SUMMER – 2022 EXAMINATION

Subject Name: Manufacturing Processes **Model AnswerSubject Code:** 22446

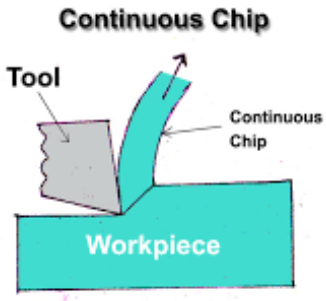
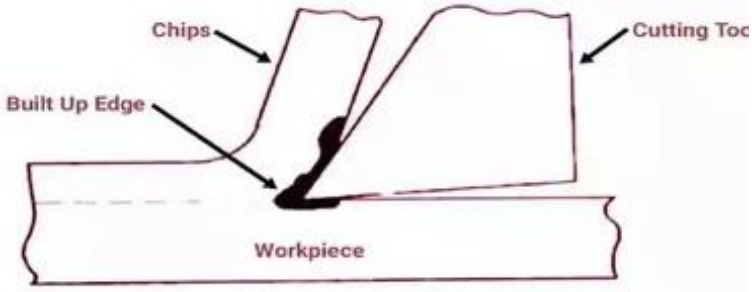
Important Instructions to examiners:

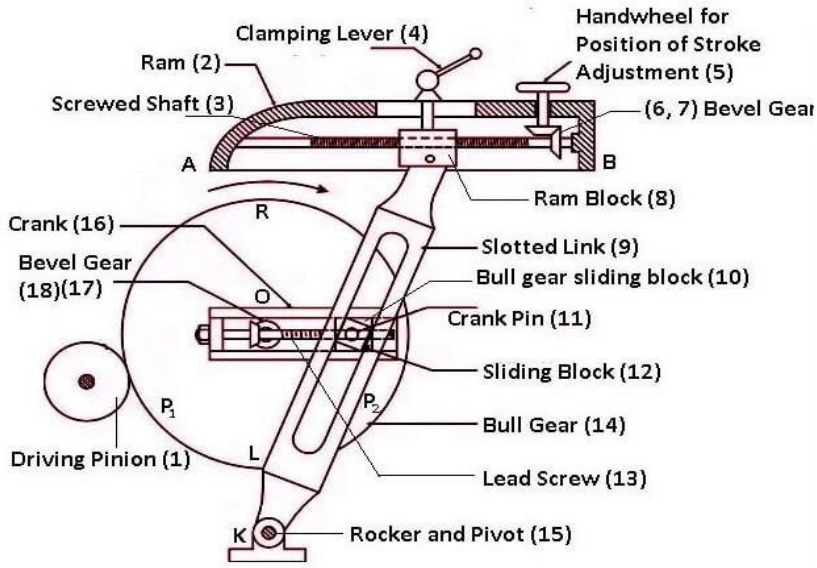
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues may vary and there may be some difference in the candidate's answers and model answer.
6) In case of somequestions 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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q.1		Attempt any FIVE of the following:	10 Marks
	a) Ans	**Explain in short mechanics of chip formation.** Metal cutting involves excessive plastic deformation and fracture between the workpiece and wedge-shaped tool. Chip formation is localized shear process in a narrow region where the metal is compressed and made to flow on the face of the tool. As the tool advances, heavy forces are exerted, and material is cut when maximum shear stress is exerted along the shear plane. Finally, chip is formed. The basic two mechanisms involved in chip formation are, Yielding – generally for ductile materials Brittle fracture – generally for brittle materials	02 Marks
	b) Ans	**Enlist types of moulding sand.** 1. Greensand 2. Dry sand 3. Loam sand 4. Facing sand 5. Backing sand 6. Parting sand 7. Core sand	½ Mark for each(any four)
	c) Ans	**Differentiate between Soldering and Brazing (Any 4 points)**	

		SrNo	Soldering	Brazing
		1	It is a method of joining similar or dis-similar metals by using filler metal whose liquidus temp. is below 400 ºC	It is a method of joining two dis-similar metals by using filler metal whose melting point is above 400 ºC but lower than base metal
		2	Filler metal is non ferrous metal or alloy. E.g.copper, zinc, aluminum alloy	Filler metals are usually lead, tin etc.
		3	Comparatively weak joint is formed.	Relatively strong joint is produced.
		4	Soldering methods-Soldering iron method, torch soldering, furnace, hot plate	Brazing methods- torch brazing, furnace brazing, resistance brazing
		5	Applications- small Pipe fittings, electronic component joining	Applications- Carbide tipped tools, electrical connections
				½ Mark for each
	d)	**State applications of extrusion process.** (any 4 points) 1. Extrusion is widely used in production of tubes and hollow pipes. 2. Aluminum extrusion is used in structure work like Channel section, I-section, Z-section, T-section 3. This process is used to produce frames, doors, window etc. in automotive industries. 4. Extrusion is widely used to produce plastic objects. 5. Variety of cross-sectional shapes such as circular, square, rectangular, hexagonal (solid or hollow).		½ Mark for each
	e)	**Enlist Elements of tool signature in single point cutting tool.** The seven elements that comprise the signature of a single point cutting tool are always stated in the following order: 1. Back rake angle (0°) 2. Side rake angle (7°) 3. End relief angle (6°) 4. Side relief angle (8°) 5. End cutting edge angle (15°) 6. Side cutting edge angle (16°) and. 7. Nose radius (0.8 mm)		½ Mark for each (values of angle are not essential)

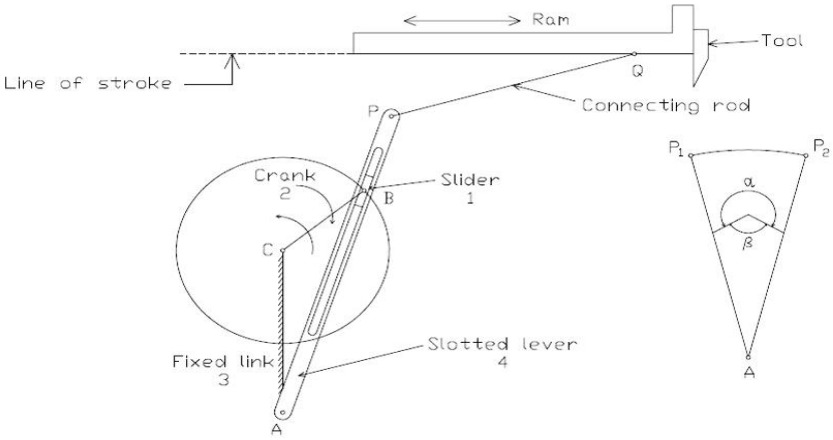
	f)	**Give classification of Shaping machines.** A] Types of shaper machine based on driving mechanism: 1. Crank type e.g., quick return motion mechanism 2. Geared shaper 3. Hydraulic shaper B] Based on ram travel: 1. Horizontal shaper 2. Vertical shaper 3. Travelling Head type C]Based on table design: 1. Standard or plain shaper 2. Universal shaper D]Types of shaping machine based on the cutting stroke: 1. Push type 2. draw cut type of shaper machine	01 Mark for 01 classification (Any 2 criterion of classification)
	g)	**State various elements of Gating system in moulding process.** 1. Pouring basin 2. Sprue or downsprue 3. Runner 4. Ingate 5. Riser	
Q. 2		**Attempt any <u>THREE</u> of the following:**	**12 Marks**
	a)	**State various types of chips and explain any one with sketch.** Mainly chips are of three types: - 1) Discontinuous chips. 2) Continuous chips. 3) Continuous Chips with built up edges (or BUE chips) 1. 2. **Discontinuous chips. :- (Segmental chips)**  Segmental chips **Segmental chips / discontinuous chips** If the chips during machining process is not continuous i.e. formed with breakage are called discontinuous chips. Discontinuous chips are formed when brittle or hard metals like brass, bronze and cast iron are used as workpiece in the machining process. Discontinuous chips are also formed in ductile material when the friction between tool and workpiece is high. Discontinuous chips is not a good sign for machining of ductile	04 01 Mark for types 03 Marks for explanation

		material as it gives poor surface finish and machining process becomes slow. **3. Continuous chips:**  Continuous chips are the chips formed during machining without breakage or without segments. These chips are formed by the continuous plastic deformation of metal without fracture in front of the cutting edge. Continuous Chips are mainly formed during cutting of ductile material like mild steel, aluminium and copper. 3. **Continuous Chip with Built Up Edge:**  This type of chip is similar to continuous chip and it has a built-up edge adjacent to the tool face and also is not as smooth as continuous edge. Actually, Built Up Edge (BUE) is an accumulation of work material against the rake face, that seizes to the tool tip, separating it from the chip. BUE is formed during machining of ductile metal when excessive friction exists between tool and workpiece. Built Up Edges are formed mainly due to friction between the tool and interface of chip. Because of friction between the tool and the chip, very intense heat is generated near the nose of the tool. The compressed metal near the nose of the tool gets welded due to high temperature near the nose. This compressed metal near welded to the nose is called built up edge, which is not desirable.	(Any one type to be explained)
	b)	**Sketch and explain Quick return mechanism in Shaping Machine** (ANY ONE SKETCH IS EXPECTED-Even sketch of Whitworth Quick return motion mechanism should be accepted)	04



02 Marks for sketch

OR



A quick return motion mechanism is used in the shaper and slotter machine in which the rotary motion is converted into reciprocating motion so that the slider moves forward and backwards, but return stroke (non- cutting stroke) is faster than forward (cutting stroke) stroke. In the forward direction, the cutting process occurs while in return there is no such cutting. The slider is free and it can slide in the slotted lever and the upper end of the slotted lever is attached to the ram of the shaper machine through a linkage. Now when the power is supplied, the crank starts rotating and the motion is transmitted to the slider and it is fitted inside the slotted lever therefore it starts oscillating.

Now ram moving forward and it travels through an angle α(Larger angle) whereas, In the return stroke, it travels through an angle β (Smaller angle).Thus, the idle time is reduced because of the fast-returning stroke.

02 Marks for explanation

	c)	**Differentiate between TIG and MIG welding.**	04

Sr.No	TIG welding	MIG Welding
1.	TIG stands for Tungsten Inert Gas Welding. It is also known as Gas Tungsten Arc Welding (GTAW).	MIG stands for Metal Inert Gas Welding. It is also known as Gas Metal Arc Welding (GMAW)
2.	It is a process in which an electric arc is formed in between a non-consumable tungsten electrode and workpiece metal.	It is a welding process in which electric arc is formed in between a consumable wire Electrode and workpiece metal.
3.	It uses constant current welding power supply for the welding.	Most commonly it uses constant voltage, direct current power source for the welding. It can also use constant current system and alternating current.
4.	It is most commonly used to weld stainless steels and non-ferrous metals like aluminum, magnesium and copper alloys.	The materials which it can weld are aluminum, non-ferrous materials and steels.
5.	High skilled operator is required to perform TIG welding process.	High skilled operator is not required to perform MIG welding process.
6.	It has low weld deposition rate as compared with MIG welding.	It has high weld deposition rate.
7.	It may require filler metal from outside in some cases depending on plate thickness.	No filler metal is required. The feed electrode wire melts and acts as filler metal.
8.	It can weld thin metal sheets upto 5 mm.	It can weld thick metal sheets upto 40 mm.
9.	It produces high quality of weld because it affords greater control over weld area.	It produces less quality of weld as compared with TIG.
10.	It is a slower welding process.	It is a faster welding process.

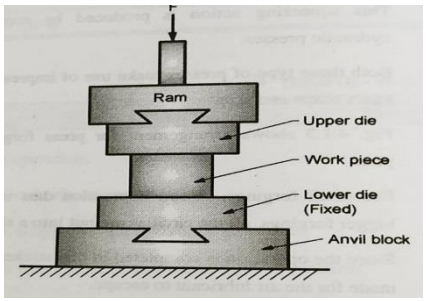
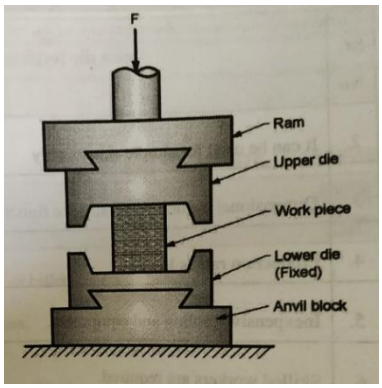
01 Mark for 01 Point

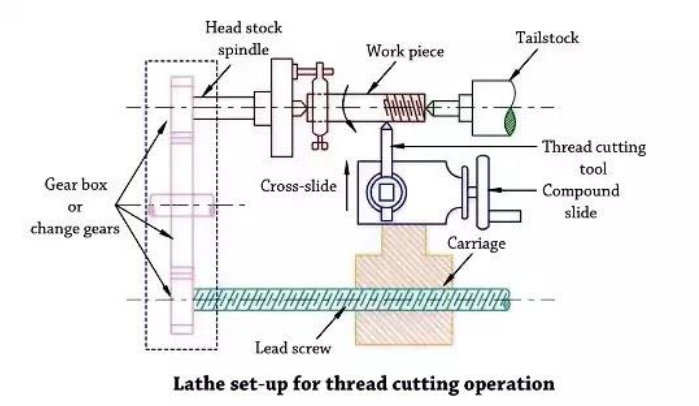
(any 4 points)

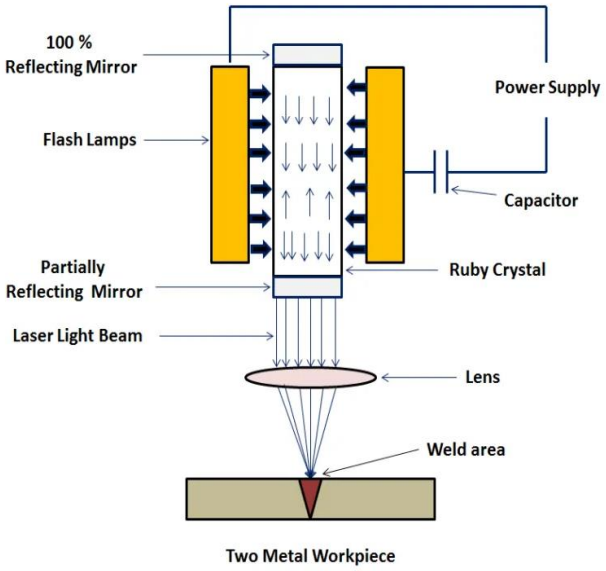
d) **Explain open and closed die forging operations.** 04

1. Open Die forging

(Sketch is not

		 Open die forging is the process, which involves the shaping of any hot metal parts. This is done with a top die that is attached to a ram and the bottom die gets attached to anvil block. Working surface of both upper and lower dies is flat and horizontal. The metal is constantly hammered and stamped to finally achieve a certain set of dimensions within the open die forging process. It gives poor accuracy and surface finish with low production rate. For this process, inexpensive tooling will work, but skilled worker is required. Open die forging helps in reducing the chances of voids. With the ability to provide continued grain flow, it can also help in generating finer grain size. It provides greater strength and improved microstructure. Steel and related alloys are generally subjected to open die forging. A lot of other metals like copper, nickel etc. can also be shaped using open die forging. **2. Closed die forging-**  Closed die forging, also known as an impression, generally confines the metal in dies. In this type of forging, cavities in the form of impressions are cut the die block. Closed dies are carefully machined matching blocks so as to produce forgings of accurate dimensions. During the forging, cavities in the die are completely filled. Excess metal is squeezed and escaped out in the form of thin fin or flash, which is removed while finishing. Closed die forging, can be entirely automated with minimal human involvement and a much simpler process in all. Complex shapes with greater accuracy and surface finish with high production rate can be produced. Skilled operator is not required. Disadvantages are high tooling cost and not suitable for production of small quantity.	mandatory) 02 Marks 02 Marks
Q.3		**Attempt any THREE of the following:**	**12 Marks**

	a)	**Explain with neat sketch thread cutting operation on lathe machine**. Threads can be cut on a cylindrical surface by forming or machining process Thread cutting by the machining process is done using a lathe. Threads of any pitch, shape and size can he cut on a lathe. The following figure shows the set-up of a lathe for thread.  **Lathe set-up for thread cutting operation** Thread cutting operation is done on a lathe using a single-point tool called thread cutting tool. The work piece is held between centres or in a chuck and the tool is held in tool post. For producing threads of pitch p mm, the tool must travel a distance equal to p [mm] as the workpiece makes one complete rotation. The definite relative rotary and linear motion between the workpiece and tool is achieved by locking or engaging the carriage with the lead screw through a screw and nut mechanism and fixing a gear ratio between the headstock spindle and lead screw. This is done by using change gear mechanism or gear box between the spindle and lead screw. To cut the threads, the tool is brought to the start of the workpiece and a small depth of cut is given to the tool using cross-slide. The carriage is engaged with the lead screw, the cut is made on the entire surface and at the end of the workpiece, carriage is disengaged. The tool is pulled out of the job and brought back to the starting position. The process is repeated until the full depth threads are obtained. The following relationship is used to determine the gears/wheels required to generate threads of definite pitch. Gearing ratio = Pitch of screw to be cut/Pitch of lead screw. = Lead of screw to be cut/Lead of lead screw threads = No. of teeth of driver/No. of teeth of driven Or = Driver/Driven	**04** 02 Marks for sketch 02 Marks for description
	b)	**Explain with neat sketch laser beam welding.**	04 02 Marks



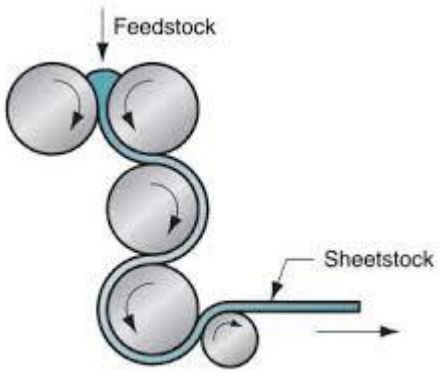
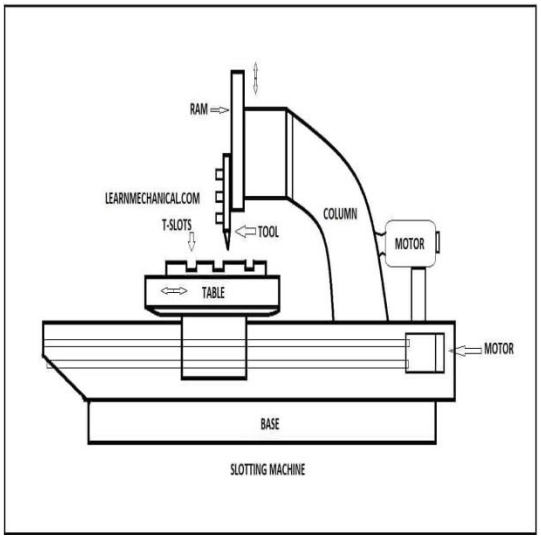
for sketch

02 Marks for description

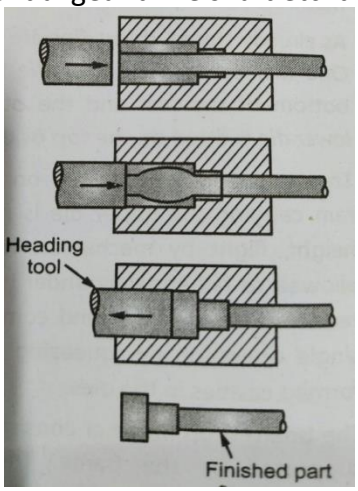
- First, the setup of welding machine at the desired location (in between the two metal pieces to be joined) is done.
- After setup, a high voltage power supply is applied to the laser machine. This starts the flash lamps of the machine and it emits light photons. The energy of the light photon is absorbed by the atoms of ruby crystal and electrons get excited to their higher energy level. When they return back to their ground state (lower Energy state) they emit a photon of light. This light photon again stimulates the excited electrons of the atom and produces two photons. This process keeps continue and we get a concentrated laser beam.
- This high concentrated laser beam is focused to the desired location for the welding of the multiple pieces together. Lens is used to focus the laser to the area where welding is needed. CAM is used to control the motion of the laser and work piece table during the welding process.
- As the laser beam strikes the cavity between the two metal pieces to be joined, it melts the base metal from both the pieces and fuses them together. After solidification, we get a strong weld.
- This is how a laser Beam Welding Works.

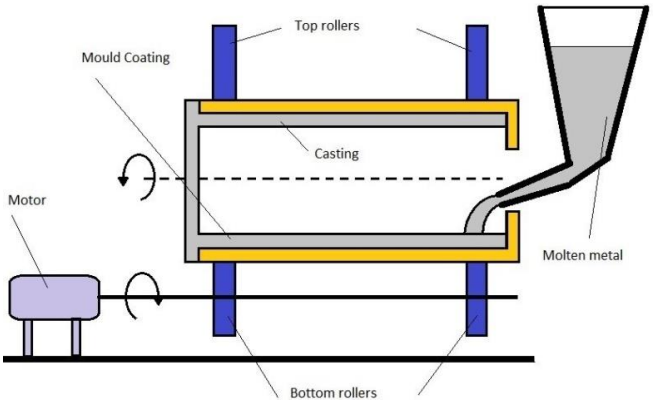
	c)	**Explain hot and cold rolling. State their applications.**	**04**
		Hot Rolling:-Hot rolling is a metalworking process in which metal is heated above the recrystallization temperature to plastically deform it in the working or rolling operation. This process is used to create shapes with the desired geometrical dimensions and material properties while maintaining the same volume of metal. The hot metal is passed between two rolls to flatten it, lengthen it, reduce the cross-sectional area and obtain a uniform thickness. Hot-rolled steel is the most common product of the hot rolling process, and is widely used in the metal industry either as an end product or as raw material for subsequent operations. **Cold Rolling:-**Cold rolling is a process which passes metal through rollers at temperatures below its recrystallization temperatures. This increases the yield strength and hardness of the metal.Cold rolling of metal strip is a special segment within the metalworking	01 Mark

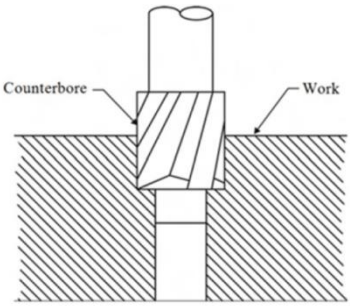
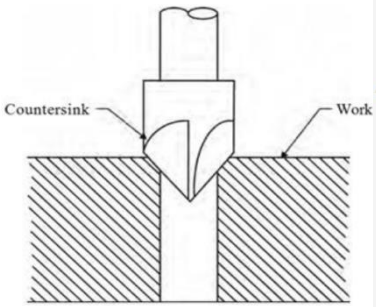
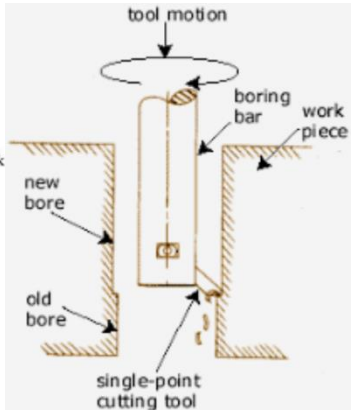
		industry.This is done by introducing defects into the crystal structure of the metal creating a hardened microstructure which prevents further slip. Because the meta is at room temperature, it is less malleable than metal above its recrystallization temperature. This makes cold rolling a more labour intensive and expensive process than hot rolling. Cold rolling can also reduce the grain size of the metal. Both hot rolling and cold rolling are used to create sheet metal. However, cold rolling produces thinner sheets. Hot rolling is also commonly used to create railroad rails, and cold rolling is often used to make beverage cans. **Applications of Hot-Rolling:-** • Automotive structural parts such as frames • Tabular products such as pipe and gas cylinders • Machine structures such as saws and springs • Agriculture equipment • Metal buildings • Guard rails **Applications of Cold-Rolling:-** • Metal furniture • Structural parts • Home appliances • Water heaters • Metal containers • Fan blades • Frying pans	01 Mark 01 Mark 01 Mark
	d)	**Explain calendaring process of plastic.** Calendering is the process of smoothing and compressing a material during production by passing a single continuous sheet through a number of pairs of heated rolls as shown in fig. The rolls in combination are called calenders. Calendering is a speciality process for high-volume, high quality plastic film and sheet, mainly used for PVC as well as for certain other modified thermoplastics. The melted polymer is subject to heat and pressure in an extruder and formed into sheet or film by calendering rolls. The temperature and speed of the rolls influences the properties of the film. Where it is squeezed into a sheet of uniform thickness, the finished product is cooled by passing through water cooled rolls. Calendering allows speciality surface treatments of the film or sheet such as embossing or enhancing the physical properties or in-line lamination.	**04** 03 Marks (Fig not asked if drawn given advantage)

		 Fig: Calendering Process	01 Marks
Q.4		**Attempt any <u>THREE</u> of the following:**	**12**
	a)	**Explain with basic diagram parts of slotting machine and state their functions.**  **1. Base or Bed** • The base is rigidly built to take up all the cutting forces and **the entire load of the machine.** • The top of the bed is accurately finished to provide guideways on which the saddle is mounted. • The guideways are perpendicular to the column face. **2. Column** • The column is the vertical member which is cast integrally with the base and houses driving mechanism of the ram and feeding mechanism. • The front vertical face of the column is accurately finished for providing ways in which the ram reciprocates. **3. Saddle**	**04** 02 Mark for sketch

		• The saddle is mounted upon the guideways and may be moved toward or away from the column either power or manual control to supply longitudinal feed to the work. • The top face of the saddle is accurately finished to provide guide ways for the cross-slide. These guideways are perpendicular to the guideways on the base. **4. Cross-slide** • The cross-slide is mounted upon the guideways of the saddle and maybe moved parallel to the face of the column. • The movement of the slide may be controlled either by hand or power to supply crossfeed. **5. Rotary Table** • The rotary table is a circular table which is mounted on the top of the cross-slide. • The table may be rotated by rotating a worm which meshes with a worm gear connected to the underside of the table. • The rotation of the table may be effected either by hand or power. • In some machines, the table is graduated in degrees that enable the table to be rotated for indexing or diving the periphery of a job in the equal number of parts. • T-slots are cut on the top face of the table for holding the work by different clamping devices. The rotary table enables a circular or contoured surface to be generated on the work piece. **6. Ram and Tool head Assembly** • The ram is the reciprocating member of the machine mounted on the guideways of the column. It supports the tool at its bottom end on a tool head. • A slot is cut on the body of the ram for changing the position of the stroke. • In some machines, special type for tool holders is provided to relieve the tool during its return stroke. **7. Ram Drive Mechanism** A ram removes metal during downward cutting stroke only, whereas during upward return stroke no metal is removed. To reduce the idle return time quick return mechanism is incorporated in the machine. slotter removes metal during downward cutting stroke only whereas during upward return stroke no metal is removed. The reduce the idle return time quick return mechanism is incorporated in the machine. The usual types of ram drive mechanism are, • Whitworth quick return mechanism. • Variable speed reversible motor drive mechanism. • Hydraulic drive mechanism.	02 marks explanation
	b)	**List out safety precaution to be taken in foundry shop.** 1. Even trace amounts of MOISTURE and MOLTEN METAL don't mix. Steam explosions are the number one cause of death in foundries. 2. NEVER put water on a metal fire. This can cause a HUGE EXPLOSION. 3. Have a DRY pile of sand and a shovel ready to put out fires or to control metal spills. 4. Have a sand bed under all areas. Always use earplugs to safeguard against the heavy	**04**

		noise. The sand bed should be at least 3 inches thick. This will help in containing metal spills and will help protect flooring. 5. Never pour over wet ground. Remember, even TRACE AMOUNTS of MOISTURE can cause EXPLOSIONS. 6. Molten metal spilled on concrete will cause the concrete to explode. Use a thick sand bed over concrete. 7. Always use clean metal as feedstock. Combustion residues from some lubricants and paints can be very toxic. 8. Always operate in a well-ventilated area. Fumes and dusts from combustion and other foundry chemicals, processes and metals can be toxic. 9. Use a NIOSH rated dusk mask. Dusts from sand, parting dusts and chemicals can be hazardous or cancer causing. Protect your lungs. 10. Always use safety glasses. Even minor mishaps can cause blindness. 11. Never use a crucible that has been damaged or dropped. It's just not worth the risk. Imagine what would happen if a white-hot crucible of brass crumbled as you were carrying it. 12. Always charge crucibles when cold. Adding metal to a hot crucible is really dangerous. If there is moisture on the metal, even just a haze, the metal can cause the entire contents of the crucible to explode. 13. Spilled molten metal can travel for a great distance. Operate in a clear work area. 14. One should not touch hot moulds and castings. 15.All foundry men should wear protective clothes, glasses, shoes, and gloves while handling molten metal.	½ for each point(any eight)
	c)	**Explain with sketch upset forging operation.** These forging operations are done to increase the cross-sectional area of the workpiece to expand the length. The force is applied in a parallel direction of the long axis. A good example of an upsetting operation is a bolt head. In upset forging a heated bar of metal is inserted between the movable and stationary halves of the set of dies. The amount of stock to be upset is set by the stop gauge. The stop is then moved away and the stock is then gripped between the female dies by bringing the moving die close to the stationary die. A punch is then forced against the workpiece, forming and enlarging the end of the workpiece to take the shape of the die cavity. For smaller job sizes, upsetting is generally done in the cold condition e.g. bolts, rivets, pins etc. For larger sizes of jobs like valves, rear axle half-shafts and differential gear drive shaft etc. the stock is heated.  	**04** 02 marks explanation

			02 Marks fig.
	d)	**State various applications of extrusion processes.** • Extrusion is widely used in production of tubes and hollow pipes. • Aluminium extrusion is used in structure work in many industries. • This process is used to produce frames, doors, window etc. in automotive industries. • Extrusion is widely used to produce plastic objects. • Electrical wires, bars and tubes are some of the items produced by hot extrusion. Collapsible tubes, gear blanks, aluminium cans, cylinders are some of the items produced by cold extrusion.	**04** 01 Mark for each applications (any four)
	e)	**Explain centrifugal casting method with neat sketch.**  Centrifugal casting, sometimes called rotocasting, is a metal casting process that uses centrifugal force to form cylindrical parts. This differs from most metal casting processes, which use gravity or pressure to fill the mold. In centrifugal casting, a permanent mold made from steel, cast iron, or graphite is typically used. However, the use of expendable sand molds is also possible. The casting process is usually performed on a horizontal centrifugal casting machine (vertical machines are also available) and includes the following steps: 1. Mold preparation - The walls of a cylindrical mold are first coated with a refractory ceramic coating, which involves a few steps (application, rotation, drying, and baking). Once prepared and secured, the mold is rotated about its axis at high speeds 2. Pouring - Molten metal is poured directly into the rotating mold, without the use of runners or a gating system. The centrifugal force drives the material towards the mold walls as the mold fills. 3. Cooling - With all of the molten metal in the mold, the mold remains spinning as the metal cools. Cooling begins quickly at the mold walls and proceeds inwards. 4. Casting removal - After the casting has cooled and solidified the rotation is stopped and the casting can be removed. 5. Finishing - While the centrifugal force drives the dense metal to the mold walls, any less dense impurities or bubbles flow to the inner surface of the casting. As a result, secondary processes such as machining, grinding, or sand-blasting, are required to clean and smooth the inner diameter of the part.	**04** 02 Mark for sketch 02 marks explanation

		Centrifugal casting is used to produce axi-symmetric parts, such as cylinders or disks, which are typically hollow. Due to the high centrifugal forces, these parts have a very fine grain on the outer surface.. These parts may be cast from ferrous metals or from non-ferrous alloys. Broadly, centrifugal casting can be classified into true centrifugal casting, semi-centrifugal casting and centrifuging. Centrifugal casting is performed in wide variety of industries, including aerospace, industrial, marine, and power transmission. Typical parts include bearings, bushings, coils, cylinder liners, nozzles, pipes/tubes, pressure vessels, pulleys, rings, and wheels.	
Q.5		**Attempt any <u>TWO</u> of the follwing**	**12**
	a)	**Explain Various drilling machine operations with neat sketch. (At least three)** **i) Counterboring:-**Counterboring is the operation of enlarging the end of a hole with a hole cylindrically. Counterbores provide a shoulder to accommodate the heads of bolts, studs, and pins. The tool used for counterboring is called a counterbore. The cutting edges may have straight or spiral teeth. The cutting speed for countersinking is 25% less than that of drilling operation.  Fig Counterboring Operation  Fig Countersinking Operation  **ii) Countersinking:-**Countersinking is the operation of producing a taper or cone shape surface at the entrance of a hole for the purpose of having the head of a flat head screw, aviation rivet or other similar fastener sit flush or below a surface. This cone shape is machined with tool called countersink. Countersinks are available as a single flute or multi flute. A variety of sizes and included angles of: 60°, 82°, 90°, 100°, 110°, and 120° are available. The cutting speed for countersinking is 25% less than that of drilling operation. **iii) Boring operation:**In machining, boring is the process of enlarging a hole that has alreadybeen drilled (or cast) by means of a single-point cutting tool , such as in boring a gun barrel or an engine cylinder. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole. Boring can be viewed as the internal - diameter counterpart to turning, which cuts external diameters.	**06** 02 Marks (01 m fig. 01 m explanation) 02 marks 02 Marks
	b)	**Explain direct and indirect extrusion. State their advantages and disadvantages.** **Direct extrusion (also called forward extrusion) :** A metal billet is loaded into a container, and a ram compresses the material, forcing it to flow through one or more openings in a die at the opposite end of the container. As the ram approaches the die, a small portion of the billet remains that cannot be forced through the die opening. This extra portion, called the butt, is separated from the product by cutting it just beyond the exit of the die. One of the problems in direct extrusion is the significant friction that exists	**06**

between the work surface and the walls of the container as thebillet is forced to slide toward the die opening. This friction causes a substantial increase in the ram force required in direct extrusion.

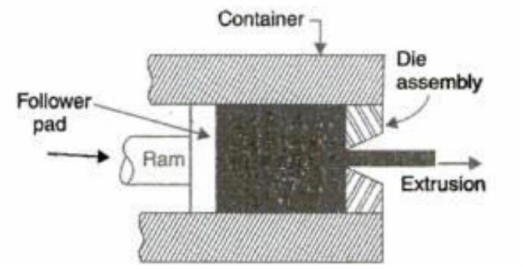
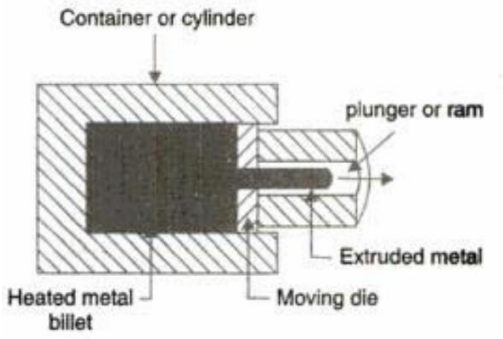


Fig not essential if drawn should be given advantage

01 Mark

Indirect extrusion (also called backward extrusion and reverse extrusion):
The die is mounted to the ram rather than at the opposite end of the container. As the ram move, the metal is forced to flow through the clearance in a direction opposite to the motion of the ram. Since the billet is not forced to move relative to the container, there is no friction at the container walls, and the ram force is therefore lower than in direct extrusion.



01 Mark

Advantages of Direct Extrusion:-

1) close tolerance can be achieved with production of long shells
2) Direct extrusion can be employed for extruding solid circular or non-circular sections, hollow sections such as tubes or cups

Disadvantages of Direct Extrusion:-

1) Friction between the container and billet is high
2) greater forces are required. 3) The corresponding extrusion pressure is also higher because of friction between container and billet.

Advantages of Indirect Extrusion:-

01 Mark

1) there is less friction between the container and billet.
2) Less forces are required for indirect extrusion.
3) Indirect extrusion can produce hollow (tubular) cross sections,

Disadvantages of Indirect Extrusion:-

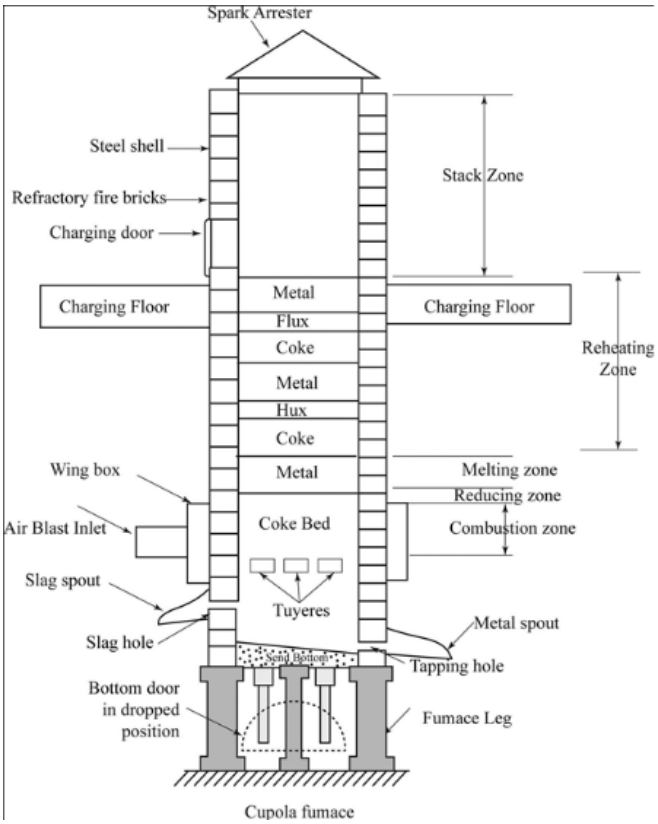
01 Mark

1) Indirect extrusion cannot be used for extruding long extrudes.
2) Support of the ram becomes a problem as work length increases.

01 Mark

01 Mark

	c)	**List Out various casting defects and state their remedies.** **Casting Defects and remedies:-** **[1] Blow holes:** It is smooth sound cavities produced in a casting due to entrapped bubbles of gases, steam. ***Remedies:-*** i) Moisture content of the sand must be well. ii) Sand of proper grain size should be used. iii) Ramming should not be too hard. iv) Vent holes should be provided. **[2] Mis-run and cold shut:-**When molten metal fails to fill the entire cavity of the mould, incomplete casting is obtained. This defeat is called mis-run and imperfect fusion of two stream of molten metal in the mould cavity results in a discontinuity called cold-shut. ***Remedies:-*** i) Use hotter metals ii) Frequent inspection and replacement of pattern. iii) Proper design of gating and raiser iv) Use of chills and padding. **[3] Drop: -** This is an irregular deformation of the casting produced when a portion of the sand drops into the molten metal. ***Remedies:*** i) These can be controlled by adopting proper moulding, gating and melting techniques. **[4] Dirt: -** Presence of particles of dirt and sand in the casting. ***Remedies:-*** i) Proper handling of mould ii) Adopting proper moulding, gating and melting techniques. iii) Proper design of gating and raiser iv) Use of chills and padding **[5] Shifts: -** It is a misalignment of top and bottom parts of mould at parting line. This results in mismatch of the casting, incorrect dimension, incorrect location of holes. ***Remedies:-*** i) ensuring proper alignment of the pattern, moulding boxes ii) correct mounting of pattern on pattern plates etc **[6] Fins and flash: -** It is a thin metal projection on casting. ***Remedies:-*** i)These can be controlled by adopting proper moulding, gating and melting techniques. ii) insufficient weight should be placed on the top part of the mould **[7] Swell: -** It is un-intentional enlargement found on the casting surface due to liquid	**06** 01 Mark for each any six

		metal pressure. ***Remedies:-*** i) Proper ramming of sand ii) uniform flow of molten metal into the mould **[8] Run-out: -** This defect occurs when molten metal leaks out to the mould during pouring. It results in incomplete casting. ***Remedies:-*** i) The corrective measures taken in respect of the above reasons will prevent this defect. **[9] Warpage: -** This is unintentional and undesirable deformation of casting produced during solidification of metal. ***Remedies:-*** i) This defect can be eliminated by modifying the casting design and proper directional solidification. **[10] Hot tears (Hot Cracks):-**These are internal or external cracks resulting immediately after the solidification of metal. ***Remedies:-*** i) abrupt change in section should be avoided ii) Pouring temperature should be correct iii) There should be even rate of cooling.	
Q.6		**Attempt any <u>TWO</u> of the following**	**12**
	a)	**Explain construction and working of cupola furnace.**  	**06** 02 Mark for diagram 02 m for constructio n 02 m for working

Construction: - Cupola Furnace is a melting device which used to melt cast iron, Bronze and other alloying elements are melted. It is mainly used to convert pig iron to cast iron. Cupola Furnace was first built in China in the Warring States Period (403 -221 BC). Cupola furnace is cylindrical in shape and the equipment of this furnace is vertically fitted inside this cylindrical shell with doors.

For many years Cupola Furnace was used to melt iron in iron foundries because it produces good Cast iron from Pig Iron. The outermost part of cupola furnace is cylindrical steel shell. The diameter of this shell ranges from 1.5 to 13 feet depending upon the size of the furnace. The inner side of the furnace is lined withrefractory brick and plastic refractory patching material.

This furnace is supported on Cast iron legs mounted on concrete base. At the bottom of the furnace, two cast iron doors are hinged with the bed plate of the furnace. Near the bottom, it has send bed above which the melted iron flow. This sand bed is tapered. Near the elevated side of the tapered sand bed, slag hole is present through which slag formed from impurities comes out. Near the downside of the down bed, the tap hole is present through which molten iron comes out.

Above the send bed, tuyers are present through which air reaches the furnace and helps in combustion.

At the top of the furnace spark arrester or cap is present that traps the burning particles and only allow the gases to release to the environment.

Near the top of the furnace, charging door is present through which metal, coke and lime stone are fed into the furnace.

Working of Cupola Furnace :

At first wood is ignited above the sand bed. When the wood starts burning properly, coke is dumped on the well from the top to a predetermined height of nearly 40 inches. This forms a 40 inch coke bed.

Then the combustion starts in the coke bed using the fire from the burning wood and using the air from the tuyers. At this time, the air blast is turned out at a lower blowing rate than normal to provoke the coke.

After nearly 3 hours of burning when the coke starts burning properly, alternate layers of limestone, pig iron and coke is charged until it reaches the level of charging door is reached. At this time the air blast is tuned on to normal blowing rate and the combustion occurs more rapidly in the coke bed.

All oxygen from the air blast is consumed by the combustion in the combustion zone.The chemical reaction which takes place is,

C + O2 -> CO2 + Heat

This is an exothermic reaction and in the combustion zone the temperature varies from 1150 to 1850 degree Celcius.

The portion of the coke bed above the combustion zone is reducing zone. This zone prevent the oxidation of metal charge above and while dropping through it.As the ho carbon dioxide moves up through this zone, some of it is reduced by the following reaction,

CO2 +C -> 2CO

The layer of iron above reducing zone is melting zone where the solid iron is converted into molten iron.This melted iron trickles down through the coke bed and is collected in the well. Sufficient carbon comtent is picked up by the molten metal in this zone and is represented by the chemical reaction given as :-

3 Fe + 2 CO —> Fe3 C + CO2

Above the melting zone, there is preheating zone where the charge is preheated by the outgoing gases and the temperature of this zone is about 1900 degree Celcius.

Apart from limestone, fluorspar and soda ash are also used as flux material. Main function of flux is to remove impurities from iron and protect iron from oxidation.
Within 5 to 10 minutes of starting of air blast to normal blowing rate , the first molten iron appears at the tap hole.

b) Explain Taper turning operation on lathe machine with neat sketch. — **06 Marks**

Taper Turning:-

A taper is defined as a uniform increase or decrease in diameter of a piece of work measured along its length. In a lathe machine, taper turning means to produce a conical surface by gradual reduction in diameter from a cylindrical job. A taper is generally turned in a lathe by feeding the tool at an angle to the axis of rotation of the workpiece. The angle formed by the path of the tool with the axis of the workpiece should correspond to the half taper angle. A taper can be turned by anyone of the following methods:

Methods of taper turning — 03 marks fig

- By a broad nose form tool
- By setting over the tailstock Centre
- By swiveling the compound rest
- By taper turning attachment
- By combining longitudinal and cross feed in lathe

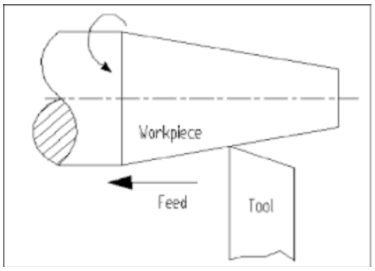


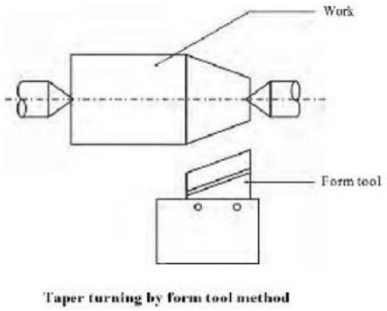
Figure :- Taper Turning

03 marks explanation

Explanation:

1. **Form tool method**:

This is one of the simplest methods to produce short taper. To the required angle the form is grounded and used. The tool is fed perpendicular to the lathe axis, when the work piece rotates.

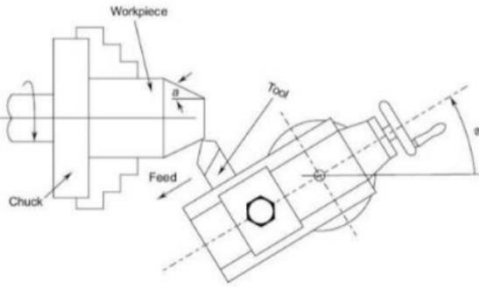


Taper turning by form tool method

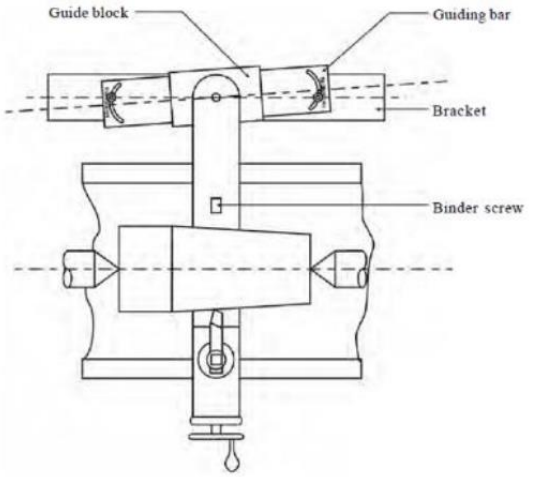
3. Compound rest method:

Generally short and steep taper are produced using this method. In this method the work piece is held in the chuck and it will be rotated about the lathe axis. The compound rest is

swiveled to the required angle and then it will be clamped in position.

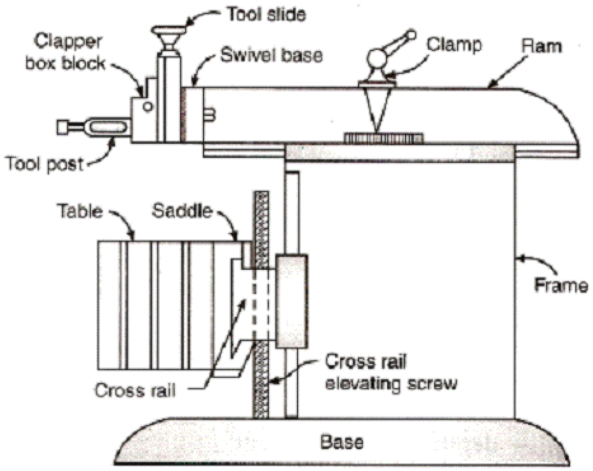


4. Taper turning attachment method:
In this method by using bottom plate or bracket, a taper turning attachment is attached to the rear end of the bed. It has a guiding bar which is usually pivoted as its center. The guiding bar has the ability to swing and it can be set in any required angle. It has graduations in degrees. It has a guide block which connects to the rear end of the cross slide and it moves on the guide bar. The binder screw is removed, before connecting the cross slide, hence the cross slide is free from the cross slide screw.



Taper turning by taper attachment method

c) Explain with neat sketch working principle of shaping. **6 Marks**



03 m fig

The shaper is a machine tool used primarily for:

		1. Producing a flat or plane surface which may be in a horizontal, a vertical or an angular plane. 2. Making slots, grooves and keyways 3. Producing contour of concave/convex or a combination of these The main parts of the Shaper machine is Base, Body (Pillar, Frame, Column), Cross rail, Ram and tool head (Tool Post, Tool Slide, Clamper Box Block). **Base**: The base is a heavy cast iron casting which is fixed to the shop floor. It supports the body frame and the entire load of the machine. The base absorbs and withstands vibrations and other forces which are likely to be induced during the shaping operations. **Body (Pillar, Frame, Column):** It is mounted on the base and houses the drive mechanism compressing the main drives, the gear box and the quick return mechanism for the ram movement. The top of the body provides guide ways for the ram and its front provides the guide ways for the cross rail. **Cross rail:** The cross rail is mounted on the front of the body frame and can be moved up and down. The vertical movement of the cross rail permits jobs of different heights to be accommodated below the tool. Sliding along the cross rail is a saddle which carries the work table. **Ram and tool head:** The ram is driven back and forth in its slides by the slotted link mechanism. The back and forth movement of ram is called stroke and it can be adjusted according to the length of the workpiece to be-machined. **Working Principle:** The job is rigidly fixed on the machine table. The single point cutting tool held properly in the tool post is mounted on a reciprocating ram. The reciprocating motion of the ram is obtained by a quick return motion mechanism. As the ram reciprocates, the tool cuts the material during its forward stroke. During return, there is no cutting action and this stroke is called the idle stroke. The forward and return strokes constitute one operating cycle of the shaper	03 m explanation

END