SUMMER – 19 EXAMINATION

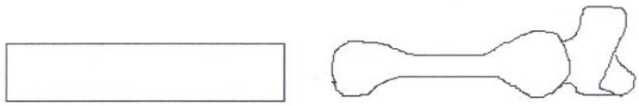
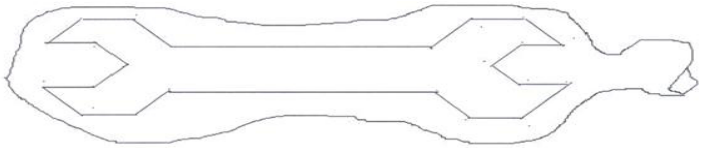
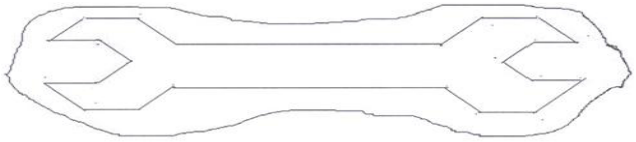
Subject Name: A M P **Model Answer** Subje 22439

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		**Attempt any FIVE of the following:**	10
	(a)	**Define term 'Forgeability'.**	02
	Ans	*(Correct Ans. 02 Mark)* **Forgeability:** The ability of material to undergo deformation by the force applied on it, without rupture. **OR** **Forgeability:** 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.	*Correct Ans. 02 Mark*
	(b)	**Enlist any four Press Operations.**	02
	Ans	*(Any Four 1/2 Mark each)* (1) Punching (2) Piercing (3) Blanking (4) Notching (5) Lancing (6) Drawing (7) Cupping (8) Coining (9) Embossing.	*Any Four 1/2 Mark each*
	(c)	**List any four Automobile Parts made from the Press Working Operations.**	02
	Ans	*(Any Four 1/2 Mark each)* **Four automobile Parts made from the press working operations:** (i) Washer (ii) Switch Panels (iii) Steel Net (iv) Cage (v) Filters (vi) Fuel Tank (vii) Wheel Rims (viii) Cover Plates (ix) Clamps (x)Frames Channels (xi) Side Panel (xii) Door Panels	*Any Four 1/2 Mark each*

		(xiii) Bonnets (xiv) Fenders (xv) Motor Cover Bracket (xvi) Automotive Body Panels (xvii) Filter Cap Brackets	
	(d)	**List the factors depends on Weldability.**	**02**
	Ans	***(Any Four 1/2 Mark each)*** **Factors Depends on Weldability:** 1. Material Grade, Material Thickness, Design, Weld Property Requirement 2. Equipment Type, Edge Preparation Design 3. Tip / Work Piece Distance, Electrode Angle 4. Current, Arc Voltage, Welding Speed 5. Availability of Equipment 6. Repetitiveness of the Operation 7. Quality Requirements (Base Metal Penetration, Consistency, Etc.) 8. Location of Work 9. Materials to be Joined i.e. Base Metal Composition 10. Appearance of the Finished Product 11. Size of the Parts to be Joined 12. Time Available for Work 13. Skill Experience of Workers 14. Cost of Materials 15. Code or Specification requirements 16. Mechanical Properties desired in Joints	*Any Four 1/2 Mark each*
	(e)	**Name four Surface Coating Processes.**	**02**
	Ans	***(Any Four 1/2 Mark each)*** **Surface Coating Processes:** **1) Metallic Coating** (A) Electroplating (B) Hot-Dipping (C) Galvanizing (D) Metal Spraying or Metalizing **2) Plastic Coating** **3) Organic Coating** **4) Inorganic Coatings** (A) Enameling of Metals (B) Ceramic Coating **5) Conversion Coating** (A) Phosphate Coatings (B) Chromate Coating (C) Oxide Coating (D) Anodic Coating **6) Other Metal Coating Processes** (A) Colorizing (B) Radio-Frequency Sputtering C) Electro less Plating	*Any Four 1/2 Mark each*
	(f)	**State the Significance of Machine Reference Point for CNC.**	**02**
	Ans	***(Any Two 01 Mark each)*** **Significance of Machine Reference Point:** (1) At this point coordinates of all axes are zero. (2) Tool moves with respect to this point and position of all axes can be seen on computer screen. (3) Machine reference point is decided by manufacturer of machine.	*Any Two 01 Mark each*
	(g)	**List four advantages of CNC machine over Conventional Machine.**	**02**
	Ans	***(Any Four 1/2 Mark each)*** **Advantages of CNC Machines:**	*Any Four 1/2 Mark*

		(1) Greater Machine Utilization. (2) It Gives High Degree of Accuracy (3) Complex Machining Operations can be easily done. (4) It Requires Less Inspection. (5) It Reduces Scrap & Waste. (6) It Gives High Production Rate. (7) Elimination of Operator Error (8) It Gives More Operator Safety. (9) It Gives More Operator Efficiency. (10) It Reduces Space Requirements (11)Flexibility in Changes of Component Design (12) Lead Time is Reduced. (13) Tool Life gets Increased. (14) Accurate Costing & Scheduling (15) Elimination of Special Jigs And Fixtures	*each*
2		**Attempt any THREE of the following:**	**12**
	(a)	**Describe Forging Sequence for the Production of Spanner.**	**04**
	Ans	***(List of operation sequence 01 ½ Mark and its sketch ½ mark each)*** **Forging sequence for manufacturing spanner (Any four steps – 1 Mark Each)** **a. Fullering:**  **b. Edging:**  **c. Blocking:**  **d. Finishing**  **e. Trimming** 	*List of operation sequence 01 ½ Mark and its sketch ½ mark each*
	(b)	**Explain working of Fly Press with neat sketch.**	**04**
	Ans	***(Working 02 Marks and neat labeled Sketch 02 Marks)*** **Working of Fly Press:-** 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 ram & punch downwards. Stroke of the collar adjusted with help of Stop Collar / Arrestor. Advance type of fly press is double side Press.	*Working 02 Marks and*

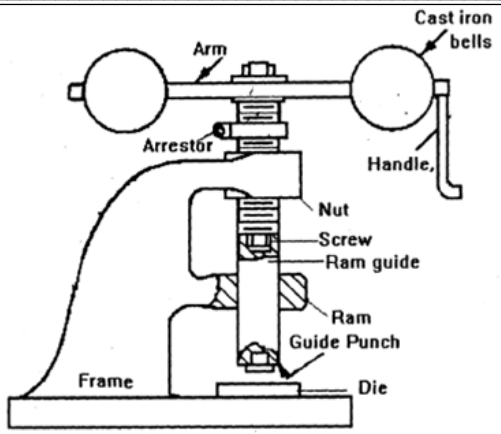


Figure: Fly Press

neat labeled Sketch 02 Marks

(c) Explain TIG welding process **04**

Ans ***(Working 02 Marks and Sketch 02 Marks)***

Tungsten Inert Gas Arc Welding (TIG, GTAW):

It is a welding process, in which heat is generated by an electric arc struck between a non-consumable tungsten electrode and the work piece. The weld pool is shielded by an inert gas (Argon, helium, Nitrogen) protecting the molten metal from atmospheric contamination. The heat produced by the arc melts the work pieces edges and joins them. Filler rod may be used, if required. Tungsten Inert Gas Arc Welding produces a high quality weld of most of metals. Flux is not used in the process.

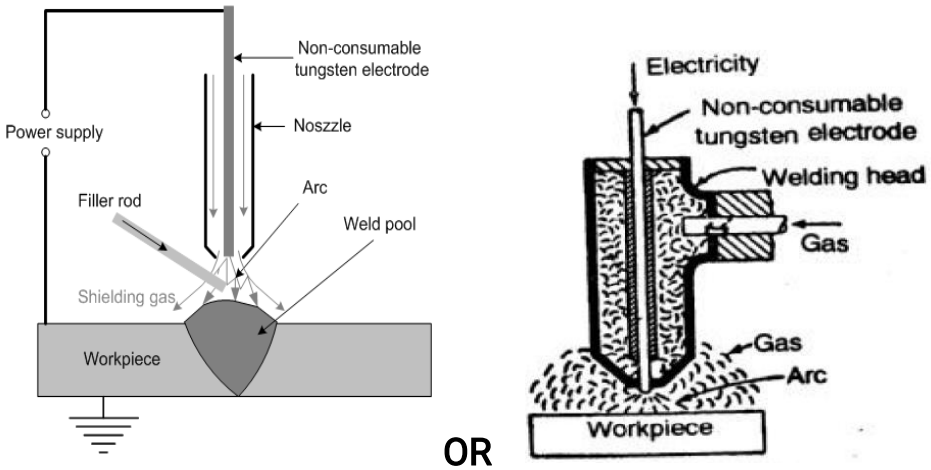


Figure: TIG Welding

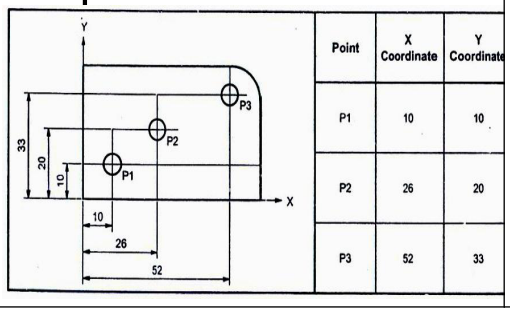
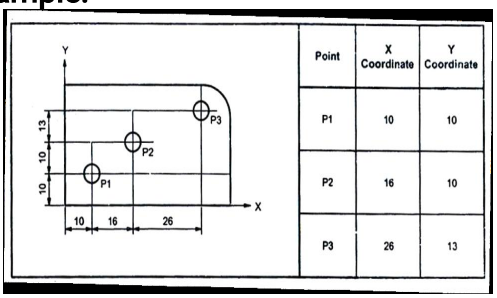
Working02 Marks and Sketch 02 Marks

(d) Compare absolute with incremental coordinate system(Four Points) **04**

Ans ***(Any Four Points 01 Mark each)***

SN	Absolute Coordinate System	Incremental Coordinate System
1	The coordinate will measured with respect to the origin of the co-ordinate system also called zero point.	The co-ordinate of any point is calculated with reference to the previous point.
2	It Is easy to check and correct the program	It is difficult to check the part program written in incremental mode
3	The main advantage of the	In incremental system, any time the

Any Four Points 01 Mark each

			absolute system as compared with the incremental system , is in the case of interruption that force the operator to stop the machine	work is interrupted , before switching on again, the operator must bring the tool manually to the exact place of the last operation occurred.	
		4	Almost all the point to point positioning system used absolute system.	Incremental systems are not often used for controlling point to point machine tools.	
		5	Absolute system is used for general program	Incremental system is used for canned cycle, do loop and subroutine program.	
		6	G90 code is used for Absolute Coordinate System in CNC program	G91 code is used for Incremental Coordinate System in CNC program	
		6	**Example:**  <table><tr><th>Point</th><th>X Coordinate</th><th>Y Coordinate</th></tr><tr><td>P1</td><td>10</td><td>10</td></tr><tr><td>P2</td><td>26</td><td>20</td></tr><tr><td>P3</td><td>52</td><td>33</td></tr></table>	**Example:**  <table><tr><th>Point</th><th>X Coordinate</th><th>Y Coordinate</th></tr><tr><td>P1</td><td>10</td><td>10</td></tr><tr><td>P2</td><td>16</td><td>10</td></tr><tr><td>P3</td><td>26</td><td>13</td></tr></table>	
3		**Attempt any THREE of the following:**			**12**
	(a)	**Classify forging processes.**			**04**
	Ans	***(Correct Answer 04 Marks)*** **Classification of Forging Process:** **(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 **OR**			*Correct Answer 04 Marks*

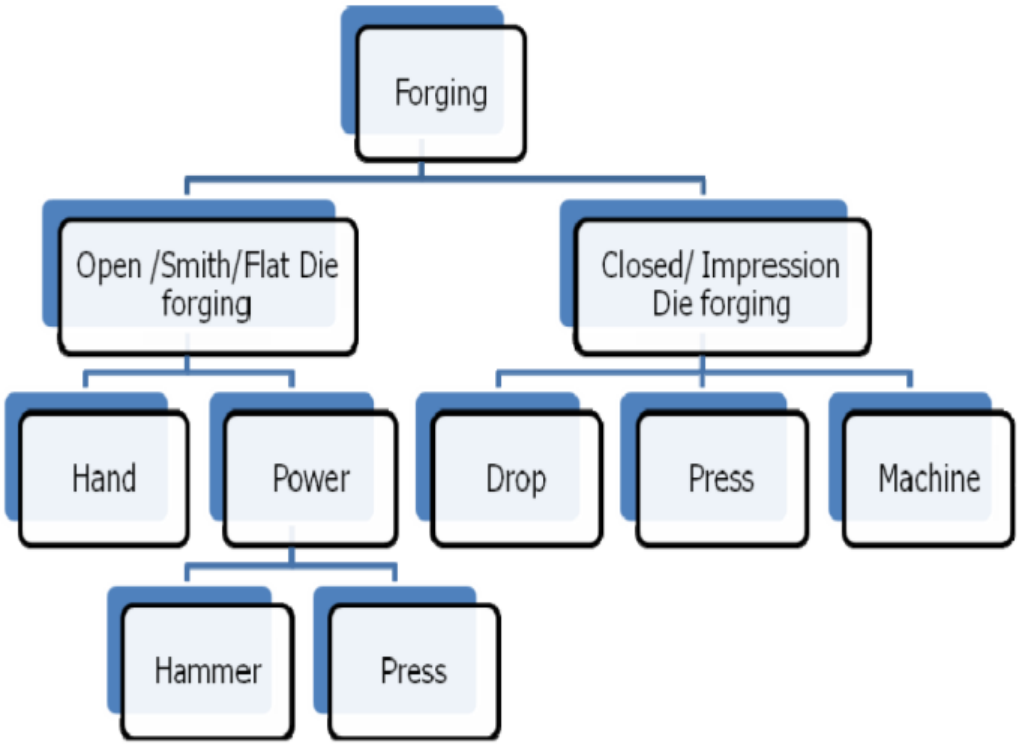
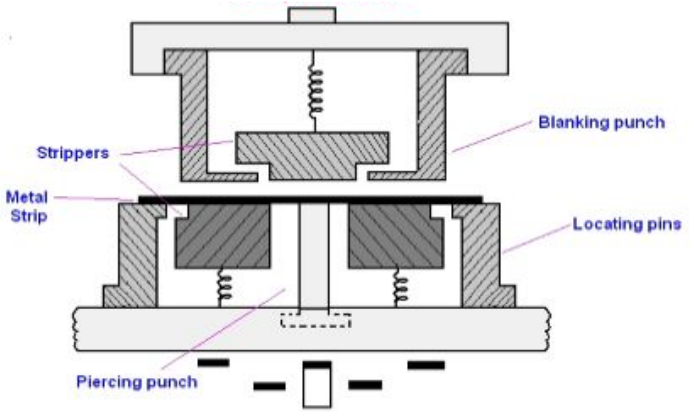
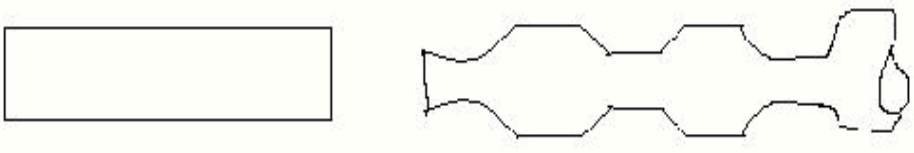
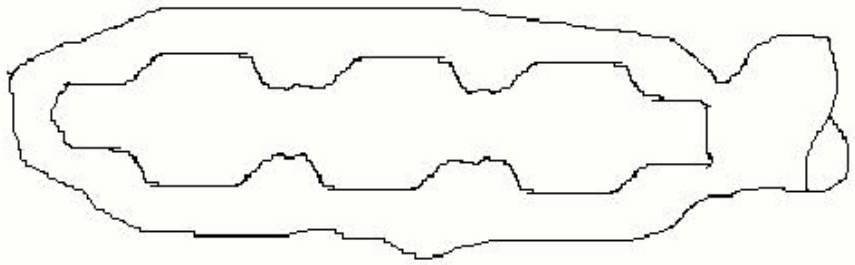


Figure: Classification of Forging

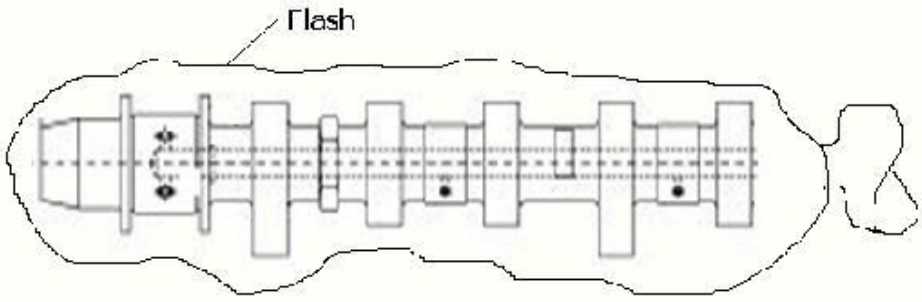
	(b)	**Enlist die accessories and state the function of any of them.**	**04**
	Ans	***(Any Four 01 Mark Each)*** **Die Accessories and their Functions:** 1) **Stripper:** To remove scrap material from the punch as it cleans the die block. 2) **Pilots:** The pilot positions, the stock strip accurately and bring it into proper position for blanking and piercing operations. They act as guides during the piercing or blanking operations. 3) **Stops:** The stops are used for correct spacing of the sheet metal as it is fed below the punch to give the greatest output in given length of the plate. 4) **Knock out:** The function of knock out is to eject the finished components from the die cavity. 5) **Strip Feeder:** It is used for feeding the strip mostly in automatic operations. 6) **Pressure pad:** It is used for drawing operation for maintaining flat surface of the cup.	*Any Four 01 Mark Each*
	(c)	**Explain constructional features of compound die with neat sketch.**	**04**
	Ans	***(Sketch 02 Marks and its construction 02 Mark)*** **Construction:** (1) Simultaneous blanking and piercing is done by using blanking and piercing element in both the member of die, i.e. the upper and the lower member of the die. (2) These elements are set exactly opposite to each other so that piercing punch acts in the opposite direction with respect to the blanking punch. In this way blanking and piercing operations are performed simultaneously. (3) Angular clearance is provided in the piercing die. This helps in easy removal of scrap from the die. (4) The blanking punch acts as a piercing die. The sidewall, which is adjacent to cutting edges of blanking die opening, is straight so that the blank does not pass through the die.	*Sketch 02 Marks and its Construction 02 Mark*

		(5) Knock out stroke is actuated during the return stroke of the press. It helps to eject the blank.  **Figure: Compound Dies**	
	(d)	**Explain Soldering Process.**	**04**
	Ans	***(Correct Answer (Any One) 04 Marks)*** **Soldering:** Soldering is a method of uniting two or more piece of metal by means of a fusible alloy or metal, called solder, applied in the molten state. Soldering is very much similar to brazing and its principle is same as that of brazing. The major difference lies with the filler metal, the filler metal used in case of soldering should have the melting temperature lower than 450oC. The surfaces to be soldered must be pre-cleaned so that these are faces of oxides, oils, etc. An appropriate flux must be applied to the faying surfaces and then surfaces are heated. Filler metal called solder is added to the joint, which distributes between the closely fitted surfaces. Strength of soldered joint is much lesser than welded joint and less than a brazed joint. **OR** **Soldering Procedure:** **(1) Work Preparation:** Workpieces which are to be joined together should be perfectly clean. **(2) Preparation of Joint:** After cleaning workpieces should be kept together in correct position to make the final joint. **(3) Fluxing:** Selection of flux depends on the material of workpiece. **(4) Tinning:** The bit of solder iron is cleaned; application of flux is done over it. It is brought in contact of solder wire so the bit carries sufficient amount of molten solder over it. After that it is used to make tags of solder at various processes throughout the joint.	*Correct Answer (Any One) 04 Marks*
4		**Attempt any THREE of the following:**	**12**
	(a)	**Write forging sequence for manufacturing of camshaft.**	**04**
	Ans	***(List of operations 1 ½ Marks and their sketches ½ Mark each)*** **Forging process for manufacturing Camshaft:** i) **Stock is Redistributed and size is increased at certain places & reduced at others by Rolled Forging.** 	*List of operations 1 ½ Marks and their sketches ½ Mark each*

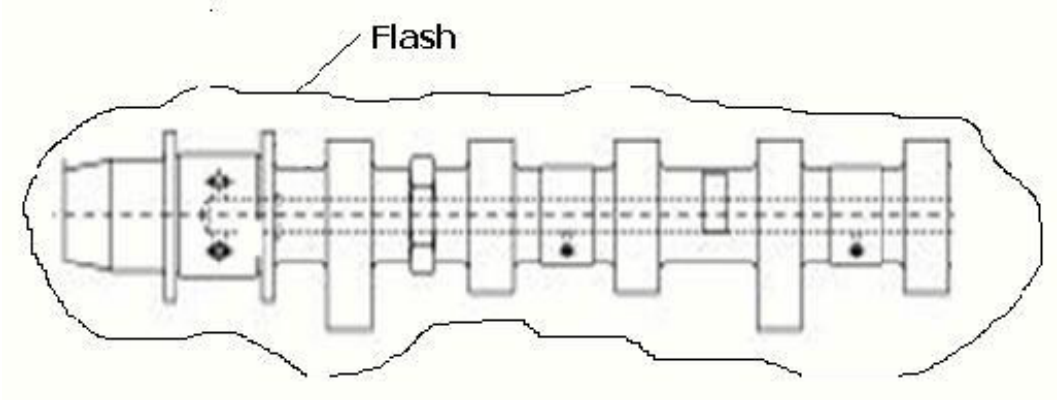
ii) **After Preliminary Roll Forging, the stock is again Roll Forged**.



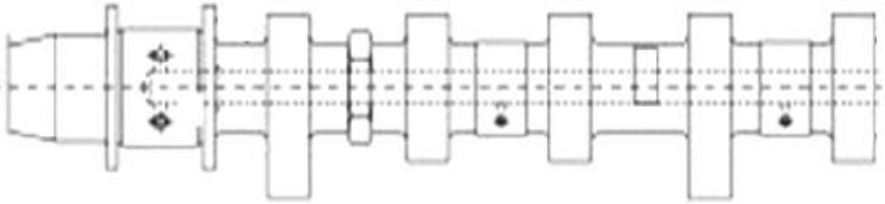
iii) **This stock is then Forged in first impression or Blocking Die**.



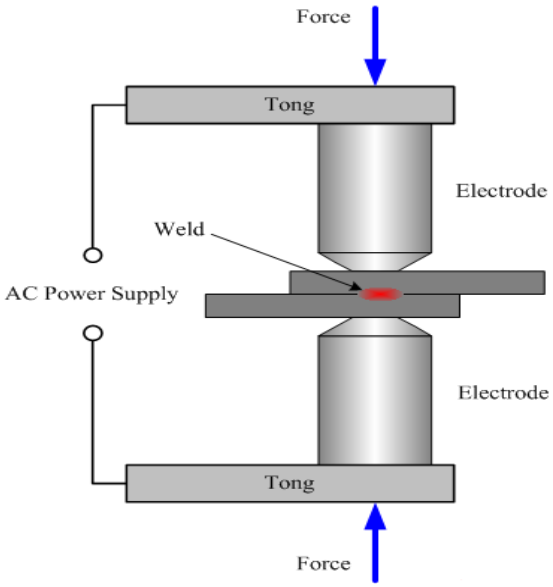
iv) **Final Shape is given to the Forging in next Blocking Die.**



v) **Finished Part is Trimmed in Blanking Die to remove excess Metal or Flash.**



	(b)	**State the use of filler and flux material in welding.**	**04**
	Ans	***(Any ONE use of each Material 01 Mark each)*** **Uses of Filler:** (1) Filler used, is of a similar alloy and melting point to the base metal. (2) In electric arc welding, a major use for the filler rod is as a consumable electrode that also generates heat in the workpiece. (3) During Welding Process, filler rod is heated, liquefy and melt to flow into the space between two close fitting parts, creating a brazed or soldered joint. **Uses of Flux:** (1) The main function of weld flux is to oxidize the base and filler materials	*Any ONE use of each Material 01 Mark each*

		during the welding process. (2) It prevents the oxidation of the surface of the weld and hence protects the weld from the foreign gases. (3) It provides material to form alloys which can improve the material properties of the weld. (4) In arc welding the flux coating helps in constricting the arc.	
	(c)	**Explain spot welding process.**	**04**
	Ans	***(Explanation 02 Marks and Sketch 02 Marks)*** **Spot Welding:** It is used to join overlapping strips, sheets or plates of metals. The pieces are assembled and squeezed between two electrodes, which must possess high electrical & thermal conductivity. When the current is turned on, the pieces are heated at their areas of contact to a welding temperature, and with the aid of mechanical pressure the electrodes are forced against the metal to be welded.  **Figure: Spot Welding**	*Explanation 02 Marks and Sketch 02 Marks*
	(d)	**List various surface cleaning processes. Explain any one of them.**	**04**
	Ans	***(List of Processes 02 Marks and Explanation of any one 02 Marks)*** **Processes used to clean the work surfaces:** **Chemical Cleaning Methods** (i) Alkaline Cleaning (ii) Emulsion Cleaning (iii) Solvent Cleaning (iv) Acid Cleaning (v) Acid Pickling (vi) Ultrasonic Cleaning **Mechanical Cleaning** (i) Blast Finishing (ii) Shot Peening (iii) Mass Finishing Processes **(1) Alkaline Cleaning:** Uses an alkali to remove oils, grease, wax, and various types of particles (metal chips, silica, light scale) from a metallic surface. Most widely used industrial cleaning method. Alkaline solutions include sodium and potassium hydroxide	*List of Processes 02 Marks and Explanation of*

(NaOH, KOH), sodium carbonate (Na2CO3), borax (Na2B4O7)
Cleaning methods: Immersion or spraying followed by water rinse to remove residue

OR

(2) Emulsion Cleaning:
Uses organic solvents (oils) dispersed in an aqueous solution. Suitable emulsifiers (soaps) results in a two-phase cleaning fluid (oil-in-water), which functions by dissolving or emulsifying the soils on the part surface. Used on either metal or nonmetallic parts. Must be followed by alkaline cleaning to eliminate all residues of the organic solvent prior to plating.

OR

(3) Solvent Cleaning:
Organic soils such as oil and grease are removed from a metallic surface by chemicals that dissolve the soils. Common application techniques: hand-wiping, immersion, spraying, and vapor degreasing – Vapor degreasing (a solvent cleaning method) uses hot vapors of chlorinated or fluorinated solvents.

OR

(4) Acid Cleaning:
Removes oils and light oxides from metal surfaces using acid solutions combined with water-miscible solvents, wetting and emulsifying agents. Common application techniques: soaking, spraying, or manual brushing or wiping carried out at ambient or elevated temperatures. Cleaning acids include hydrochloric (HCl), nitric (HNO3), phosphoric (H3PO4), and sulfuric (H2SO4).

OR

(5) Acid Pickling:
More severe acid treatment to remove thicker oxides, rusts, and scales. Distinction between acid cleaning and acid pickling is a matter of degree. Generally results in some etching of the metallic surface which serves to improve organic paint adhesion.

any one 02 Marks

OR

(6) Ultrasonic Cleaning
Mechanical agitation of cleaning fluid by high frequency vibrations (between 20 and 45 kHz) to cause cavitations (formation of low pressure vapor bubbles that scrub the surface). Combines chemical cleaning and mechanical agitation of the cleaning fluid. Cleaning fluid is generally an aqueous solution containing alkaline detergents. Highly effective for removing surface contaminants

OR

(7) Blast Finishing
High velocity impact of particulate media to clean and finish a surface. Media is propelled at the target surface by pressurized air or centrifugal force. Most well-known method is sand blasting, which uses grits of sand as blasting media
– Other blasting media:
• Hard abrasives such as Al2O3 and SiC
• Soft media such as nylon beads

OR

(8) Shot Peening:
High velocity stream of small cast steel pellets (called shot) is directed at a metallic surface to cold work and induce compressive stresses into surface layers. Used primarily to improve fatigue strength of metal parts. Purpose is therefore different from blast finishing,
although surface cleaning is accomplished as a byproduct of the operation

OR

(9) Mass Finishing:

Finishing parts in bulk by a mixing action in a container, usually in the presence of an abrasive media. Mixing causes parts to rub against media and each other to achieve desired finishing action. Parts are usually small and therefore uneconomical to finish individually

• **Processes include:**

- **Tumbling**
- **Vibratory finishing**

OR

- **Tumbling:**

Use of a horizontally oriented barrel of hexagonal or octagonal cross section in which parts are mixed by rotating the barrel at speeds of 10 to 50 rev/min. Finishing by "landslide" action - media and parts rise in the barrel as it rotates, then top layer tumbles down due to gravity. *Drawbacks: slow, noisy, and large floor-space required.*

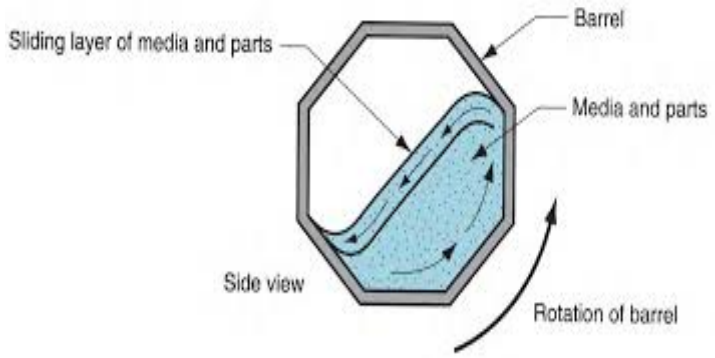


Figure: Tumbling Process

OR

- **Vibratory Finishing:**

Alternative to tumbling. Vibrating vessel subjects all parts to agitation with the abrasive media, as opposed to only the top layer as in barrel finishing. Processing times for vibratory finishing are significantly reduced. Open tubs permit inspection of parts during processing, and noise is reduced

	(e)	**Write the procedure for developing part programming for CNC.**	**04**
	Ans	***(Any one method 04 marks)*** **Procedure for Developing Part Program :** There are two methods of part programming:- **A) 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** **B) Computer –Assisted Part Programming (CAPP): -** This method is useful for most critical and complex parts. The part programmer and the computer are the main tool in this method.	*Any one method 04 marks*

		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	
5		**Attempt any TWO of the following:**	**12**
	(a)	**Name the different types of presses used in industry. Draw the labeled diagram of 'Standard Die Set'.**	**06**
	Ans	***(Types of Presses 04 Mark and Neat labelled sketch of Standard Die Set 02 Marks)*** **Types of Presses** **Basically classified into two groups :** a) Manually operated – hand, ball or fly press b) Power operated – mechanical, hydraulic etc. **Presses are briefly classified as :** **a. According to the type & design of frame :** 1. Inclinable 2. Straight Side 3. Adjustable Bed 4. Gap Frame 5. Horning 6. Open End 7. Pillar **b. According to the positions of frame :** 1. Inclinable 2. Inclined 3. Vertical 4. Horizontal **c. According to the actions :** 1. Single Action 2. Double Action 3. Triple Action **d. According to the mechanism used for applying power to ram :** 1. Crank 2. Eccentric 3. Cam 4. Toggle 5. Screw 6. Knuckle 7. Rack & Pinion 8. Hydraulic 9. Pneumatic **e. According to the number of drive gears :** 1. Single Drive 2. Twin Drive 3. Quadruple Drive **f. According to the number of crankshaft used :** 1. Single Crank 2. Double Crank **g. According to the method of transmission of power from motor to crankshaft :** 1. Direct 2. Non – Geared 3. Single Geared 4. Double Geared 5. Multiple Geared **h. According to the purpose for which used :** 1. Shears 2. Brakes 3. Punching 4. Seaming 5. Extruding 6. Coining 7. Straightening 8.Transfer 9. Forging	*Types of Presses 04 Mark and Neat labelled sketch of Standard Die Set 02 Marks*

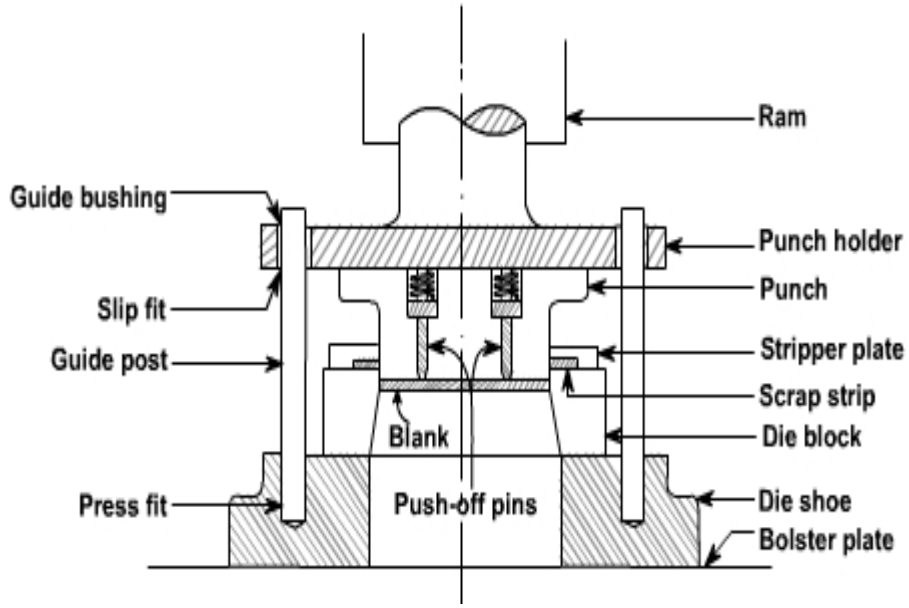
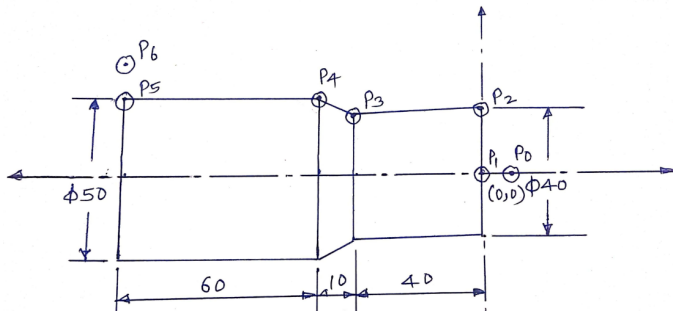


Figure: Standard Die Set Components

	(b)	**List any four factors affecting on selection of surface finishing process. List application of lapping, honing, buffing and burnishing.**	**06**
	Ans	***(Any four Factors 02 Marks and any two application of each process 01 Mark each)*** **Factors Governing Selection of Finishing Process:** i) Shape of surface ii) Minor imperfection in shape iii) Dimensional accuracy iv) Close fit between the contact surfaces v) Fine surface finish vi) Types of Marks on the surface vii) Surface condition viii) Allowable metal loss **Applications:** **(1) Lapping:** 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. **(2) Honing :** Engine cylinder, bearings, gun barrels, ring gauges, shafts and flange faces, piston pin, automobile crankshaft journals etc. **(3) Buffing:** It is used to polish soft metals including copper and brass as well as plastics such as perspex **(4) Burnishing:** Cutting Tools, Turbine Blades, Air foils Optics, Sanitary Pipes, Capillary Tubes, Needle, Biopsy Needles and Curved Pipes.	*Any four Factors 02 Marks and any two application of each process 01 Mark Each.*
	(c)	**State the significance of following ISO codes in CNC:** **(i) G00** **(ii) G01** **(iii) G04** **(iv) M03** **(v) M05**	**06**

		(vi) M06	
	Ans	***(Meaning ½ mark each and its significance ½ mark each)*** **Code — Meaning — Significance** **G00: Rapid Transverse——** To move tool to work zero from any reference. **G01: Linear Interpolation–** To move the tool / table with given federate. **G04: Dwell Time————** To improve surface finish. **M03: Spindle Start in Clockwise Direction——** To rotate the spindle / chuck in clockwise direction with given RPM. **M05: Spindle Stop————** To stop the spindle / chuck after desired operation **M06: Tool Change————** To change the tool of previous operation to perform next operation.	*Meaning ½ mark each and its significance ½ mark each*
6		**Attempt any TWO of the following:**	**12**
	(a)	**Prepare the part program for the given workpiece Fig. No. 1 on Turning Centre (CNC Lathe) using ISO codes. Assume Suitable data.**	**06**
	Ans	***(Axis Coordinates 01 Mark and Program 05 Marks)*** **(NOTE: Meaning of the codes are not compulsory)**	*Axis Coordinates 01 Mark and Program 05 Marks*

Points	X	Z
P0	0.0	2.0
P1	0.0	0.0
P2	40.0	0.0
P3	40.0	-40.0
P4	50.0	-50.0
P5	50.0	-110.0
P6	52.0	-110.0

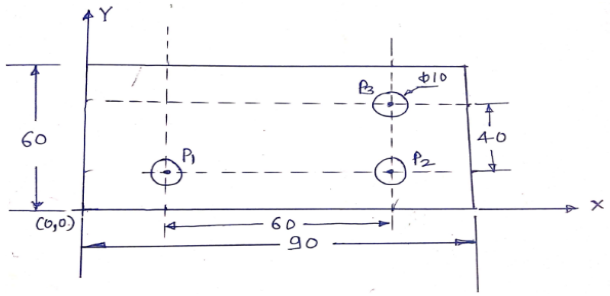


Program:

Block No.	Program	Meanings
	O0001 ;	Program No.
N001	**G28 U0.0 W0.0 ;**	Move tool tip to reference position.
N002	**G90 G21 G98 G97 ;**	Absolute Programming, Metric unit, Feed in mm/min., Spindle speed in RPM.
N003	**M06 T0101 M08 ;**	Tool Change, Tool No. 01 & Offset No. 01, Coolant ON
N004	**M04 S1000 ;**	Spindle Start Counter-Clockwise with 1000 rpm
N005	**G00 X0.0 Z2.0 ;**	Rapidly move the tool tip to point P0 i.e. 2mm, away from work zero.
N006	**G01 X0.0 Z0.0 F 50 ;**	Move the tool to point P1 i.e. work zero, with feed rate of 50 mm/min.
N007	**X40.0 ;**	Move the tool to point P2
N008	**Z - 40.0 ;**	Move the tool to point P3
N009	**X 50.0 Z – 50.0 ;**	Move the tool to point P4
N010	**Z – 110.0 ;**	Move the tool to point P5
N011	**X 52.0;**	Move the tool to point P6
N012	**M05 M09 ;**	Spindle Stop & coolant Stop

		N013	G28 U0.0 W0.0 ;	Move tool tip to reference position.	
		N014	M02 ;	End of Program	
	(b)	**Prepare the part program for the drilling operations on the given plate Fig. No. 2 having thickness 15 mm. Assume Suitable data.**			**06**
	Ans	***(Axis Coordinates 01 Mark and Program 05 Marks)*** **(NOTE: Meaning of the codes are not compulsory)** **[Thickness of plate = 15 mm, Drill dia. used = 10 mm]**			*Axis Coordinates 01 Mark and Program 05 Marks*

Points	X	Y	Z
P0	0.0	0.0	5.0
P1	15.0	15.0	- 20.0
P2	75.0	15.0	- 20.0
P3	75.0	50.0	- 20.0



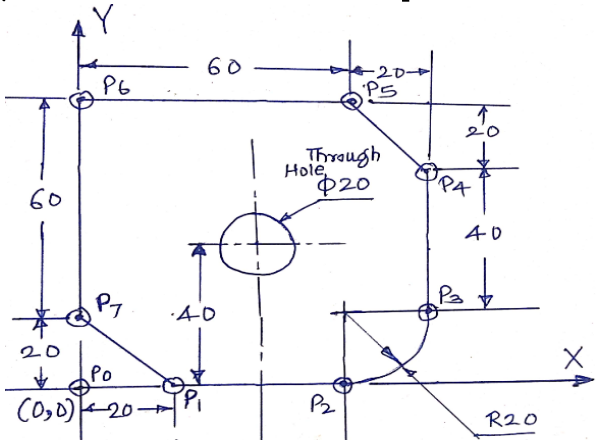
Program:

Block No.	Program	Meanings
	O0002 ;	Program No.
N001	G28 U0.0 V0.0 W0.0 ;	Move tool tip to reference position.
N002	G90 G21 G98 G97 ;	Absolute Programming, Metric unit, Feed in mm/min., Spindle speed in RPM.
N003	M06 T0101 M08 ;	Tool Change, Tool No. 01 & Offset No. 01, Coolant ON
N004	M03 S1000 ;	Spindle Start Counter-Clockwise with 1000 rpm
N005	G00 X0.0 Y0.0 Z 5.0 ;	Rapidly move the tool to point P0 i.e. 5 mm away from work zero.
N006	G00 X15.0 Y15.0 Z 5.0 ;	Rapidly move the tool to point P1 i.e. 5 mm above the work surface
N007	G74 R 5.0 ;	Peck drilling with Retraction amount 5 mm
N008	G74 Z-20.0 Q 2.0 F200 ;	Peck drilling Canned Cycle with feed rate 200 mm/min and step over of Q = 2.0 mm X=15.0, Y= 15.0 Z= -20.0
N009	G00 Z 5.0;	Move the tool rapidly 5 mm above work surface.
N010	G00 X75.0 Y15.0 Z 5.0 ;	Rapidly move the tool to point P2 i.e. 5 mm above the work surface
N011	G74 R 5.0 ;	Peck drilling with Retraction amount 5 mm
N012	G74 Z-20.0 Q 2.0 F200 ;	Peck drilling Canned Cycle with feed rate 200 mm/min and step over of Q = 2.0 mm X=75.0, Y= 15.0 Z= -20.0
N013	G00 Z 5.0;	Move the tool rapidly 5 mm above work surface.
N014	G00 X75.0 Y50.0 Z 5.0 ;	Rapidly move the tool to point P3 i.e. 5 mm above the work surface
N015	G74 R 5.0 ;	Peck drilling with Retraction amount 5

				mm	
		N016	G74 Z-20.0 Q 2.0 F200 ;	Peck drilling Canned Cycle with feed rate 200 mm/min and step over of Q = 2.0 mm X=75.0, Y= 15.0 Z= -20.0	
		N017	G00 Z 5.0;	Move the tool rapidly 5 mm above work surface.	
		N018	M05 M09 ;	Spindle Stop & coolant Stop	
		N019	G28 U0.0 W0.0 ;	Move tool tip to reference position.	
		N020	M30 ;	Program End and reset.	
	(c)	**Prepare the part program for the given workpiece Fig. No. 3 on VMC using ISO codes. Assume Suitable data.**			**06**
	Ans	***(Axis Coordinates 01 Mark and Program 05 Marks)***			

(NOTE: Meaning of the codes are not compulsory)
[Assume Thickness of Plate = 15 mm, End Mill Dia. used = 20 mm]

Points	X	Y	Z
P0	0.0	0.0	-20.0
P1	20.0	0.0	-20.0
P2	60.0	0.0	-20.0
P3	80.0	20.0	-20.0
P4	80.0	60.0	-20.0
P5	60.0	80.0	-20.0
P6	0.0	80.0	-20.0
P7	0.0	20.0	-20.0
P1	20.0	0.0	-20.0
P10	40.0	40.0	5.0



Program:

Block No.	Program	Meanings
	O0003 ;	Program No.
N001	G28 U0.0 V0.0 W0.0 ;	Move tool tip to reference position.
N002	G90 G21 G94 G97 G42 ;	Absolute Programming, Metric unit, Feed in mm/min., Spindle speed in RPM. Cutter Radius compensation Right.
N003	M06 T0101 M08 ;	Tool Change, Tool No. 01 & Offset No. 01, Coolant ON
N004	M 03 S 1000 ;	Spindle Start Counter-Clockwise with 1000 rpm
N005	G00 X 0.0 Y 0.0 Z -20.0 ;	Rapidly move the tool to point P0 i.e. 5 mm away from work zero.
N006	G01 X 20.0 Y 0.0 F150 ;	Move the tool to point P1 with feed rate of 150mm/min.
N007	X 60.0 Y 0.0 ;	Move the tool to point P2
N008	G03 X 80.0 Y 20.0 R 20 ;	Move the tool to point P3
N009	G01 X 80.0 Y60.0;	Move the tool to point P4
N010	X 60.0 Y 80.0 ;	Move the tool to point P5
N011	X0.0 Y 80.0 ;	Move the tool to point P6

Axis Coordinates 01 Mark and Program 05 Marks

N012	X0.0 Y20.0 ;	Move the tool to point P7
N013	X20.0 Y0.0 ;	Move the tool to point P1
N014	G00 Z 5.0 ;	Move the end mill above the work surface.
N015	M06 T 0202 ;	Tool Change, Tool No. 02 & Offset No. 02, (Drill Dia. 20 mm used)
N016	G00 X 40.0 Y 40.0 Z5.0	Rapidly move the tool to point P10 i.e. 5 mm away from work zero.
N017	G74 R 5.0 ;	Peck drilling with Retraction amount 5 mm
N018	G74 Z-20.0 Q 2.0 F200 ;	Peck drilling Canned Cycle with feed rate 200 mm/min and step over of Q = 2.0 mm X=40.0, Y= 40.0 Z= -20.0
N019	G00 Z 5.0;	Move the tool rapidly 5 mm above work surface.
N020	M05 M09 ;	Spindle Stop & coolant Stop
N021	G28 U0.0 W0.0 ;	Move tool tip to reference position.
N022	M30 ;	Program End and reset.