WINTER– 2017 EXAMINATION

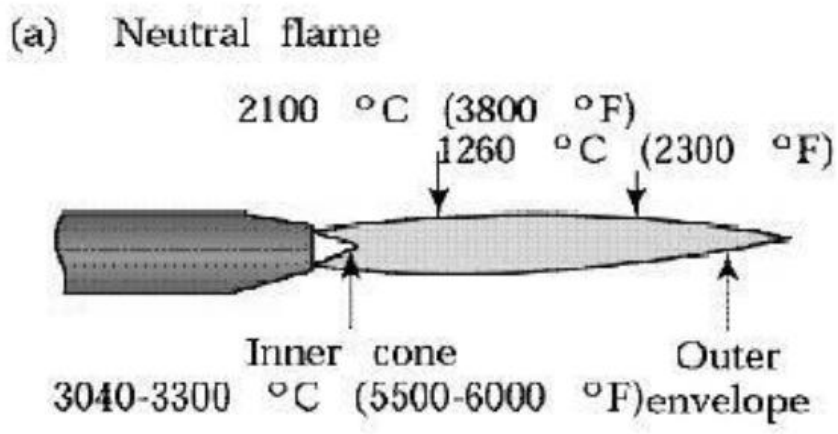
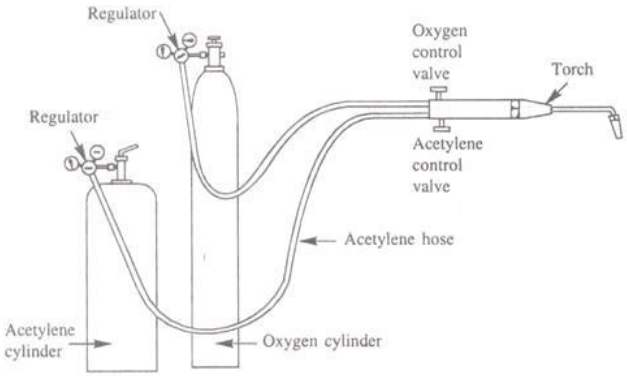
Model Answer

Subject: Automobile Manufacturing Processes **Subject Code: 17403**

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. No.	Sub Q. N.	Answer	Marking Scheme
1	(a)	**Attempt any SIX of the following: (2 x 6 =12)**	12
	i	**Define forgeability and name any two forgeable materials.**	02
	ANS	**Answer:** *(Definition 1 mark, materials 01 M)* **Forgeability:** Forgeability can be defined as the tolerance of a metal or alloy for deformation without failure. OR Forgeability is defined as the ability of a metal to change size and shape when heated to required temperature and compressed by applying some pressure. **Forgeable Materials**: (Any Two) 1) Aluminum alloys 2) Magnesium alloys 3) Copper alloys. 4) Carbon and low alloy steels 5) Martensitic stainless steels 6) Austenitic stainless steels 7) Nickel alloys 8) Titanium alloys 9) Columbium alloys 10) Tantalum alloys 11) Molybdenum alloys 12) Tungsten alloys 13) Beryllium.	01 01
	ii	**List the parts of standard die set.**	02
		1)Die 2)Die Block 3)Lower Shoe 4)Punch 5)Upper Shoe	02

		6)Back Up Plate 7)Stripper	
	iii	**Explain working principle of gas welding.**	**02**
		Answer: (Working Principle 02 marks, credits should be given diagram) **Working Principle of gas welding**  **OR**  **Working principle of gas welding:** Gas Welding is a fusion welding process. It joins metals, using the heat of combustion of the oxygen/air and combustible gas (i.e. acetylene, hydrogen, propane, or butane) mixture. The purpose of flame is to heat and melt the parent metal and filler rod of the joint. The intense heat produced melts the edges of parts and fuses together to form the welded, generally with the addition of a filler metal. The torch mixes a combustible gas with oxygen in the proper ratio and flow rate providing combustion process at a required temperature. The flame temperature is determined by a type of the combustible gas and proportion of oxygen in the combustion mixture: 4500°F - 6300°F (2500°C - 3500°C). Depending on the proportion of the fuel gas and oxygen in the combustion mixture, the flame may be chemically neutral (stochiometric content of the gases), oxidizing (excess of oxygen), and carburizing (excess of fuel gas). Welding does not require the components to be forced together under pressure until the weld is forms and solidifies.	**02**

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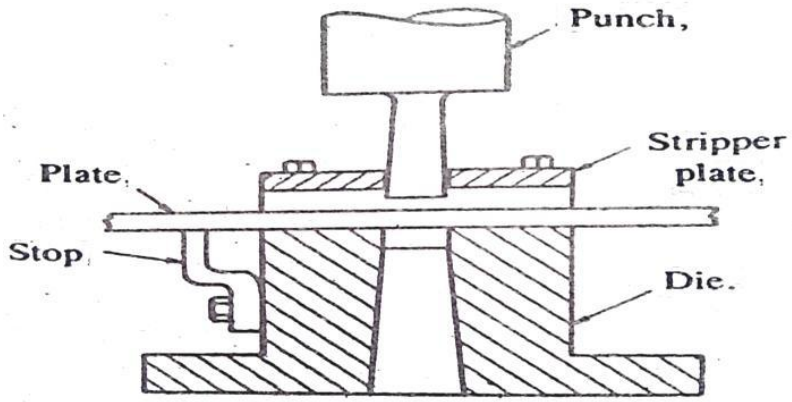
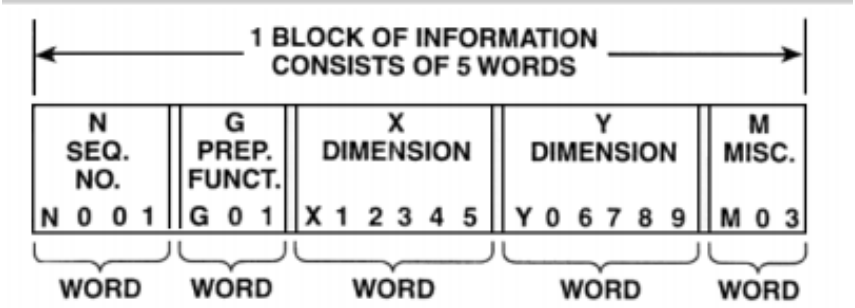
	iv	**Explain piercing operation.**	**02**
		Answer: Piercing: The piercing is the operation of production of hole in a sheet metal by the punch and the die. The materials punched out to form the hole constitute the waste. The punch point diameter in the case of piercing is less than or equal to the work material thickness. The punch governs the size of the hole and clearance is provided on the die. Fig. shows punch and die set for piercing.  **Punch and die set up for piercing, punching and blanking**	**01** **01**
	v	**State objective of surface cleaning.**	**02**
		Answer: Objective of surface cleaning is to remove oil and grease from machined surface when extreme cleanliness is required.	
	vi	**Write CNC program format with meaning of each term.**	**02**
		Answer: (format 1 mark and meaning 1 mark) **N001 G01 X12345 Y06789 M03 EOB** 1. N001 represents the sequence number of the operation. 2. G01 represents linear interpolation 3. X12345 will move the table 1.2345 in. in a positive direction along the X axis. 4. Y06789 will move the table 0.6789 in. along the Y axis. 5. M03 Spindle on CW. 6. EOB End of Block  	**01** **01**

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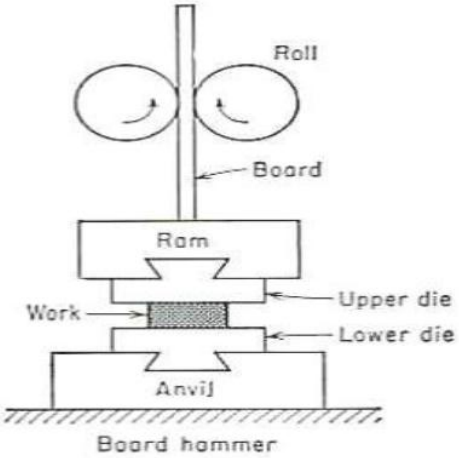
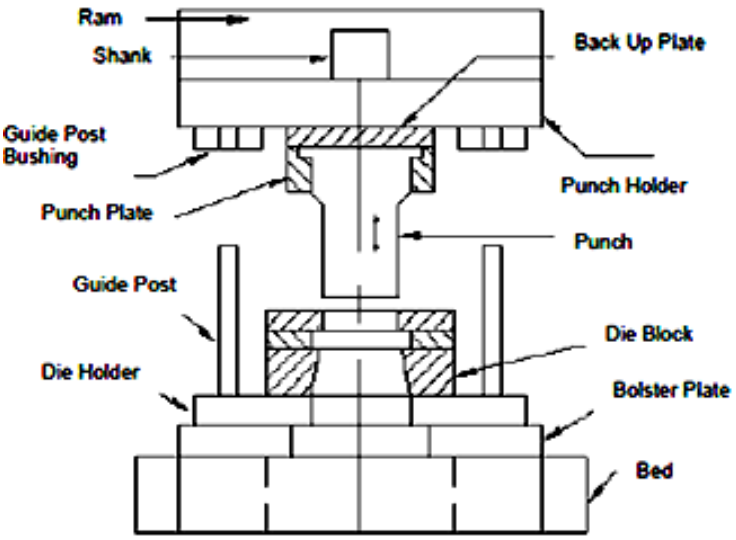
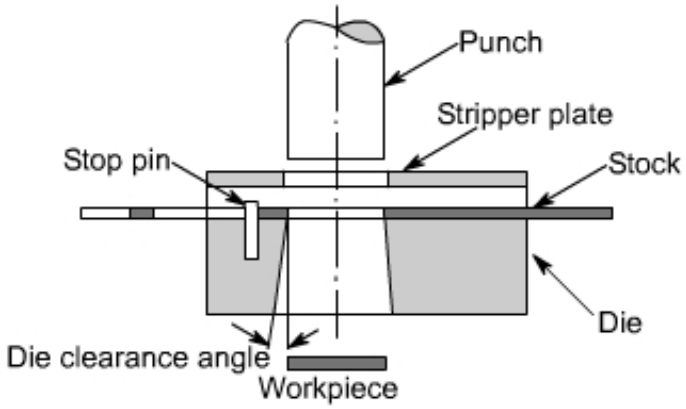
	vii	**State machine reference point for CNC.**	**02**
		Answer: The machine reference point – R The position of the reference point R is determined by the manufacturer. The value of machine reference co-ordinates XMR and ZMR are fixed and cannot be changed by the user. The machine reference point serves for the calibration of the measuring system.	**02**
	viii	**Name forging defects.**	**02**
		1. Cold shuts 2. Pitting 3. Die shift 4. Incomplete filling of dies 5. Dents **6.** Flakes	**(any four)** **02**
1.	**b)**	**Attempt any two of the following**	**08**
	i	**Explain drop forging**	**04**
		Answer ***(Explanation 2 marks and diagram 2 marks)*** **Drop Forging Process:** Drop forging is carried out by using drop hammers. They are board or gravity hammer, air lift hammer and power drop hammer. Anvil of drop forging hammer is attached to the frame to permit accurate alignment of upper and lower dies. The ram is fastened to the lower end of vertical hard wood board. [1] The upper die and ram are raised by friction rolls gripping the board. [2] After releasing the board, the ram falls under gravity to produce the blow energy. [3] The hammer can strike between 60-150 blows per minute depending on size and capacity. [4] The board hammer is an energy restricted machine. The blow energy supplied equals the potential energy due to the weight and the height of the fall. [5] This energy will be delivered to the metal work-piece to produce plastic deformation.  Figure: Drop Forging	**02** **02**

	ii	**Explain simple die with neat sketch**	**04**
		Simple Die:  Figure : Simple Die **OR**  **Figure : Simple Die** Simple die or single action dies perform single operation for each stroke of the press slide. The operation may be cutting or forming operation such as blanking, punching, piercing etc. performed on these dies. The operations can be performed in a single action of the press slide giving output. These dies are simple in construction and can manufacture by conventional machining processes.	**02** **02**

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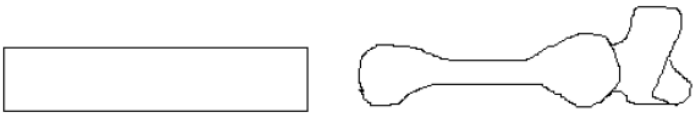
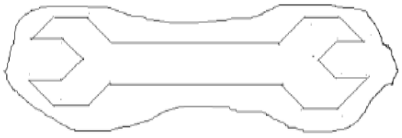
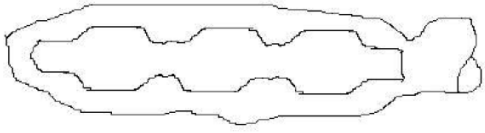
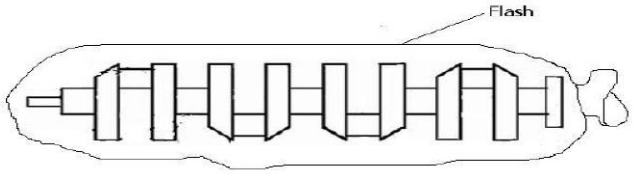
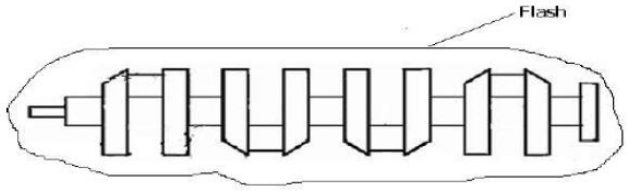
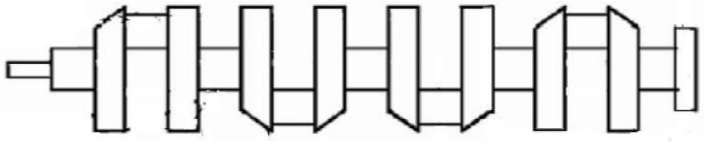
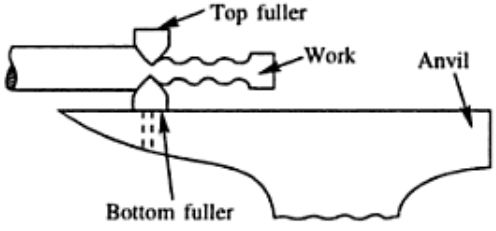
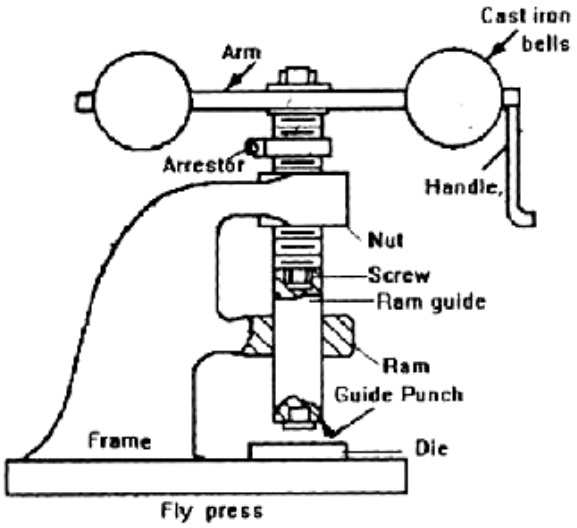
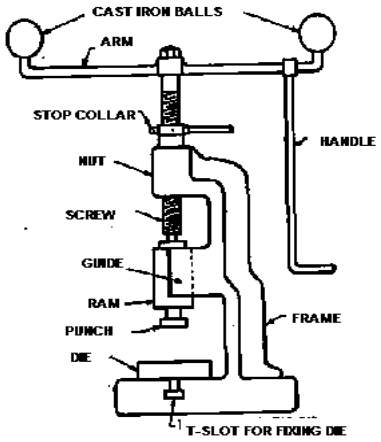
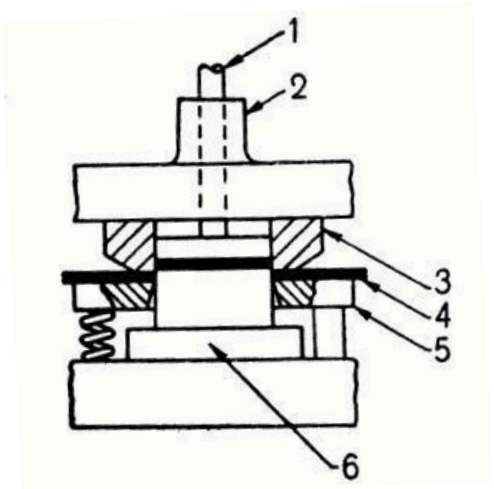
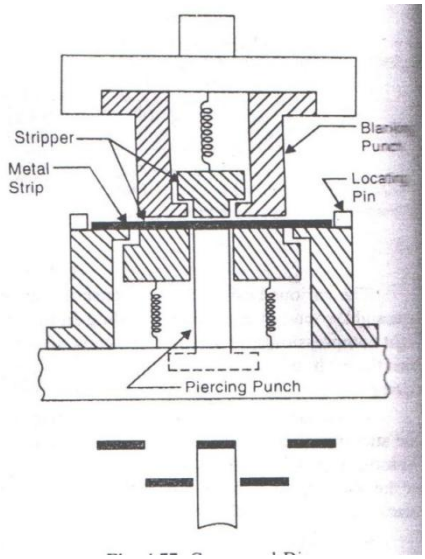
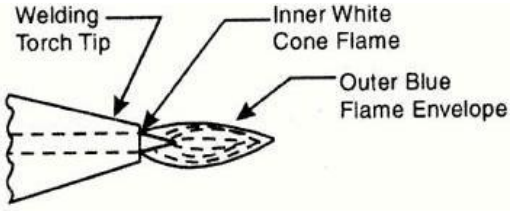
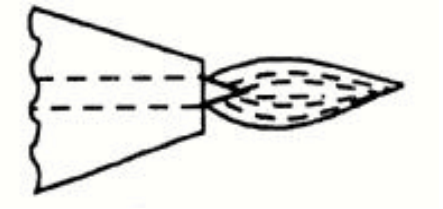
	iii	**Describe forging sequence for production of spanner.**	**04**
		Answer: *(04 marks for complete sequence with neat sketches)* **Forging Sequence for Production of Spanners:** 1) The heated stock is elongated by reducing its cross section in first die. The operation is known as "Fullering".  2) The metal is redistributed, increasing the cross section at certain places and reducing at others as required filling the cavities of the die. The operation is known as "Edging".  3) General shape is given in first blocking die.  4) Finished shape is given to forging in final impression die.  5) Flash is removed.  6) Heat treatment and machining is done as per requirement.	**04**
2		**Attempt any four of the following**	**16**
	a	**Describe forging sequence for crank shaft.**	**04**
		Answer: *(04 marks for complete sequence with neat sketches)* **Forging Sequence for Manufacturing Crank Shaft:** [1] Stock is redistributed and size is increased at certain place and reduced at other place by roll forging.  [2] After preliminary roll forging, stock is again roll forged. 	

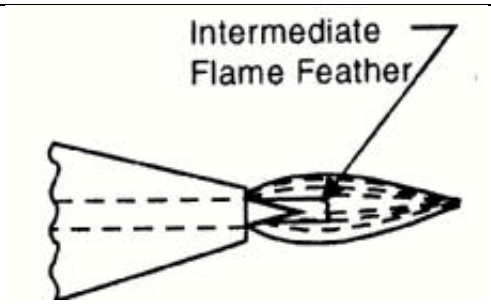
		[3] This stock is then forged in first impression or blocking die.  [4] The final shape is given to the forging in next blocking die.  [5] Then the finished part is then trimmed in blanking die to remove excess metal or flash. 	
	b	**Classify forging. State Fullering**	**04**
		Answer: Classification of forging processes *(Any four)* **1.Open die forging:** a) Hand forging b) Power forging: i. Hammer forging ii. Press forging **2.Close die forging:** a) Drop forging b) Press forging c) Machine forging **Fullering:**  **Figure. Fullering operation** In Fullering, the material cross section is decreased and length is increased. Figure shows that the bottom fuller is kept in the anvil hole with the heated stock over the fuller. The top fuller is then kept above the stock and then with the sledge hammer. The force is applied on the top fuller which results in decreasing the cross section at that point.	**02** **01** **01**

	c	**State terminology used in presses**	**04**
		Answer: Shut Height- The space available between the press bed or bolster and the slide or ram is called the ***shut height.*** It is always measured with the press ***shut*** or at bottom dead center. It may be specified as the vertical space between the ram and either the top of the bed or bolster **Bed and Bolster-** The bolster adds stiffness to the press bed and has tapped holes, or preferably T-slots, to permit the die to be fastened in the press. T-slots permit dies to be changed quickly and fastened in the press more securely than tapped holes. **Press Frame Members-**The strength of the parts that make up the framework or housing of presses determines the force capacity of the machine. Heavy frames limit deflection and help damp harmful vibrations. **BRAKE-**The friction mechanism used to stop or control the motion of a press, feed or other mechanism. Brake stopping time must be monitored in MS / milliseconds to assure that the press slide stops within a safe acceptable limit. **CLUTCH -**A coupling used to connect or disconnect a driving machine-member, such as a shaft or wheel, to or from a driven machine-member, such as another wheel or shaft. The engaging or disengaging can be done by a hand operated controlling device operated manually or automatically. **FLYWHEEL -**A wheel used on an engine or machine with a rotation energy or inertia able to prevent excessive or sudden changes in speed. In modern mechanical presses the flywheel is usually driven by multiple belts from the main motor pulley to the flywheel. A clutch is mounted on or within the flywheel which, when engaged starts slide movement **STROKE-**The reciprocating motion of a press slide, usually specified as the number of inches between the terminal points of the motion. Stroke length relates to speed ranges, the longer the stroke the slower the press speed range.	**04(Any Four)**
	d	**Explain fly press with neat sketch**	**04**
		Answer:*(sketch - 2 marks, construction- 1 mark, working -1mark)* **Fly press Construction: -** It is simplest type of all presses, called as hand press / ball press/single side fly press. It consists of robust cast iron frame. Top portion of frame forms the nut. Vertical screws which can 2 go through the nut. Screw carries an arm. Arm supports two cast iron weights (balls) at two ends. Handle used for rotating the arm. Frame extended below the nut to form guides. Ram attached at the bottom of the screw. Ram carries punch at its bottom. Die is fixed at the press base. **Working: -** Sheet metal placed over the die. Arm gets quick rotation with the help of handle. Heavy balls stores kinetic energy for long time movement of screw. Movement of screw causes movement of 2 ram & punch downwards. Stroke of the collar adjusted with help of Stop Collar / Arrestor. Advance type of fly press is double side Press.	**01** **01**

		 Fly press **Or** 	**02**
	e	**Explain material used in press work for automobile applications**	**04**
		Answer: Materials used in press work *(Any four - 1/2 Marks Each)* 1) Aluminium, 2) copper, 3) brass, 4) mild steel, 5) Galvanized iron (G.I) sheets, 6) Duralumin, 7) Y-alloys, 8) naval brass, 9) cartridge brass, 10) Babbitt metal, 11) stainless steel & its alloys, 12) Different types of steels & its alloys.	**04**

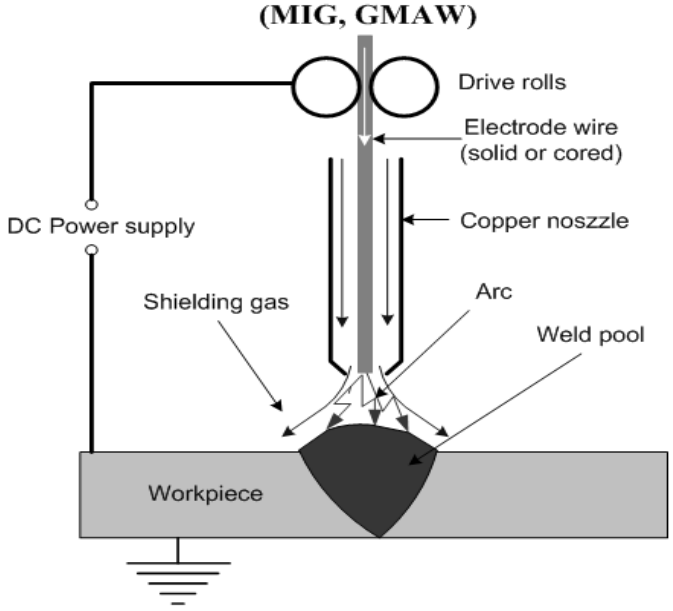
	f	**Enlist die accessories and state function of knock out**	**04**
		Answer: ***(Note: Listing – 2marks & Explanation of knock out neat sketch –2 marks)*** **Die Accessories are as follows:** ***(Any two -1/2 Mark Each)*** 1) Stops a)Button stop b) Lever stop 2) Pilot a)Direct pilot b)Indirect Pilot 3) Knock out 4) Strippers a) Fixed stripper b) Spring loaded strippers 5) Pressure Pad **Knock out:** The function of knock out is to eject the finished components from the die cavity.  1. Stripper, 2. Die holder, 3. Dic, 4. Plate, 5. Knockout plate, 6. Punch.	**02** **02**
03		**Attempt any four of the following**	**16**
	a)	**Explain the compound die with neat sketch.**	**04**
		Answer: ***(Note: Explanation – 02 marks & Sketch – 02 marks)*** In these dies, two or more operations can be performed at one station. Such dies are considered as cutting tools. As shown in fig No. the washer is produced by simultaneous operation of blanking and piercing. These dies are economical for mass production. These dies can be modified to combine more than one operation on single station. The blanking operation on the metal sheet is carried out by the telescopic action of the upper and lower dies as the upper dies descend. At the same time that the blank is cut the punch parts a hole in the center of the blank. Compound dies make close tolerance and concentric parts	**02**

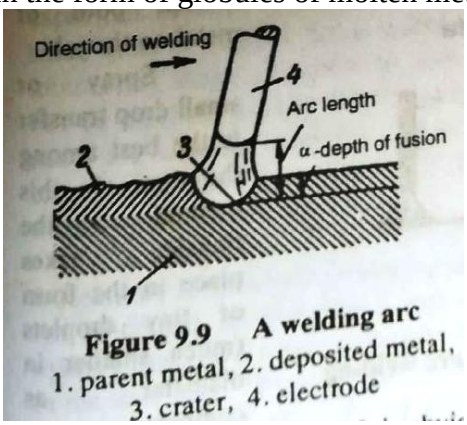
		as all work is done in one stroke.  **Figure: compound die**	**02**
	b)	**Name the types of flames with application.**	**04**
		Answer: *(Types- 2 marks, applications -2 marks)* 1) **Neutral Flame**: - A neutral flame is obtained when equal amounts of oxygen and acetylene are mixed and burnt in a torch.  **Applications**: - stainless steel, cast iron, copper, mild steel and aluminum 2) **Oxidizing Flame: -** If more oxygen is added, the cone becomes darker and more pointed, while the envelope becomes shorter and is called Oxidizing flame  **Applications**: - copper base alloy, zinc base metal, Brass and Bronze 3) **Carburizing Flame**: A carburizing or reducing flame is obtained when acetylene is supplied more than oxygen.	

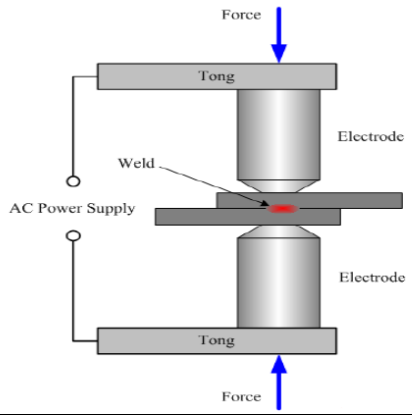
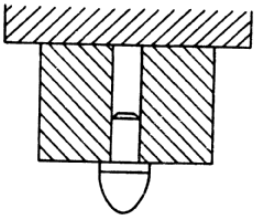
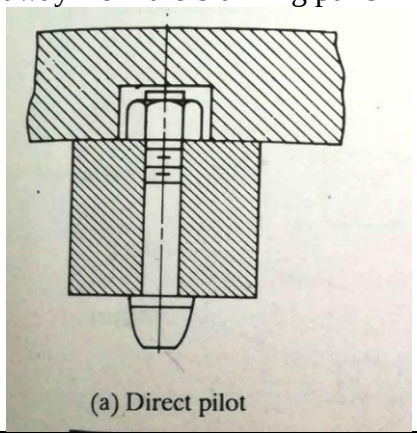
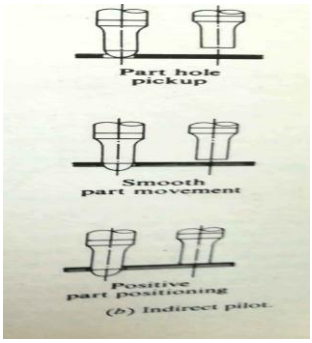


Applications:-high carbon steel, nonferrous alloy

	c)	**With neat sketch explain MIG welding**	**04**
		Answer: ***(Note: Explanation – 02 marks & Sketch – 02 marks)***	
		MIG Welding:	
		Gas-metal-arc welding is a gas shielded metal arc welding process which uses the high heat of an electric arc between a continuously fed, consumable electrode wire and the material to be welded. Metal is transferred through protected arc column to the work. In this process, the welding machine is a D.C. constant voltage which at a given wire feed rate will produce necessary current to produce arc. The wire is fed continuously from a reel through a gun to constant surface which imparts a current upon the wire. The welding gun is either air cooled or water cooled depending upon the current being used. The fused electrode material is supplied to the surfaces of the work pieces, fills the weld pool and forms joint. The welding area is flooded with a gas (an inert gas i.e. Argon, helium, CO2, argon + Oxygen or other gas mixtures) which will not combine with metal. Carbon dioxide is most commonly used as it inexpensive.	**02**
		Metal inert gas welding (MIG, GMAW)	**02**



	d)	**Describe the working principle of Arc Welding.**	
		Answer: ***(Note: Explanation – 02 marks & Sketch – 02 marks)*** Arc welding is the most extensively employed method of joining metal parts. Here the source of heat is an electric arc. The arc column is generated between an anode which is the positive pole of D.C. power supply and the cathode negative pole. When this two conductor of an electric circuits are brought together and separated for a small distance to 2 to 4 mm such that the current continue to flow through a path of a ionized particles called plasma and electric arc is formed. The heat of the arc rises the temperature of the parent metal which is melted forming a pool of molten metal. The electrode metal or a welding rod is also melted and is transferred in to the metal in the form of globules of molten metal.  **Figure 9.9 A welding arc** 1. parent metal, 2. deposited metal, 3. crater, 4. electrode **Figure: Arc Welding**	**02** **02**
	e)	**Describe resistance welding with neat sketch.**	**04**
		Answer: ***(Note: Explanation – 02 marks & Sketch – 02 marks)*** **Resistance Welding:** Resistance welding is a group of welding processes wherein coalescence is produced by the heat obtained from resistance of the work to the flow of electric current in a circuit of which the work is a part and by the application of pressure. No filler material is needed. Resistance welding is employed to join overlapping strips, sheets or plates of metal at small areas .The pieces are assembled between two electrodes, which must possess high electrical and thermal conductivity and retain the required strength at high temperatures, so they are made of pure copper for a limited amount of service, and of alloys of copper or tungsten, or copper and chromium for continuous working. When current is turned on, the pieces are heated at their contacts to a welding temperature, and with the aid of mechanical pressure the electrodes are forced against the metal to be welded.	**02**

			02
	f)	**Explain with neat sketch pilots and its types.**	**04**
		Answer: ***(Note: Explanation – 02 marks & Sketch – 02 marks)*** The pilot illustrated in Fig. enables the correct location of the blank when it is fed by mechanical means. The pilot enters into the previously pierced hole and moves the blank to the correct position to be finally spaced by the stops. The pilots are fitted to the punch holders.  **Types of Pilots** Direct pilot and Indirect pilot. Direct Pilot: The pilot which are mounted on the face of punch are called direct pilot. The pilot holder is generally a block of steel which can be fastened to the punch holder. Indirect Pilot: It is not always necessary to fix a pilot to the bottom of a blanking punch the pilots may be independent of the blanking punch and directly retained in the punch holder. They are designed to enter previous punched holes in the strips some distance away from the blanking punch  	**02** **02**

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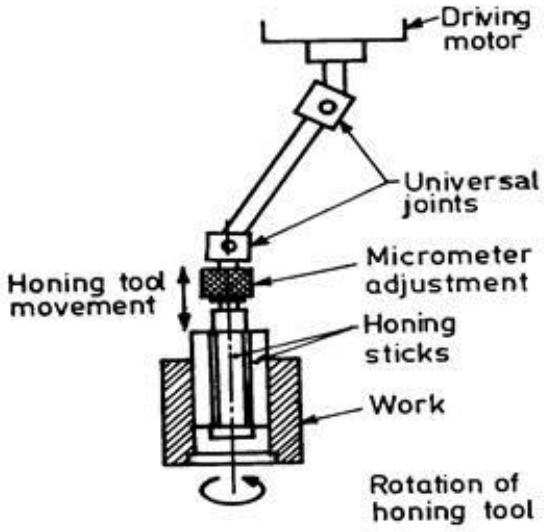
<table>
<tr><td>04</td><td></td><td colspan="2">Attempt any four of the following</td><td>16</td></tr>
<tr><td></td><td>a)</td><td colspan="2">Compare soldering with brazing.</td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Answer: Comparison of Brazing and Soldering (Any Four – 1 Mark Each)
<table>
<tr><th>Point</th><th>Soldering</th><th>Brazing</th></tr>
<tr><td>Temperatures used</td><td>below 470^0C</td><td>above 470^0C</td></tr>
<tr><td>Filler material</td><td>Solder.</td><td>Spelter.</td></tr>
<tr><td>Joint strength</td><td>Weak or less</td><td>More or strong.</td></tr>
<tr><td>Applications</td><td>Connections of radio & T.V. sets, wiring joints in electric connections & battery terminals, Radiator brass tube, copper tubing, Brass halved bearings etc.</td><td>Parts of bicycle such as frames & rims, Exhaust pipe in motor engine, band saw, tipped tool, pipe joints subjected to vibration etc.</td></tr>
</table></td><td>04</td></tr>
<tr><td></td><td>b)</td><td colspan="2">State blasting and tumbling.</td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Answer: (Note: Stating each process – 02 mark each)
1. Blasting (Abrasive blast cleaning):
This method is widely used for removing all classes of scale and rust from forgings, Castings, weld elements, and heat treated parts. Depending on the finish requirements, Blasting alone or blasting with pickling is used. In this process the parts are generally cleaned by the use of abrasive particles such as sand, steel grit or shot impelled against the surface to be cleaned. Some cleaning is performed by means of high-velocity air blast, with the blast directed by hand. In many cases, an airless blast machine that cleans by impact is also used. The abrasive is fed from an overhead storage hopper to the center of a radially rotating wheel, whereupon the metallic shot or grit is thrown in a controlled stream upon the work to be cleaned. All traces of sand, scale, oxides and other material are removed, providing an excellent surface for bonding final finishes.
2. Tumbling:
It is least expensive process for removing rust and scale from metal parts. This operation is accomplished by placing work pieces in a drum or barrel, together with stars, jacks, slugs, or abrasive materials. The abrasive materials can be sand, granite chips, and slag or aluminum oxide pallets. In this operation, the barrel is rotated and the movement of the work pieces and the accompanying slugs or abrasive materials against each other produces by friction a fine cutting action which removes fins, flashes, and scales from the products.</td><td>02

02</td></tr>
</table>

	c)	**Explain honing with neat sketch.**	
		Answer: ***(Note: Explanation – 02 marks & Sketch – 02 marks)*** **Honing Process (micro finishing process):** To correct hole geometry in component, honing is used as a micro finishing process**.** Honing is an abrading process used mainly for finishing round holes by means of bonded abrasive stones called hones. Honing is primarily used to correct out of roundness, taper, tool marks and axial distortion. Abrasives used in honing are Silicon carbide, aluminum oxide, diamond or cubic boron nitride. When honing is done manually; the honing tool is rotated and work piece is passed back and forth over the tool. Length of motion is such that the stones extend beyond the work piece surface at the end of each stroke. For precision honing, the work is usually held in a fixture and the tool is given a slow reciprocating motion as it rotates (shown in Fig.). The stones are thus given a complex motion as rotation is combined with oscillatory axial motion. These two motions combine to give a resulting cross-hatch lay pattern. Honing stones may be held in the honing head by cementing them into metal shells, which are clamped into holder or they are cemented directly into holders. Coolants are essential to the operation of this process, to flush away small chips and to keep temperatures uniform.  Fig. Honing.	**02** **02**

d) Compare galvanizing with electroplating.

Galvanizing Process	Electroplating process
1) In galvanizing the work is immersed in molten zinc. As it is withdrawn, the zinc cools and forms a coating of zinc on the work	1) In this the steel is immersed in an aqueous bath, and electricity is used to induce anodes to dissolve in the aqueous solution, transport the ions, and electroplate them onto the work.
2) Galvanized coatings are almost always several times thicker	2) Electroplating coatings are almost always several times thinner
3) Galvanizing may be spangled, or gray and drippy.	3) Electroplated zinc coatings can be smooth and shiny, and preferable for aesthetic reason
4) More corrosion resistant	4) Less corrosion resistant as compared with galvanizing
5) Galvanized coatings are heavy and will interfere with fastener threads unless they are specially dimensioned to take the coating into account	5) Electroplating is thin and usually does not cause any problems with fastener specially dimensioned to take the coating into account
6) Galvanized coatings are up to 10x as thick and applicable to outdoor or more wet climate	6) Electroplated zinc coatings are not often adequate for direct outdoor exposure. i.e. applicable to indoors in dry climate
7) Cost is more as it is significantly thicker	7) The cost should be significantly lower than the cost of hot dip galvanizing

1 mark each

e) State advantages of CNC over NC. **04**

Answer: Advantages of CNC over NC *(Any Eight - 1/2 Marks Each)*

1. Complex machining operations can be easily done.
2. It requires less inspection. 3. It reduces scrap & waste.
4. It gives high production rate.
5. It reduces human error
6. It gives more operator safety.
7. It gives more operator efficiency.
8. Tool life gets increased.
9. Lead time is reduced.
10. In case of CNC lathe the carbide tip tools are used hence cutting speed faster than conventional lathe & also high feed rate.
11. CNC lathe movement is controlled by computer (which runs the program while in conventional lathe manual or auto feed is given. More flexibility available in CNC lathe.
12. CNC lathe can achieve higher accuracy with closed tolerance and very good surface

finish as compared to conventional lathe.
13. Once the program is prepared and fed, less manual interference required in case of CNC lathe hence less skill operator can work on the machine.
14. Though the initial cost of CNC lathe is more but for mass production and accuracy and quality job CNC lathe has very good option than conventional lathe.
15. Program can be stored in the memory and can be used when ever required in batch production. Such facility is not available in conventional lathe.
16. Machines are comparatively small; need not required rigid foundations as conventional machines. Less vibration.
17. For superior repeatability, reduce machine down time as fast machining cycle.
18. Tool path simulation is available in CNC lathe which gives idea about job. This feature is not available in conventional machine

f) Compare absolute with incremental coordinate system (Four points) — **04**

Any four- (each 01 mark)

Absolute coordinate system	Incremental coordinate system
Coordinates of points are always referred with the reference to same datum	Coordinates of any points are calculated with reference to the previous points
The datum is defined by the user before starting operation	The datum is taken as where the cutting tool is currently lying
Very easy to check and correct a program written using this method	It is difficult to check the part program written using this method
If mistake committed in the dimension, it will affect only on that dimensions	If mistake committed in the dimension, it will affect on all dimensions
It is always preferable to write the main program with this system	It is always preferable to write the subroutine program with this system

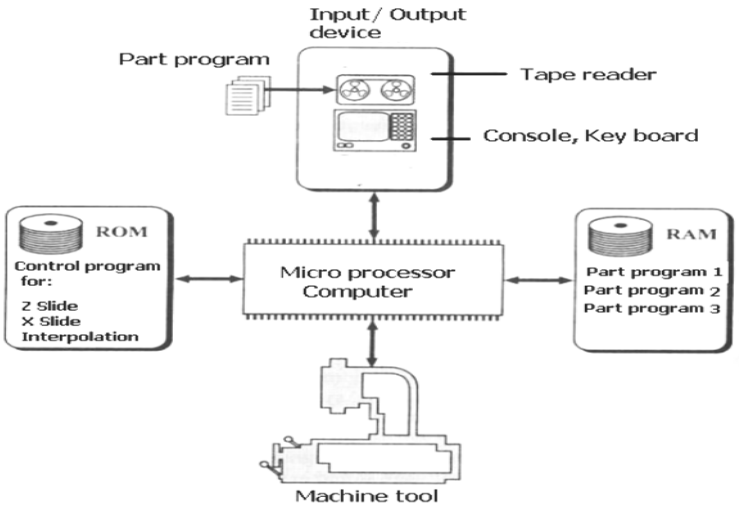
Q. [5] (a) Attempt any Four of the Following: (4 x 4 =16) — **16**

Explain working principle of CNC Machine. — **04**

Working principle of CNC Machine:

(3 Marks for working principle, 1 Mark for suitable sketch. Equivalent credit shall be considered to any suitable points other than below mentioned.)

In CNC machine, tape reader or any other input media is used for entry of part program. In CNC, entire program is first feed to the inbuilt computer memory. Once the program is stored, the machine cycle is then executed by the program. Software with control algorithms converts part program instruction into actions by the machine tool. This is done by generating pulses for each axis from the controller. Each pulse produces one small unit of motion (SUM). The slide travel is thus decided by the number of pulses. In a closed loop system, the pulses are feed to reference. The feedback device also send signal to the reference. These two signals are compared and necessary action is controlled.

		Or *In case of Computer Numerical Control (CNC) machine tools, a dedicated computer is used to perform all the basic NC functions.* The complete part programme to produce a component is input and stored in the computer memory and the information for each operation is fed to the machine tools, i.e. motors, etc. the part programmes can be stored in the memory of the computer and used in future.  **Figure: Working Principle of CNC Machine**	
	b)	**Explain Closed loop and Open loop system with sketch.**	**04**
		(2 Marks for Closed loop system with suitable sketch, 2 Marks for Open Loop System with suitable sketch) **Closed Loop System:** [1] *The name indicates that the closed loop control system has a loop that is closed* as shown in figure. [2] A feedback device is used for this purpose. This makes the design of closed loop a little complicated and expensive. [3] But a very high degree of accuracy is achieved in the movement of slide. [4] This system is similar to open loop control system. But it consists of two additional devices in the form of feedback transducer and a comparator. [5] The transducer feedbacks the actual slide displacement to the comparator. [6] The comparator compares the actually achieved slide movement with command signal. If there is any error then it is feedback to the Machine Control Unit (MCU). [7] The MCU then sends the corrective commands to the drive unit and the cycle repeats until there is no error signal from the comparator. [8] Nowadays, almost all CNC machines use this control system.	

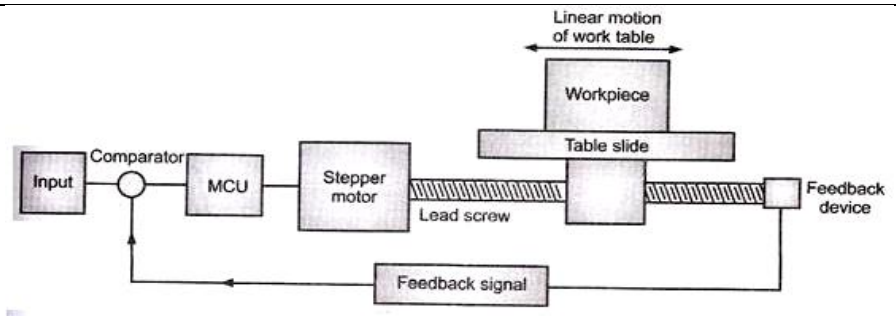


Figure: Closed Loop Control System

Open Loop System:

[1] *The term open-loop means that there is no feedback, and in open loop systems the motion controller produces outputs depending only on its set points, without feedback information.*

[2] Machine Tool Controls in which there is no provision to compare the actual position of the cutting tool or work piece with the input command value, are called Open loop systems.

[3] In this, the electric motor continues to run until the absence of power from input command signal, indicates that the programmed location has been attained.

[4] There is no monitoring of the actual displacement of the machine slide.

[5] In this system, the control may indicate a movement of 50 mm whereas actually the slide may have moved only 49.8 mm.

[6] Open loop system are less accurate compared to a closed loop system, but it is less expensive than closed loop system due to the absence of monitoring devices and their maintenance is not complicated.

[7] For these reasons, the open-loop system is generally used in point-to-point systems where the accuracy requirements are not critical.

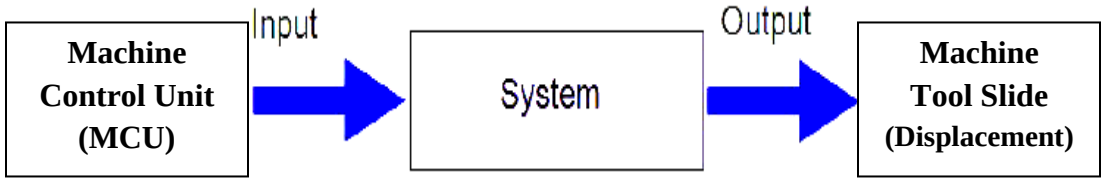


Figure: Open Loop Control System

	c)	**State canned cycle & subroutines.**	**04**
		(2 Marks for appropriate statements of canned cycle, 2 Marks for appropriate statements of Subroutines) **Canned cycle (Fixed cycle):** *It is defined as a set of instructions, inbuilt or stored in the system memory, to perform a fixed sequence of operations.* [1] It reduces programming time and effort. [2] Canned cycle is used for repetitive and commonly used machining operations. [3] To save the repetition of programming of common operations, the cycle is used called affixed cycle/canned cycle. [4] The sequence of standard cycle of operation is stored in the memory of the computer. [5] When that information is required at the time of machining is activated from memory, by using proper G–code. [6] One of the most frequently used canned cycles is the drilling cycles. **Subroutines:** *Subroutine called, subprogrammes, are a powerful time saving technique. It provides the capability of programming certain fixed sequence or frequently repeated operations. These are independent programs with all the operations of a usual part program.* [1] Subroutines are stored in the memory under separate program numbers. [2] When particular operation is required in the program, the associated subroutine is called for completing the operation. [3] Subroutine also called as sub programs. [4] After completion of subroutine the control returns to main program.	
	d)	**State procedure for developing part program.**	**04**
		Procedure for developing part program: ***(04 Marks for Any one method mentioned below)*** **Manual Part Programming:** To prepare a part program using the manual method; [1] The programmer writes the machining instructions on a special form called a part programming manuscript. The manuscript is a listing of the relative tool and work piece location. [2] The NC tape is prepared directly from the manuscript. [3] Define the axis coordinates in relation to the work part. [4] Define safe (target point)point & origin point (work zero) [5] The tape is inserted to read the first block in to the system. [6] The function like machining, tool changing, spindle ON/OFF, coolant ON/OFF, program stop and tape rewinding are carried out as per the program.	

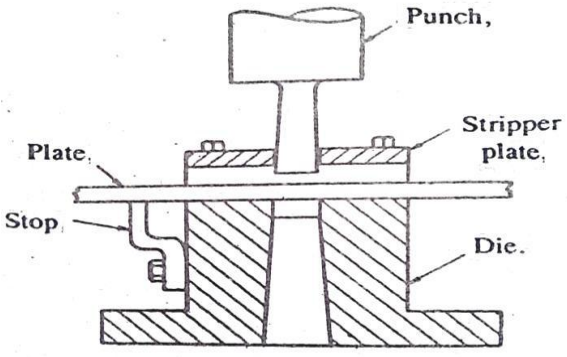
		OR **Computer Assisted Part Programming:** This method is useful for most critical and complex parts. The part programmer and the computer are the main tool in this method. [1] The part programmer first defines the work part geometry. [2] He specifies the operation sequence and tool path. [3] The computer interprets the list of part programming instructions, performs the necessary calculations to convert this into a detailed set of machine tool motion commands, and then controls a tape device to prepare the tape. [4] The tape is verified for accuracy. [5] The NC system machine makes the part according to the instructions on tape.	
	e)	**State function of preparatory and miscellaneous code with two examples each.**	**04**
		1 & ½ Marks for Function of Preparatory Code & ½ Mark for suitable examples, ***1 & ½ Marks for Miscellaneous Code & ½ Mark for suitable examples)*** **Function of Preparatory Code (G-Code):** *Preparatory functions are the G-codes that identify the type of activities the machine will execute.* [1] A program block may contain one or more G-codes. [2] G codes are designated by the letter G and a two digit numeric value proceeded by G i.e. G00, G99. [3] 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. [4] The preparatory function enables the controller to interpret the data which follows and it precedes the coordinate words. E.g. G01 is used to prepare the controller for linear interpolation. **Examples of Preparatory Function (G-Code): *(Any two)*** Some examples of preparatory functions are given below; G00 Rapid Traverse G01 Linear Interpolation G02 Circular Interpolation (Clockwise) G03 Circular Interpolation (Counter Clockwise) G04 Dwell G05 Hold/Delay **Function of Miscellaneous Code (M-Code):** *The miscellaneous function word is used to specify certain miscellaneous or auxiliary functions which do not relate the dimensional movements of the machine.* [1] The M word is used to specify certain miscellaneous function such as spindle starts, spindle stop, coolant ON/OFF etc. [2] The miscellaneous function as are those functions which do not related to the dimensional movement of the machine. [3] These function actually operate some control on the machine. E.g. M02 which indicate end of program.	

		Examples of Miscellaneous Function (M-Code): ***(Any two)*** M00 Program Stop M01 Optional Stop M02 Program End Without Rewind M03 Spindle ON Clockwise (CW) Rotation M06 Tool Change M08 Coolant On M09 Coolant Off M30 Program Stop and Tape Rewind	
	f)	**Give application of lapping, honing, buffing and burnishing.**	**04**
		(Enlist any two suitable applications of each process, ½ Mark for each application) **Applications of Lapping:** *(List any two, Each of ½ Mark)* Press work dies, Moulding dies, Limit gauges, Surface plates, Engine valve and valve seat, Races of ball and roller bearings, Gears, Piston rings, Slip gauges, Crankshaft. **Applications of Honing:** *(List any two, Each of ½ Mark)* Engine cylinder, bearings, gun barrels, ring gauges, shafts and flange faces, piston pin, automobile crankshaft journals **Applications of Buffing:** *(List any two, Each of ½ Mark)* Automobiles, motor-cycles, boats, bicycles, sporting items, tools, store fixtures, commercial and residential hardware and household utensils and appliances. **Applications of Burnishing:** *(List any two, Each of ½ Mark)* For various flat, tapered, conical and cylindrical surfaces, to remove scratches and tool marks on the surface. Burnishing components are Cam & followers, matting parts of engine, aesthetical components etc.	
Q. 6		**Attempt any TWO of the Following: (2 x 8 = 16)**	**16**
	(a)	**Enlist press operations (any eight). Explain lancing and piercing.**	**08**
		(Enlist any eight appropriate operations, ½ Mark for each, Brief Description of Lancing & Piercing Operation, each of 2 Marks) **Press Operations:** (*Enlist any eight appropriate operations, ½ Mark for each)* **[1] Cutting or Shearing Operations:** Blanking, Punching, Piercing, Notching, perforating, trimming, shaving, slitting, lancing. **[2] Bending Operation:** Angle bending **[3] Forming Operations:** Flanging, curling, wiring, tube forming, stretch forming, embossing **[4] Drawing Operations:** Cupping, redrawing, Reverse redrawing, deep drawing, panel drawing, bulging.	

[5] Reducing Operations: Ironing, necking, redrawing
[6] Squeezing Operation: Coining, sizing, swaging, hot pressing.
Lancing operation: *(2 Marks for Brief Description of Lancing Operation)*
The lancing is the operation of cutting a sheet metal through part of its length and then bending the cut portion. It is the operation of cutting through a metal sheet partially without removing any material, in which a hole is partially cut and then one side is bent down to form a sort of tab or louver. Since no metal is removed, there will be no scrap. This operation commonly incorporates a single shear angle on the face of the punch.

Figure: Lancing Operation

Piercing: *(2 Marks for Brief Description of Piercing Operation)*
The piercing is the operation of production of hole in a sheet metal by the punch and the die. The materials punched out to form the hole constitute the waste. The punch point diameter in the case of piercing is less than or equal to the work material thickness. The punch governs the size of the hole and clearance is provided on the die. Figure shows punch and die set for piercing.



Punch and die set up for piercing, punching and blanking

	(b)	**Write a part program by absolute mode to reduce diameter of bar from 34 mm to 26 mm. (Refer Fig. No. 1)**	**08**
		(***Equivalent credit shall be considered to appropriate steps of part program, 01 Marks for Tool Movement on sketch, 1 Marks for Tool Position Table, 06 Marks for Part Program)***	

Let,

Spindle Speed (S) = 350 rpm

Feed (F) = 0.4 mm/rev.

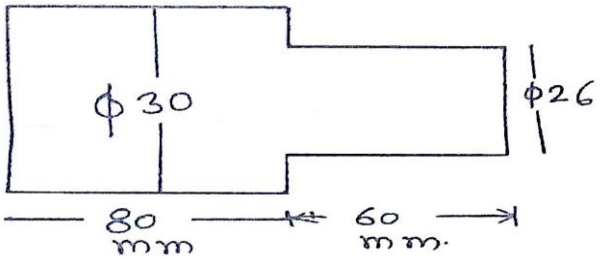


Fig. No. 1

The tool movements for removal of material from the work piece to be obtained required components are shown in below figure.

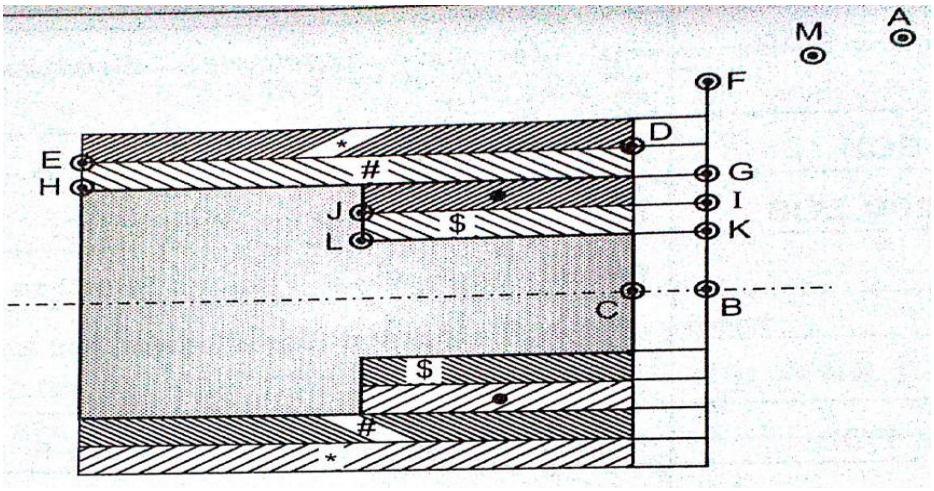


Figure: Tool Movement

X & Y Coordinates for Various Tool Positions

Position No.	X & Y Coordinates
A	Machine home position
B	0, 2
C	0,0
D	32, 0
E	32, -140
F	36, 02
G	30, 02
H	30, -140
I	28, 02
J	28, -60
K	26, 02
L	26, -60
M	85, 50

Stepwise Part Program:

Program	Description
N110 G90 G21 G94 EOB	Absolute mode, input in mm, feed in mm/min.
N120 M03 S800 M08 EOB	Spindle start clockwise direction, spindle speed, coolant On
N130 G00 X0 Z2 EOB	Rapid travel of tool to position B
N140 G01 Z 0 F 200 EOB	Movement of tool to position C
N150 X32 EOB	Facing operation. Tool at position D
N160 Z -140 EOB	Turning to diameter 32 mm for length of 140 mm (Position E)
N170 G00 X36 Z2 EOB	Rapid travel of tool to position F
N180 G01 X30 F200 EOB	Movement of tool to position G
N190 Z -140 EOB	Tuning to diameter 30 mm for length of 140 mm (Position H)
N200 G00 X36 Z2 EOB	Rapid travel of tool to position F
N210 G01 X28 F200 EOB	Movement of tool to position I
N220 Z-60 F200 EOB	Turning to diameter 28 mm for a length of 60 mm (Position J)
N230 G00 X36 Z2 EOB	Rapid travel of tool to position F
N240 G01 X26 F200 EOB	Movement of tool to position K
N250 Z-60 F200 EOB	Turning to diameter 26 mm for length of 60 mm (Position L)
N260 G00 X80 Z50 EOB	Rapid travel of tool away from the work piece (Position M)
N270 G28 EOB	Rapid return to machine reference position

		N280 M05 EOB	Spindle stop	
		N290 M09 EOB	Coolant off	
		N300 M30 EOB	Program end and tape rewind	
	(c)	**Prepare a program to drill two holes shown in figure No. 2. Plate thickness is 10 mm. Use incremental mode.**		**08**
		(***Equivalent credit shall be considered to suitable and appropriate steps of part Program, 01 Marks for Tool position on sketch, 01 Marks for Tool Position Table, 06 Marks for Part Program)***		

Assume:

1. The cutting tool diameter is 10 mm. reference plane is at the top surface of the plate.
2. ***For incremental mode*** spindle is manually positioned to the tool change position. In this case it is (-10, -10, 5).

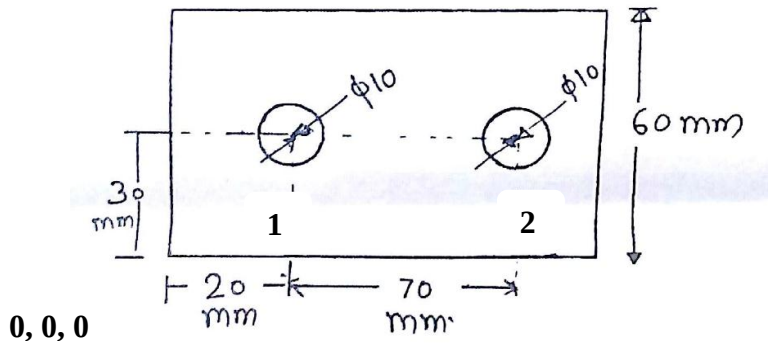


Fig. No. 2

X & Y Coordinates for Various Tool Positions

Position No.	X & Y Coordinates
1	30,20
2	70,00

Stepwise Part Program:

Program	Description
N110 G91 G21 G94 EOB	***Incremental mode***, input in mm, feed in mm/min, tool diameter compensation cancel.
N120 M03 S1100 M08 EOB	Spindle starts clockwise direction, spindle speed, coolant ON.
N130 G00 X30 Y40 Z5 EOB	Tool travel to position 1 (30, 40), and 5 mm above the W/p.
N140 G01 Z15 F90 EOB	Movement of tool 10 mm inside the W/p (Drilling). Total Tool movement is 15 mm in Z direction.

		N150 G00 Z15 EOB	Rapid travel of tool to 5 mm above the plate surface.		
		N160 G00 X70 EOB	Rapid travel of tool to position 2 (70, 00).		
		N170 G01 Z-15 F90 EOB	Movement of tool 10 mm inside the W/p (Drilling).		
		N180 G00 Z15 EOB	Rapid travel of tool to 5 mm above the plate surface.		
		N190 G28 EOB	Rapid return to machine reference position.		
		N200 M05 EOB	Spindle stop.		
		N210 M09 EOB	Coolant off.		
		N220 M30 EOB	Program end and tape rewind.		