.
4	Cost is involved with repair or replacement of equipment.	Estimated 12% to 18% cost savings over breakdown maintenance program.
5	Possible secondary equipment or process damage from equipment failure.	Increased component life cycle.
6	Inefficient use of staff resources.	Efficient use of staff resources

ii) Precision grinders:

(01 Mark)

Precision grinders are those that finish the components to a very accurate dimension and with good surface finish.

Labeled sketch:

(02 Mark)

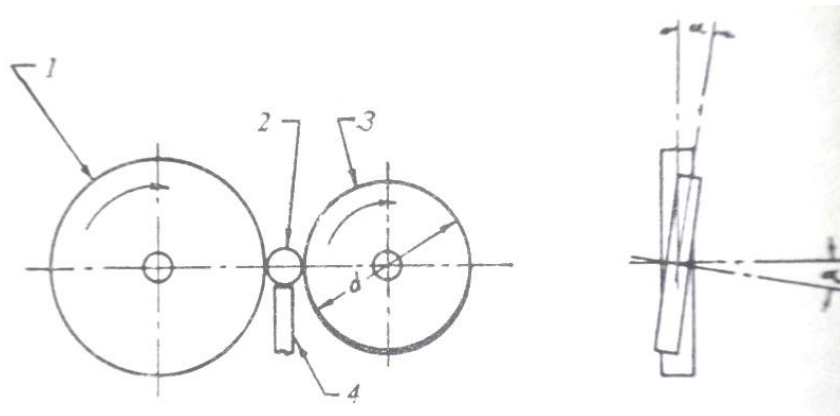


Fig. Centerless grinding machine

1. Grinding wheel 2. Work 3. Regulating wheel 4. Work-rest

Working of Centerless grinding machine:

(03 Marks)



Center less grinding machine is used for grinding exterior cylindrical, tapered and formed surfaces on the work pieces that are not held and rotated on centers. The principal elements of this machine shown in fig. are grinding wheel, regulating wheel and work rest. Both wheels are rotated in the same direction. The work rest is located between wheels. The work is placed upon the work rest and latter together with the regulating wheel, is fed forward, forcing the work against the grinding wheel. As true floating condition exists during the grinding process less metal needs to be removed.

The axial movement of the work past the grinding wheel is obtained by tilting regulating wheel at an angle 8 to 10 degrees with the horizontal. Actual feed can be calculated by the formula - $S = \pi d n \sin \alpha$

Where s – feed per minute, d – diameter of regulating wheel,
 n – revolution per minute α – inclination of wheel

Q.5 Answer **any four** of the following:

i) Give the maintenance practice for bearings and chain of the machine.

Ans : Bearing maintenance practice

Bearings are the medium of contact between rigid and moveable parts. Various types of the bearings are used in machine tools. They are used in power transmission by shafts, axles, spindles etc. To avoid failure of the bearings following preventive maintenance is carried out at regular intervals.

a) To remove the dirt entered in the recesses of the bearings, Grinding and polishing of journal surfaces is done. Oil and filters are changed at regular intervals.

b) After excessive running time fatigue cracks are occur in the bearings. It is due to the cyclic load, loads due to dirt accumulation, misalignment and poor geometry (eccentricity) of the shaft. To avoid the cracks in the bearing surfaces Proper lubrication is provided on the surface and oil film thickness is increased at desired level.

c) Temperature of the contact surfaces should not allow to rise more than specified level by providing sufficient flow of oil.

d) Cleaning of mating surfaces during assembly and removing the burrs at the time of installation of bearing. This avoid rubbing of the matting surfaces of the bearing.

e) Make proper fitting during mounting of the bearing to avoid over heating.

f) To avoid corrosion prevent leakage of coolant in to oil.

Chain maintenance practice

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.

.(02Marks for bearings and 02 marks for chain , 02 points each)

ii) What is maintenance record ? What are the content of maintenance record?

Ans: 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. The maintenance records include following reports.

1.Machine history card.

2.Preventive maintenance chart.

3. Break down Report.

By using these previous record and its analysis it is easy for fast decision making when faults occur in the machine.

Machine History Card :

Name of company :

Section :

Machine No :

Machine Name :

Make :

Date	Nature of fault	Action	Lost hours	Lost in Quantity	Remark	Sign

Checked by
(maintenance)

Manager

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

Checked by

Approved by



Breakdown Maintenance Chart

Company Name :

Department Section :

Maintenance Staff:

Name of Machine :

Sr.No	Name of defective part	Action	Repair details	Breakdown			
				Date	Time	Date	Time

Checked by

Approved by

(01 mark for meaning of maintenance record. And 03 marks for contents with description. One can explain contents with above charts.)

iii) Explain Repair Complexity :

Ans:- Repair Complexity is defined as the extent of complexity of machine tool considered for the maintenance work which is represented by a comparative index number. This number is called as repair complexity number .If the repair complexity number is high, then repair cycle of the machine is longer because it consists high number of maintenance activities. Repair complexity number is useful to decide the number of staff required for maintenance, to decide inventory of spares required for maintenance. To decide the repair cycle of the particular machine. To find out the number of critical maintenance points of the machine. To forecast the maintenance cost of the machine or plant. Also repair complexity decides the time interval of repair cycle. On the basis of repair complexity number maintenance schedule is prepared for the machine or plant. For higher number long schedule is prepared while for small complexity number short schedule is needed. For example repair complexity number of various machines are given as follows.

Type of machine/equipment	Repair complexity number
Boiler	12
Air compressor	8
Turbine	14
Rolling mill	15
Centre lathe	5

(01 mark for definition/meaning 03 marks for description and example of complexity number.)

iv) How grinding wheel is designated?

Ans: The grinding wheels are designated by six symbols. Which indicates following parameters

a)Manufacturers symbol .It is optional prefix.

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

c)Grain size .Its types are

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



Subject Code: 17527

WINTER- 14 EXAMINATION

Model Answer

Medium:30,35,46,54,60

Fine:80,100,120,150,180

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

d) 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.

e)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

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

Example of designation of grinding wheel

51	A	46	L	6	V
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(04 marks for description for all six designation of wheel./One may explain with taking suitable example)

v) What are the safety precautions to be observed while using grinding machines?

Ans: The following safety precautions are to be observed while working on the grinding machines.

- 1)Always wear safety goggles while grinding.
- 2)Stand to one side of the wheel before starting the grinding machine.
- 3)Always have wheel guard covering the half portion of grinding wheel.
- 4)Never run the grinding wheel faster than the recommended speed.
- 5)Before starting the machine always make sure that all magnetic chucks are in turn on position.
- 6) Do not try to clean, mount, remove the work or magnetic chuck until the wheel has completely stopped.

(4 marks Any 04 precautions)

vi)Differentiate between honing and lapping.

Ans: The honing and lapping can be differentiated by following points (4 marks Any 04 points)

Honing	Lapping
Honing is applied to get high degree of surface finish as well as to correct the roundness, taper in the work.	Lapping is applied to get geometrical true surfaces, correct minor surface imperfections and improve the dimensional accuracy.
Honing is slow speed finishing process.	Lapping is low pressure, low speed abrading process to refine surface finish.
Honing action is rotates and reciprocate in the hole of work piece.	Lapping action is either rotary or reciprocating.

Metal removal rate in honing is 0.5 mm in primary and 0.01 mm for secondary.	Metal removal rate in lapping is 0 .005 mm to 0.01 mm
Honing stones are used as cutter.	Abrasive particles are loaded on laps are used as a tool.
Applications are on internal and external cylindrical surfaces.	Mostly used on flat or regular surfaces.

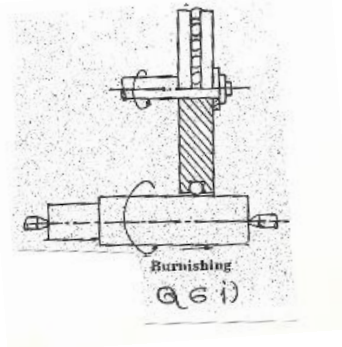
Q.6 Answer **any four** of the following:

i)What is burnishing ?What are its advantages ?

Ans: Burnishing is super finishing process of obtaining a very fine surface finish having grainless appearance on metal objects. This process is used on various flat, cylindrical or conical surfaces. It removes scratches and tool marks on the surface.

Advantages of burnishing

1. There is no cutting action in this process. Only rubbing and peening action takes place.
2. It produces mirror like glazed and geometrically smooth surfaces.
3. Average 0.002 to 0.02 mm stock is removed from the surface.
4. Economical process as compared to the other super finishing processes.

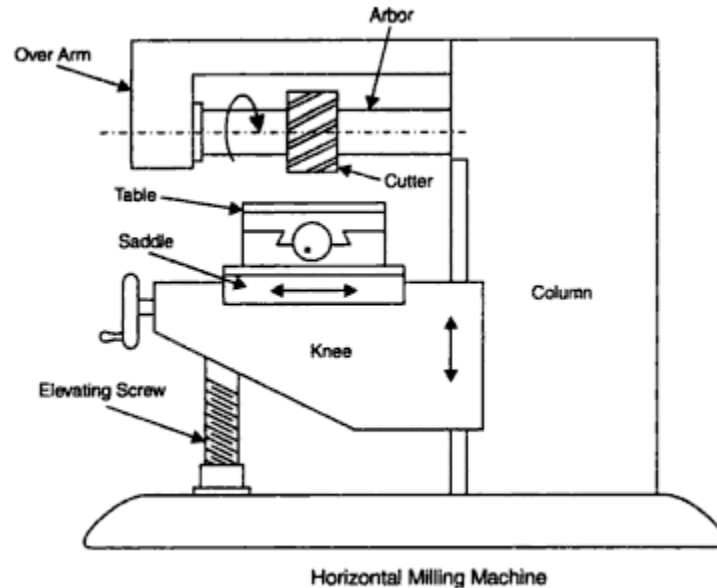


(02 marks for definition/meaning ,02 marks for any 02 advantages.)

ii)Describe the construction and working of plain milling machine with neat sketch.

Ans: Plain milling machine is also called as horizontal milling machine. It is more rigid and sturdy in construction .It is provided with a power feeding mechanism to control the table movements. Figure shows the block diagram of plain milling machine .It has a base or bed which supports all the moving as well as fixed parts of the machine. The vertical column is hollow and sturdy structure. It houses driving mechanism for spindle and mechanism for controlling table and knee movements. The acts as a support for the saddle, table and other accessories such as indexing head etc. Over arm provides supports for yoke which, in turn ,supports the free end of the arbor.

Working:- The arbor carrying the cutter rotates about the horizontal axis. The knee can be raised or lowered on vertical ways on the face of the column. The saddle is mounted on the top of the knee and is traversed in crosswise direction. i.e. parallel with the axis of spindle. The top of saddle has ways on which the table is traversed in longitudinal direction, perpendicular to the spindle axis. All adjustment of the knee, saddle and table are controlled by lead screws, provided with micrometer adjustments at hand wheel. One or more number of cutters can be mounted on the arbor and fed simultaneously to the work. The machine can be used for gang milling, straddle milling, form milling, slotting, grooving, key way cutting etc.



(Figure with label 02 marks,01 for construction,01 for working.)

iii)What are the different methods of manufacturing gears ?

Ans:The gears can be manufactured by following methods.

- 1.Casting process. e.g. sand casting, die casting, Injection moulding etc.
- 2.Stamping process. E.g. punching, forging etc.
- 3.By Powder metallurgy .
- 4.Machining or Gear generating. E.g. milling, hobbing, rack and pinion etc
5. Gear Cutting e.g form cutters like disc ,end mill

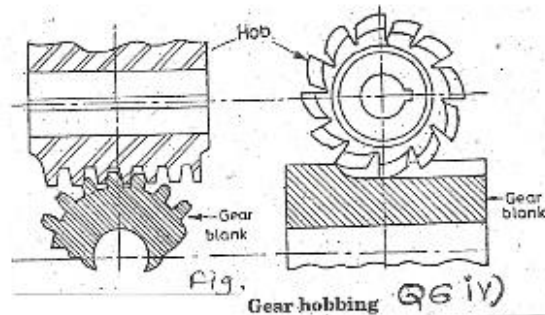
(01 mark for each method, any 04 methods can be listed.)

iv)Explain gear hobbing process with neat sketch.

Ans: Gear hobbing is a process in which gear is cut by a generating process by rotating the gear blank and the cutter called a hob at the same time with a fixed gearing ratio between hob and gear blank.

In this process the gear blank is fed towards the rotating hob until the required depth is reached. The hob is fed across the face of the blank until all the teeth are complete. In hobbing spur gear the hob teeth are set parallel to the axis of rotation of the blank. For helical teeth hobbing, the axis of the hob is set over an angle to produce the proper helix. While worm gears are produced with the axis of the hob set right angle to the gear blank. Generally two techniques are used in hobbing process. i) Conventional hobbing
ii) Climb hobbing.

The rate of production is quite high as compared to the other gear generating processes. The process can be used for production of spur, helical, worm gears, sprockets, splines etc. But due to the rotary cutter cutting up to the shoulder is not possible.



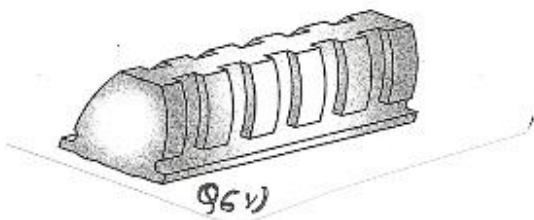
(02 marks for figure with label, 02 marks for explanation)

v) Why gear shaving process is employed? Explain the process.

Ans: In majority cases, the teeth of machined gears are to undergo a finishing operation. Gear shaving is the gear finishing process.

Gear shaving is employed to remove the material on the teeth in the form of very fine chips of sizes 0.005 mm to 0.1 mm thick from gear tooth by the edges of a shaving cutter.

Gear shaving process- 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 obtain 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.

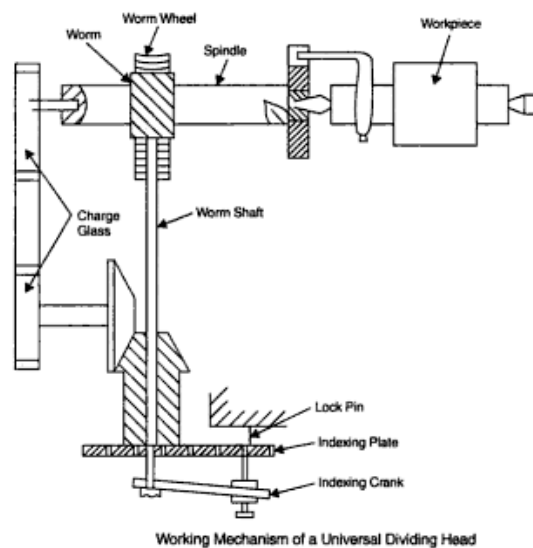


Gear shaving tool with serration.

(01 mark for reason and 03 for explanation with sketch.)

vi)What is the function of dividing head? Sketch the internal mechanism of universal dividing head.

Ans: The function of dividing head is to divide the periphery of a work piece into any number of equal parts(Indexing). To provides a continuous rotary motion to the job during the helical milling. To set the work piece in a desired position position in relation to the machine table. Acts both as a holding as well as supporting device for the work during the operation.



(02 marks for figure and 02 marks for functions any two. Three dimensional arrangement is also acceptable)
