

STUDY MATERIAL

SUBJECT : BASIC MANUFACTURING PROCESSES (BMP)

MODULE-III

SEMESTER : 5TH

BRANCH : MECHANICAL ENGG.

CONTENTS :

- **OBJECTIVE TYPE QUESTIONS AND ANSWERS**
- **SHORT TYPE QUESTIONS AND ANSWERS**
- **LONG TYPE QUESTIONS AND ANSWERS**

DEPARTMENT OF MECHANICAL ENGINEERING

CHAPTER : 02

MECHANICAL FORMING PROCESSES

OBJECTIVE TYPE QUESTIONS AND ANSWERS

IES - 2016

1. Surface cracking occurring at low temperatures in hydrostatic extrusion is known as
 - (a) fluid defect
 - (b) bamboo defect
 - (c) fishtailing
 - (d) arrowhead fracture
2. Consider the following statements about forging:
 1. Forgings have high strength and ductility.
 2. Forgings offer great resistance to impact and fatigue loads.
 3. Forging assures uniformity in density as well as dimensions of the forged parts.Which of the above statements are correct?
 - (a) 1 and 2 only
 - (b) 1 and 3 only
 - (c) 2 and 3 only
 - (d) 1, 2 and 3
3. **Statement (I)** : Employing the extrusion process is not economical in case of large billets.
Statement (II) : A significant part of the press capacity is lost overcoming frictional resistance between workpiece and cylinder wall during the extrusion process.
4. **Statement (I)** : In drop forging, the excess metal added to the stock for complete filling of the die cavity is called flash.
Statement (II) : Flash acts as a cushion against impact blows attributable to the finishing impression.
5. **Statement (I)** : In wire-drawing, the end of the stock is made 'pointed' to make for easier entrance of the wire into the die.
Statement (II) : The pointing of the wire is done exclusively by rotary swaging and not by simple hammering.
6. The recrystallization behaviour of a particular metal alloy is specified in terms of recrystallization temperature, which is typically $1/3$ rd of the absolute melting temperature of a metal or an alloy and depends on several factors including the amount of
 1. cold working and purity of the metal and alloy
 2. hot working and purity of the metal and alloyWhich of the above is/are correct?
 - (a) 1 only
 - (b) 2 only
 - (c) Both 1 and 2
 - (d) Neither 1 nor 2
7. Consider the following in case of high-energy forming processes :
 1. The evacuation between die and blank in explosive forming is done by a vacuum pump.
 2. The pressure waves produced in water in explosive forming deform the blank to the die shape.
 3. The electrohydraulic forming makes use of discharge of large amount of electrical energy used in a capacitor bank.

4. In Petroforge, the piston is moved by combustion of fuel moving at the rate of 150-200 m/s.

Which of the above are correct?

- (a) 1, 2, 3 and 4 (b) 1, 2 and 3 only
(c) 3 and 4 only (d) 1, 2 and 4 only

IES - 2015

8. Which of the following statements apply to provision of flash gutter and flash land around the parts to be forged?
- Small cavities are provided which are directly outside the die impression.
 - The volume of flash land and flash gutter should be about 20% - 25% of the volume of forging.
 - Gutter is provided to ensure complete closing of the die.
- (a) 1 and 2 only (b) 1 and 3 only
(c) 1, 2 and 3 (d) 2 and 3 only
9. Rotary swaging is a process for shaping
- (a) round bars and tubes
(b) billets
(c) dies
(d) rectangular blocks

IES - 2014

10. In wire-drawing operation, the maximum reduction per pass for perfectly plastic material in ideal condition is
- (a) 68% (b) 63%
(c) 58% (d) 50%
11. In the process of metal rolling operation, along the arc of contact in the roll gap there is a point called the neutral point, because
- (a) on one side of this point, the work material is in tension and on the other side, the work material is in compression
(b) on one side of this point, the work material has velocity greater than that of the roll

and on the other side, it has velocity lesser than that of the roll

- (c) on one side of this point, the work material has rough surface finish and on the other side, the work material has very fine finish
(d) at this point there is no increase in material width, but on either side of neutral point, the material width increases
12. A toothpaste tube can be produced by
- (a) solid forward extrusion
(b) solid backward extrusion
(c) hollow backward extrusion
(d) hollow forward extrusion
13. **Statement (I):** In drawing process, cross-section of round wire is reduced by pulling it through a die.
Statement (II): Bundle drawing produces wires that are polygonal in cross-section rather than round.
14. **Statement (I):** For high extrusion pressure, the initial temperature of billet should be high
Statement (II): As the speed of hot extrusion is increased, it may lead to melting of alloy constituents
15. **Statement (I):** In the manufacture of gears by extrusion, the outside surface of the material is hard and smooth.
Statement (II): The material in this process passes through one hot and smooth die.

IES - 2013

16. **Statement (I):** The dies used in the forging process are made in pair.
Statement (II): The material is pressed between two surfaces and the compression force applied, gives it a shape.
17. **Statement (I):** In high velocity forming process, high energy can be transferred to metal with relatively small weight.
Statement (II): The kinetic energy is the function of mass and velocity.

18. **Statement (I):** In power forging energy is provided by compressed air or oil pressure or gravity.

Statement (II): The capacity of the hammer is given by the total weight, which the falling pans weigh.

19. Consider the following statements pertaining to the open-die forging of a cylindrical specimen between two flat dies:

1. Lubricated specimens show more surface movement than unlubricated ones
2. Lubricated specimens show less surface movement than unlubricated ones.
3. Lubricated specimens show more barreling than unlubricated ones.
4. Lubricated specimens show less barreling than unlubricated ones.

Which of these statements are correct?

- (a) 1 and 3 (b) 1 and 4
(c) 2 and 3 (d) 2 and 4

20. In the forging process:

1. The metal structure is refined
2. Original unidirectional fibers are distorted
3. Poor reliability, as flaws are always there due to intense working
4. Part are shaped by plastic deformation of material

- (a) 1, 2 and 3 (b) 1, 3 and 4
(c) 1, 2 and 4 (d) 2, 3 and 4

IES - 2012

21. Which of the following statements is correct for forging?

- (a) Forgeability is property of forging tool, by which forging can be done easily
(b) Forgeability decreases with temperature upto lower critical temperature
(c) Certain mechanical properties of the material are influenced by forging
(d) Pure metals have good malleability therefore, poor forging properties

22. Assumptions adopted in the analysis of open die forging are

1. Forging force attain maximum value at the middle of the operation
 2. Coefficient of friction is constant between work piece and die
 3. Stress in the vertical (Y-direction) is zero.
- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

23. Which of the following are correct for an indirect hot extrusion process?

1. Billet remains stationary
2. There is no friction force between billet and container walls
3. The force required on the punch is more in comparison to direct extrusion

4. Extrude parts have to be provided a support

- (a) 1, 2, 3 and 4 (b) 1, 2 and 3 only
(c) 1, 2 and 4 only (d) 2, 3 and 4 only

24. Extrusion process can effectively reduce the cost of product through

- (a) Material saving
(b) Process time saving
(c) Saving in tooling cost
(d) Saving in administrative cost

25. Which of the following processes is also known as high energy rate forming?

- (a) High velocity forming
(b) Explosive fabrication
(c) Electro hydraulic forming
(d) Magnetic pulse forming

26. **Statement (I):** It is difficult to maintain close tolerance in normal forging operation.

Statement (II): Forging is workable for simple shapes and has limitation for parts having undercuts.

IES - 2011

27. Consider the following statements

1. Any metal will require some time to undergo complete plastic deformation

- particularly if deforming metal has to fill cavities and corners of small radii.
2. For large work piece of metals that can retain toughness at forging temperature it is preferable to use forge press rather than forge hammer.
- (a) 1 and 2 are correct and 2 is the reason for 1
 - (b) 1 and 2 are correct and 1 is the reason for 2
 - (c) 1 and 2 are correct but unrelated
 - (d) 1 only correct
28. Which of the following processes belong to forging operation?
1. Fullering
 2. Swaging
 3. Welding
- (a) 1 and 2 only
 - (b) 2 and 3 only
 - (c) 1 and 3 only
 - (d) 1, 2 and 3
29. Match **List-I** with **List-II** and select the correct answer using the code given below the lists:
- | List-I | List-II |
|----------------------|--------------|
| A. Connections rods | 1. Welding |
| B. Pressure vessels | 2. Extrusion |
| C. Machine tool beds | 3. Forging |
| D. Collapsible tubes | 4. Casting |
- Codes:**
- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 1 | 4 | 3 |
| (b) | 3 | 1 | 4 | 2 |
| (c) | 2 | 4 | 1 | 3 |
| (d) | 3 | 4 | 1 | 2 |
30. High energy rate forming process used for forming components from thin metal sheets or deform thin tubes is
- (a) Petro-forming
 - (b) Magnetic pulse forming
 - (c) Explosive forming
 - (d) Electrohydraulic forming

31. **Assertion (A):** Hot tears occur during forging because of inclusions in the blank material.
Reason (R): Bonding between the inclusions and the parent material is through physical and chemical bonding.
32. **Assertion (A):** Lead, Zinc and tin are always hot worked.
Reason (R): If they are worked in cold state they cannot retain their mechanical properties.
33. **Assertion (A):** Excess defects are created by hammering the crystalline materials.
Reason (R): The thermal fluctuations create the point defects in crystalline materials.

IES - 2010

34. Consider the following statements:
The material properties which principally determine how well a metal maybe drawn are
1. Ratio of yield stress to ultimate stress.
 2. Rate of increase of yield stress relative to progressive amounts of cold work.
 3. Rate of work hardening.
- Which of these statements is/are correct?
- (a) 1 and 2 only
 - (b) 2 and 3 only
 - (c) 1 only
 - (d) 1, 2 and 3
35. **Assertion (A):** Plastic deformation is a function of applied stress, temperature and strain rate.
Reason (R): Plastic deformation is accompanied by changes in both the internal and external state of the material.
36. **Assertion (A):** In the high energy rate forming method, the explosive forming has proved to be an excellent method of utilizing energy at high rate and utilize both the high explosives and low explosive.
Reason (R): The gas pressure and rate of detonation can be controlled for both types of explosives.
37. **Assertion (A):** Pickling and washing of rolled rods is carried out before wire drawing.
Reason (R): They lubricate the surface to reduce friction while drawing wires.

38. Consider the following characteristics:
1. Porosity in the metal is largely eliminated.
 2. Strength is decreased
 3. Close tolerances cannot be maintained.
- Which of the above characteristics of hot working is/are correct?
- (a) 1 only (b) 3 only
(c) 2 and 3 (d) 1 and 3
39. Which one of the following processes is the wire drawing process?
- (a) Compressive (b) Tensile
(c) Shear (d) Hydrostatic stress
40. Which one of the following statements is correct?
- (a) In extrusion process, thicker walls can be obtained by increasing the forming pressure
- (b) Extrusion is an ideal process for obtaining rods from metal having poor density
- (c) As compared to roll forming, extruding speed is high
- (d) Impact extrusion is quite similar to Hooker's process including the flow of metal being in the same direction
41. What is the major problem in hot extrusion?
- (a) Design of punch
(b) Design of die
(c) Wear and tear of die
(d) Wear of punch
42. Which one of the following is a high energy rate forming process?
- (a) Roll forming
(b) Electrohydraulic forming
(c) Rotary forging
(d) Forward extrusion

43. Consider the following statements:
1. Metal forming decreases harmful effects of impurities and improves mechanical strength.

2. Metal working process is a plastic deformation process.
3. Very intricate shapes can be produced by forging process as compared to casting process.

Which of these statements are correct?

- (a) 1, 2 and 3 (b) 1 and 2 only
(c) 2 and 3 only (d) 1 and 3 only

44. Match List-I (Forging/Technique) with List-II (Process) and select the correct answer using the code given below the lists:

List-I

- A. Smith Forging B. Drop Forging
C. Press Forging D. Machine Forging

List-II

1. Material is only upset to get the desired shape
2. Carried out manually in open dies
3. Done in closed impression dies by hammers in blows
4. Done in closed impression dies by continuous squeezing force

Codes:

- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 3 | 4 | 1 |
| (b) | 4 | 3 | 2 | 1 |
| (c) | 2 | 1 | 4 | 3 |
| (d) | 4 | 1 | 2 | 3 |

45. Cold forging results in improved quality due to which of the following?

1. Better mechanical properties of the process.
2. Unbroken grain flow
3. Smoother finishes.
4. High pressure

Select the correct answer using the code given below:

- (a) 1, 2 and 3 (b) 1, 2 and 4
(c) 2, 3 and 4 (d) 1, 3 and 4

IES - 2007

46. Which metal forming process is used for manufacture of long steel wire?
- (a) Deep drawing (b) Forging
(c) Drawing (d) Extrusion
47. Which one of the following is the correct statements?
- (a) Extrusion is used for the manufacture of seamless tubes
(b) Extrusion is used for reducing the diameter of round bars and tubes by rotating dies which open and close rapidly on the work
(c) Extrusion is used to improve fatigue resistance of the metal by setting up compressive stresses on its surface
(d) Extrusion comprises pressing the metal inside a chamber to force it out by high pressure through an orifice which is shaped to provide the desired form of the finished part
48. Which one of the following metal forming processes is not a high energy rate forming processes?
- (a) Electro-magnetic
(b) Roll-forming
(c) Explosive forming
(d) Electro-hydraulic forming
49. **Assertion (A):** Greater force on the plunger is required in case of direct extrusion than indirect one.

Reason (R): In case of direct extrusion, the direction of the force applied on the plunger and the direction of the movement of the extruded metal are the same.

IES - 2006

50. What does hydrostatic pressure in extrusion process improve?
- (a) Ductility
(b) Compressive strength
(c) Brittleness
(d) Tensile strength

51. Which one of the following is a continuous bending process in which opposing rolls are used to produce long sections of formed shapes from coil or strip stock?
- (a) Stretch forming (b) Roll forming
(c) Roll bending (d) Spinning
52. **Assertion (A):** Forging dies are provided with taper or draft angles on vertical surfaces.
Reason (R): It facilitates complete filling of die cavity and favorable grain flow.

IES - 2005

53. Which of the following materials is used in the manufacture of extrusion nozzles?
- (a) Grey cast iron (b) Malleable cast iron
(c) White cast iron (d) Nodular cast iron
54. The process of removing the burs or flash from a forged component in drop forging is called
- (a) Swaging (b) Perforating
(c) Trimming (d) Fettling
55. Magnetic forming is an example of
- (a) Cold forming
(b) Hot forming
(c) High energy rate forming
(d) Roll forming
56. Match List-I (Type of Forging) with List-II (Operation) and select the correct answer using the code given below the lists:

List-I

- | | |
|------------------|------------------|
| A. Drop Forging | B. Press Forging |
| C. Upset Forging | D. Roll Forging |

List-II

1. Metal is gripped in the dies and pressure is applied on the heated end.
2. Squeezing action
3. Metal is placed between rollers and pushed
4. Repeated hammer blows

Codes:

	A	B	C	D
(a)	4	1	2	3
(b)	3	2	1	4
(c)	4	2	1	3
(d)	3	1	2	4

57. Which of the following types of stresses is/are involved in the wire drawing operation?

- (a) Tensile only
- (b) Compressive only
- (c) A combination of tensile and compressive stresses
- (d) A combination of tensile and compressive and shear stresses

IES - 2004

58. Match **List-I** (Type of moulding) with **List-II** (Mechanical involved) and select the correct answer using the codes given below the lists:

List-I

- A. Compression moulding
- B. Injected moulding
- C. Jet moulding
- D. Extrusion moulding

List-II

- 1. Mould cavity must be heated to cure the plastic forced into it
- 2. Similar to Hydraulic extrusion
- 3. Analogous to hot-pressing of powdered metals
- 4. Analogous to die casting of metals

Codes:

	A	B	C	D
(a)	2	4	1	3
(b)	3	1	4	2
(c)	2	1	4	3
(d)	3	4	1	2

59. Consider the following statements:

In comparison to hot working, in cold working,

- 1. higher forces are required.
- 2. no heating is required
- 3. less ductility is required
- 4. better surface finish is obtained

Which of these statements are correct?

- (a) 1, 2 and 3
- (b) 1, 2 and 4
- (c) 1 and 3
- (d) 2, 3 and 4

IES - 2003

60. Cold working produces the following effects:

- 1. Stresses are set up in the metal
- 2. Grain structure gets distorted
- 3. Strength and hardness of the metal are decreased
- 4. Surface finish is reduced

Which of these statements are correct?

- (a) 1 and 2
- (b) 1, 2 and 3
- (c) 3 and 4
- (d) 1 and 4

61. A forging method for reducing the diameter of a bar and in the process making it longer is termed as

- (a) Fullering
- (b) Punching
- (c) Upsetting
- (d) Extruding

62. A wide strip is rolled to a final thickness of 6.35 mm with a reduction of 30 percent. The roll radius is 50 cm and coefficient of friction is 0.2. Then angle of contact is

- (a) 0.5 radians
- (b) 0.0738 radians
- (c) 0.0123 radians
- (d) 0.0235 radians

63. The extrusion processes used for the production of toothpaste tube is/are

- 1. Tube extrusion
- 2. Forward extrusion
- 3. Impact extrusion

Select the correct answer using the codes given below:

- (a) 1 only
- (b) 1 and 2
- (c) 2 and 3
- (d) 3 only

64. **Assertion (A):** While rolling metal sheet in rolling mill, the edges are sometimes not straight and flat but are wavy.

Reason (R): Non-uniform mechanical properties of the flat material rolled out result in waviness of the edges.

IES - 2002

65. Consider the following steps involved in hammer forging a connecting rod from bar stock

1. Blocking
2. Trimming
3. Finishing
4. Fullering
5. Edging

Which of the following is the correct sequence of operations?

- (a) 1, 4, 3, 2 and 5 (b) 4, 5, 1, 3 and 2
(c) 5, 4, 3, 2, and 1 (d) 5, 1, 4, 2 and 3

66. Match List-I (Parts) with List-II (Manufacturing processes) and select the correct answer using the codes given below the lists:

List-I

- A. Seamless tubes
B. Accurate and smooth tubes
C. Surfaces having higher hardness and fatigue strength

List-II

1. Roll forming
2. Shot peening
3. Forging
4. Cold forming

Codes:

- | | A | B | C |
|-----|---|---|----|
| (a) | 1 | 4 | 2 |
| (b) | 2 | 3 | 1 |
| (c) | 1 | 3 | 2* |
| (d) | 2 | 4 | 1 |

67. Consider the following statements related to piercing and blanking

1. Shear on the punch reduces the maximum cutting force.
2. Shear increases the capacity of the press needed.

3. Shear increases the life of the punch
4. The total energy needed to make the cut remains unaltered due to provision of shear.

Which of these statements are correct?

- (a) 1 and 2 (b) 1 and 4
(c) 2 and 3 (d) 3 and 4

68. In rolling operation the maximum draft is given by (R = Radius of roll, μ = coefficient of friction)

- (a) μR (b) $\mu \sqrt{R}$
(c) $\mu^2 R^2$ (d) $\mu^2 R$

69. In rolling a strip between two rolls, the position of the neutral point in the arc of contact does not depend on

- (a) amount of reduction
(b) diameter of the rolls
(c) coefficient of friction
(d) material of the rolls

IES - 2001

70. In the forging operation, fullering is done to

- (a) draw out the material
(b) bend the material
(c) upset the material
(d) extrude the material

71. Which of the following assumptions are correct for cold rolling?

1. The material is plastic.
2. The arc of contact is circular with a radius greater than the radius of the roll.
3. Coefficient of friction is constant over the arc of contact and acts in one direction throughout the arc of contact.

Select the correct answer using the codes given below:

- (a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

72. A strip is to be rolled from a thickness of 30 mm to 15mm using a two-high mill having rolls of diameter 300mm. The coefficient of friction for unaided bite should nearly be

- (a) 0.35 (b) 0.5
(c) 0.25 (d) 0.07

73. Which of the following statements are the salient features of hydrostatic extrusion?

1. It is suitable for soft and ductile material.
2. It is suitable for high-strength super-alloys.
3. the billet is inserted into the extrusion chamber and pressure is applied by a ram to extrude the billet through the die.
4. The billet is inserted into the extrusion chamber where it is surrounded by a suitable liquid. The billet is extruded through the die by applying pressure to the liquid.

Select the correct answer using the codes given below:

- (a) 1 and 3 (b) 1 and 4
(c) 2 and 3 (d) 2 and 4

IES - 2000

74. Best position of crank for blanking operation in a mechanical press is

- (a) top dead centre
(b) 20 degrees below top dead centre
(c) 20 degrees before bottom dead centre
(d) bottom dead centre

75. Match List-I (Components of a table fan) with List-II (Manufacturing processes) and select the correct answer using the codes given below the lists:

List-I

- A. Base with stand B. Blade
C. Armature coil wire D. Armature shaft

List-II

1. Stamping and pressing
2. Wire drawing
3. Turning
4. Casting

Codes:

	A	B	C	D
(a)	4	3	2	1
(b)	2	1	4	3
(c)	2	3	4	1
(d)	4	1	2	3

76. **Assertion (A):** To obtain large deformations by cold working intermediate annealing is not required.

Reason (R): Cold working is performed below the recrystallisation temperature of the work material.

77. In the rolling process, roll separating force can be decreased by

- (a) reducing the roll diameter
(b) increasing the roll diameter
(c) providing back-up rolls
(d) increasing the friction between the rolls and the metal

78. Consider the following statements:

In forward extrusion process

1. the ram and the extruded product travel in the same direction
2. the ram and the extruded product travel in the opposite direction.
3. the speed of travel of the extruded product is same as that of the ram.
4. the speed of travel of the extruded product is greater than that of the ram.

Which of these statements are correct?

- (a) 1 and 3 (b) 2 and 3
(c) 1 and 4 (d) 2 and 4

79. Which one of the following lubricants is most suitable for drawing mild steel wires?

- (a) Sodium (b) Water
(c) Lime-water (d) Kerosene

IES - 1999

80. Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I

- A. Drawing
- B. Rolling
- C. Wire drawing
- D. Sheet metal operations using progressive dies

List-II

- 1. Soap solution
- 2. Chamber
- 3. Pilots
- 4. Crater
- 5. Ironing

Codes:

- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 5 | 1 | 4 |
| (b) | 4 | 1 | 5 | 3 |
| (c) | 5 | 2 | 3 | 4 |
| (d) | 5 | 2 | 1 | 3 |

81. Consider the following operations involved in forging a hexagonal bolt from a round bar stock, whose diameter is equal to the bolt diameter

- 1. Flattening
- 2. Upsetting
- 3. Swaging
- 4. Cambering

The correct sequence of these operation is

- (a) 1, 2, 3, 4
- (b) 2, 3, 4, 1
- (c) 2, 1, 3, 4
- (d) 3, 2, 1, 4

82. Which one of the following is the correct temperature range for hot extrusion of aluminium?

- (a) 300–340°C
- (b) 350–400°C
- (c) 430–480°C
- (d) 550–650°C

83. **Assertion (A):** In a two high rolling mill there is a limit to the possible reduction in thickness in one pass.

Reason (R): The reduction possible in the second pass is less than that in the first pass.

84. Consider the following statements:

Earing in a drawn cup can be due to non-uniform

- 1. Speed of the press
- 2. Clearance between tools
- 3. Material properties
- 4. blank holding

Which of these statements are correct?

- (a) 1, 2 and 3
- (b) 2, 3 and 4
- (c) 1, 3 and 4
- (d) 1, 2 and 4

85. **Assertion (A):** In sheet metal blanking operation, clearance must be given to the die.

Reason (R): The blank should be of required dimensions.

IES – 1998

86. Which one of the following processes is most commonly used for the forging of bolt heads of hexagonal shape?

- (a) Closed die drop forging
- (b) Open die upset forging
- (c) Close die press forging
- (d) Open die progressive forging

87. The bending force required for V-bending, U-bending and Edge-bending will be in the ratio of

- (a) 1 : 2 : 0.5
- (b) 2 : 1 : 0.5
- (c) 1 : 2 : 1
- (d) 1 : 1 : 1

88. **Assertion (A):** In drop forging besides the provision for flash, provision is also to be made in the forging die for additional space called gutter.

Reason (R): The gutter helps to restrict the outward flow of metal thereby helping to fill thin ribs and bases in the upper die.

89. A cup of 10 cm height and 5 cm diameter is to be made from a sheet metal of 2 mm thickness. The number of deductions necessary will be

- (a) one
- (b) two
- (c) three
- (d) four

90. Match List-I (Metal forming process) with List-II (Associated force) and select the correct answer using the codes given below the lists:

List-I	List-II
A. Wire drawing	1. Shear force
B. Extrusion	2. Tensile force
C. Blanking	3. Compressive force
D. Bending	4. Spring back force

Codes:

	A	B	C	D
(a)	4	2	1	3
(b)	2	1	3	4

- (c) 2 3 1 4
(d) 4 3 2 1

91. In wire drawing process, the bright shining surface on the wire is obtained if one

- (a) not using a lubricant
(b) low tooling cost
(c) uses thick paste lubricant
(d) use thin fluid lubricant

92. Which one of the following is an advantage for forging?

- (a) Good surface finish
(b) Low tooling cost
(c) Close tolerance
(d) Improved physical property

ANSWER KEY

1. (b)	24. (c)	47. (a)	70. (a)
2. (c)	25. (c)	48. (b)	71. (a)
3. (a)	26. (b)	49. (b)	72. (a)
4. (a)	27. (a)	50. (a)	73. (d)
5. (c)	28. (a)	51. (c)	74. (b)
6. (a)	29. (b)	52. (c)	75. (d)
7. (a)	30. (b)	53. (c)	76. (d)
8. (c)	31. (c)	54. (c)	77. (a)
9. (a)	32. (b)	55. (c)	78. (c)
10. (b)	33. (c)	56. (c)	79. (c)
11. (b)	34. (d)	57. (a)	80. (d)
12. (c)	35. (b)	58. (d)	81. (c)
13. (b)	36. (a)	59. (b)	82. (c)
14. (d)	37. (c)	60. (a)	83. (b)
15. (c)	38. (d)	61. (a)	84. (b)
16. (b)	39. (b)	62. (b)	85. (d)
17. (b)	40. (b)	63. (d)	86. (c)
18. (b)	41. (b)	64. (c)	87. (a)
19. (b)	42. (b)	65. (b)	88. (a)
20. (c)	43. (b)	66. (a)	89. (c)
21. (c)	44. (a)	67. (b)	90. (c)
22. (c)	45. (a)	68. (d)	91. (d)
23. (c)	46. (c)	69. (d)	92. (d)

Sol-1: (b)

Bamboo defect is surface cracking at low temperature in hydrostatic extrusion. The cracks appear at spaced intervals around the part's periphery resembling a bamboo tree.

Sol-2: (c)

Forgings have high strength and reduced ductility due to work hardening. Forging have high impact and fatigue strength as well.

Sol-3: (a)

Extrusion is not economical for large billets as large forces are required to overcome the friction between the workpiece and cylinder wall.

Sol-4: (a)

In closed die drop forging the excess material added to stock is called flash. Since, this flash cools more rapidly and offers resistance to further flash formation and helps in complete filling of die.

The flash acts as barrier or cushion for further metal flow and facilitates finishing the impression of on forgings.

Sol-5: (c)

In wire drawing, the end of stock is made pointed to facilitate entry into the die. This pointed end can be made by simple hammering or rotary swaging.

Sol-6: (a)

Recrystallization temperature of a metal depends on

- (1) Degree of cold working:- Higher the degree of cold working, lower is the recrystallization temperature.
- (2) Annealing temperature and
- (3) Impurities in metals, higher the impurities, difficult is the process of recrystallization.
- (4) High temperature results in faster recrystallization.

Sol-7: (a)

In petroforge which is similar to combustion engine cylinder where a fuel air mixture is used to power upper portion of die to forge components at a speed of 150-200 m/s.

Sol-8: (c)

- Small cavities are provided which are directly outside the die impression.
- The volume of flash land and flash gutter should be about 20% - 25% of the volume of forging.
- Gutter is provided to ensure complete closing of the die.

Sol-9: (a)

Rotary swaging is used to shape round bars and tubes such as gun barrels

Sol-10: (b)

In wire drawing operation, drawing stress can never be more than yield stress. For perfectly plastic material in ideal condition,

$$\sigma_d = \sigma_y \ln \left(\frac{A_0}{A_f} \right)$$

$$\sigma_y = \sigma_y \ln \left(\frac{A_0}{A_f} \right) \quad (\because \sigma_d = \sigma_y)$$

$$1 = \ln \left(\frac{A_0}{A_f} \right)$$

$$\therefore \frac{A_0}{A_f} = e$$

$$\text{Maximum reduction per pass} = \frac{A_0 - A_f}{A_0}$$

$$= 1 - \frac{A_f}{A_0} = \left(1 - \frac{1}{e} \right)$$

$$= 0.63 = 63\%$$

Sol-11: (b)

In rolling operation when the strip is passed through roll gap, the velocity of the strip increases from its entry value and is highest at the exit from the roll gap. Because the surface speed of the roll is constant, there

is relative sliding between the roll and the strip along the arc of contact in the roll gap. At one point along the contact length, called the neutral point or no-slip point, the velocity of strip is the same as that of the roll. To left of this point, the roll moves faster than the strip, to the right of this point, the strip moves faster than the roll.

Sol-12: (c)

Hollow backward extrusion (impact extrusion) is used with low strength metals such as lead, tin, zinc and aluminium to produce collapsible tubes for toothpaste, medications and other creams.

Sol-13: (b)

In drawing process, the cross-section of a round wire is typically reduced or changed by pulling it through a die. Although very fine wire can be produced by drawing, the cost can be high. So in order to increase productivity, many wire are drawn simultaneously as a bundle, called bundle drawing. But bundling produces wires that are somewhat polygonal in cross-section rather than round.

Sol-14: (d)

Extrusion is carried out at elevated temperatures for metals and alloys that do not have sufficient ductility at room temperature, in order to reduce the forces required, i.e., extrusion pressure decreases with increase in speed of hot extrusion, there may be melting of alloy constituents.

Sol-15: (c)

For producing gears by extrusion, the blank (billet) is passed through a die, thus producing gears whose outside surface is hard and smooth.

So, statement (II) is incorrect.

Sol-16: (b)

Dies used in forging are generally made in two parts. Upper half is movable and lower

half of die is fixed. The material is compressed by downward motion of the upper half of the die.

Sol-17: (b)

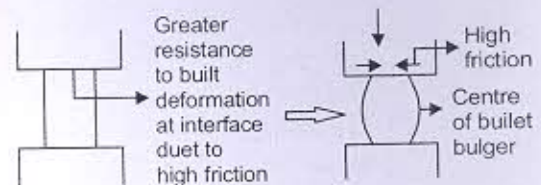
Both statements are individually true. In HERF process, high energy is applied to workplace in a short duration of time in the form of compressive shock wave.

Sol-18: (b)

Hammer forging can be gravity hammer drop where parts are forged by hammer due to gravity force. Power forging involves hammer movement by compressed air or oil pressure.

Sol-19: (b)

Lubricated specimens show more surface movement than unlubricated ones. Also, barreling is a forging defect, which occurs as billet faces greater resistance to deformation at die billet interface, consequently, centre portion of billet bulges and may crack



Barreling can be avoided by proper lubrication at die billet interface.

Sol-20: (c)

Forging greatly improves mechanical properties of the forged part including fatigue strength. Therefore, forging improves reliability of the part.

Unidirectional fibres are distorted and grain boundaries have random orientation.

Forging involves plastic deformations.

Sol-21: (c)

Forgeability is the ability of the work material to get forged. It is not the property of forging tool. Mechanical properties do improve during forging (due to strain hardening). Pure metals having good malleability have good forging properties under compressive stresses.

Sol-22: (c)

Assumptions in analysis of open die forging are:

1. Forging force attains maximum value at the end of operation.
2. Stresses in Y direction are assumed to be negligible and
3. Coefficient of friction is constant between workplace and die.

Sol-23: (c)

In indirect extrusion, the billet is stationary and there is no relative motion between billet and container walls. This results in lower friction and thus lower force is required in indirect extrusion.

Sol-24: (c)

Extrusion process can effectively reduce the cost of product through saving in tooling cost as it requires a die having an orifice that has a good life cycle.

Sol-25: (c)

Electrohydraulic forming is a HERF process. Explosive fabrication is a welding process and not same as explosive forming.

Sol-26: (b)

Undercutting severely reduces the capacity of workplace to carry stresses due to excessive stress concentration in cuts. Thus, parts having undercuts cannot undergo large plastic deformations.

Sol-27: (a)

Forging press ensures that deformed metal fills cavities and corners of small radius and it gives energy at a low rate so that enough time is available for deformation of metal.

Sol-28: (a)

Fullerjing : Deforming material away from center.

Swaging : Repeated radial hammer blows to increase the length.

Welding : It is a separate fabrication process of joining of metals.

Sol-29: (b)

Connecting rods: Forging (as these are subjected to fatigue loading, they must have high fatigue strength).

Pressure vessels: Welding (to make them leak proof).

Machine tool beds : Casting (Due to there large size and excellent suitability of cast iron).

Collapsible tubes : Impact extrusion.

Sol-30: (b)

- Magnetic pulse forming is most affective method to deform thin metal sheets or deform thin tubes.
- Explosive forming is not suitable for this sheet and thin tubes as amount of energy released is too high and it may damage the workpiece.

Sol-31: (c)

Inclusions are casting defects, where foreign material is trapped in the casting while solidifications. Hot tears are cracks in the work. There is no chemical bonding between inclusion and parent material.

Sol-32: (b)

Lead, zinc and tin are hot worked because they have low melting points and their recrystallisation temperature is below room temperature.

Sol-33: (c)

Number of edge dislocations increases exponentially when stress is applied to crystalline materials. Point defects result during the casting stages and not thermal fluctuations.

Sol-34: (d)

Sol-35: (b)

Plastic deformation depends on stress applied (higher the stress, higher is the deformation), temperatures (high temperature, high deformation) and strain rate. Plastic deformation increases number of dislocations inside the material.

Sol-36: (a)

In explosive forming, the gas pressure generated is directly proportional to weight of explosive and inversely proportional to the distance between work and explosive. By varying both these parameters gas pressure and rate of detonation can be controlled.

$$\text{Peak pressure (P)} = K \left[\frac{\sqrt[3]{M}}{R} \right]^a$$

M = Weight of explosive

R = Distance between explosive and work

K = Constant depending on type of explosive

Sol-37: (c)

Washing and pickling is carried out to remove oxide layer(scale) from rod surface and to remove other surface impurities like rust etc. It does not lubricate the rod surface.

Sol-38: (d)

In hot working, ductility increases due to high temperatures involved but has no appreciable effect on ultimate tensile strength. Surface finish is poor due to oxide scale formation at high temperatures and due to this accuracy is not maintained.

Porosity is largely eliminated as cavities, micro porosity and voids are filled under the action of hot working.

Sol-39: (b)

- Wire drawing involves tensile stress.
- Rolling and extrusion involves compressive stress
- Sheet metal forming process involves shear stress.

Sol-40: (b)

- In extrusion, thinner walls can be obtained by increasing the forming pressure and thicker walls can be obtained by increasing the gap between mandrel and die wall.
- It is an ideal process for obtaining rods having poor ductility.

- As compared to roll forming extruding speed is low.
- Impact extrusion is quite similar to Hooke's process but the flow of metal is in opposite direction.

Sol-41: (b)

Design of die is important in hot extrusion and there are chances of heat checking in dies (cracks due to thermal stresses).

Due to alternate heating and cooling of dies in each extrusion cycle, fluctuating thermal stress develops in dies.

Sol-42: (b)

Electrohydraulic forming is a HERF process where a capacitor bank is used to produce an electric arc shock wave through a liquid to form the workpiece.

Roll forming, rotary forging & forward extrusion are normal forming processes.

Sol-43: (b)

Metal forming improves mechanical properties due to strain hardening. It is a plastic deformation process. Forging is not suitable for producing intricate shapes compared to casting.

Sol-44: (a)

Smith forging : Carried out manually in open dies.

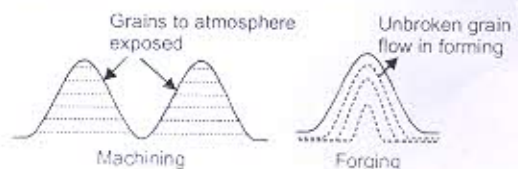
Drop forging : Closed impression dies by hammer blows.

Press forging : Closed impression dies by continuous squaring force.

Machine forging : Material only upset to get the desired shape.

Sol-45: (a)

Improved quality in cold forging is due to better mechanical properties (strain hardening) unbroken grain flow and better surface finish (due to no scale formation)

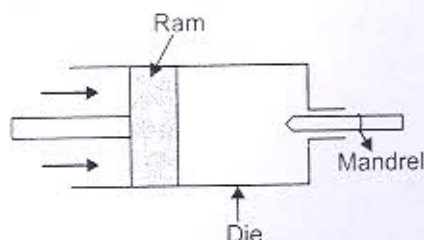


Sol-46: (c)

Long steel wire can be made by drawing. Extrusion is not a suitable process for steels. Deep drawing are used to produced cups and deep parts.

Sol-47: (a)

Extrusion is used to produce seamless tubes with the use of a mandrel



Sol-48: (b)

In high energy rate forming (HERF) process high amount of energy is applied to work in a very small amount of time. These process include explosive forming, electrohydraulic forming and electromagnetic forming. Roll forming is a normal forming process and not a HERF.

Sol-49: (b)

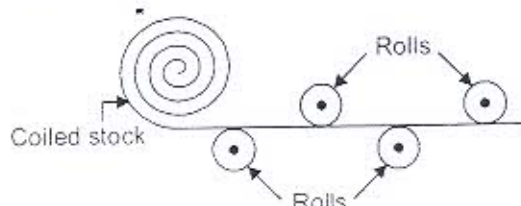
Greater force on the plunger is required in core of direct or forward extrusion than indirect one because it has to overcome the friction between billet and container, which is absent in indirect extrusion.

Sol-50: (a)

Main advantage of hydrostatic extrusion is that brittle materials can be extruded as hydrostatic pressure improves ductility of the material.

Sol-51: (b)

Roll bending is a continuous bending process in which upper roll controls that degree of curvature.



Sol-52: (c)

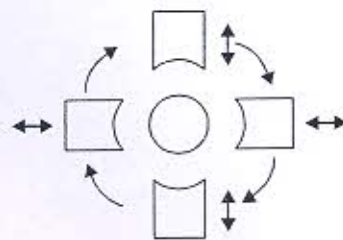
Forging dies are provided with taper or draft angles on vertical surfaces to facilitate easy removal of the part from the die.

Sol-53: (c)

While cast iron being very hard and brittle has very limited applications. Some of them are extrusion nozzles, roll mills due to high wear resistance.

Sol-54: (c)

- Trimming removes burrs and flash from forged component in drop forging
- Swaging is to reduce diameter of solid rod or hollow rods by radial impacts from headers. Generally used to form gun barrels



- Fettling is removing extra material from casting
- Perforating is producing closely spaced holes in sheet metal

Sol-55: (c)

Magnetic forming is a high energy rate forming (HERF) process.

Sol-56: (c)

- **Drop forging** : Repeated hammer blows under gravity force only.
- **Press forging** : Squaring action.
- **Upset forging** : Metal is gripped in the dies and pressure is applied on the heated end.
- **Roll forging** : Metal is placed between rollers and pushed.

Sol-57: (a)

- Only tensile stresses are involved in wire drawing operation.
- Extrusion involves compressive forces only.

- Deep drawing involves tensile and compressive stress.

Sol-58: (d)

Compression moulding : Analogous to hot pressing of powdered metals.

Injection moulding : Analogous to die casting of metals.

Jet moulding : Mould cavity must be heated to cure the plastic forced into it.

Extrusion moulding : Similar to hydraulic extrusion.

Sol-59: (b)

In comparison to hot working in cold working

- Higher forces are required as deformation is undertaken below recrystallization temperature
- No heating is required.
- High ductility is required i.e. annealing is required between successive stages of deformation.
- Better surface finish is obtained as no scale is formed on metal surface.

Sol-60: (a)

Advantages of cold working are :

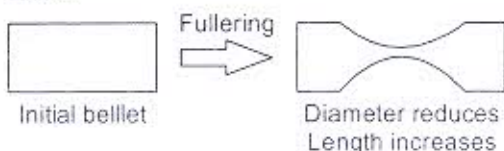
- Better mechanical properties (strength and hardness) due to strain hardening
- Good surface finish

Disadvantages include :

- High stresses in metal as deformation is carried out below recrystallization temperature
- Grain structure gets distorted

Sol-61: (a)

Fullering is the process where diameter of bar is reduced and in process making it longer



Sol-62: (b)

Initial height of strip

$$h_1 = \frac{6.35}{0.7} = 9.072$$

$$\text{Draft } \Delta h = h_1 - h_2 = 2.7214 \text{ mm}$$

$$\text{also } \Delta h = 2R(1 - \cos \alpha)$$

$$\frac{\Delta h}{2R} = 1 - \cos \alpha$$

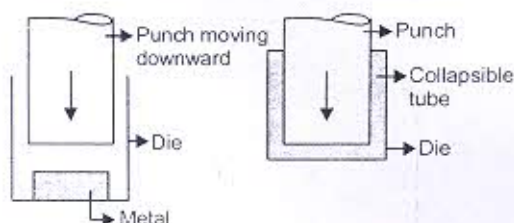
$$\cos \alpha = 1 - \frac{\Delta h}{2R} = 1 - \frac{2.7214}{2 \times 500} = 0.99728$$

$$\alpha = 4.227^\circ$$

$$\text{or } 4.227 \times \frac{\pi}{180} = 0.0738 \text{ radians}$$

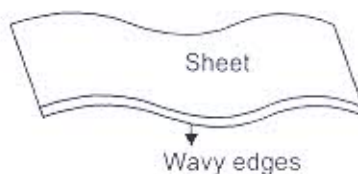
Sol-63: (d)

Impact extrusion is used to produce toothpaste tubes. Here a punch descends in a die forcing the material in between the clearance of punch and die. Impact extrusion is similar to indirect extrusion. It is used for extruding non ferrous metals



Sol-64: (c)

Wavy edges is breaking of edges of sheets while rolling. The sheet becomes thinner at the edges and thick at the centre. Wavy edges occur due to roll bending



Sol-65: (b)

The correct sequence is

Fullering → Edging → Blocking → Finis high → Trimming



Blocking operation provides a rough shape to billet.

Sol-66: (a)

Seamless tube : Roll forming (Here rod is placed between rotating rolls and a mandrel is used to produce tubes).

Accurate and smooth tubes : Cold forming.

Surface having high hardness and fatigue strength : Shot peening (Here small diameter balls are shot at high speed at the workpiece surface. These balls introduce compressive stress on surface due to small plastic deformation).

Sol-67: (b)

Shear reduce maximum cutting force on punch however, shear has no effect what so ever on total energy needed. However, shear on punch increase the depth of die as punch travel increases.

Sol-68: (d)

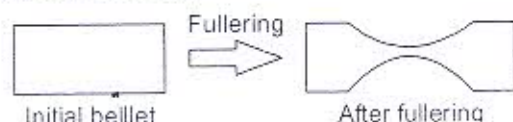
Maximum draft is $\mu^2 R$.

Sol-69: (d)

The position of neutral point in arc of contact does not depend on material of rolls. However, it depends on diameter of rolls, coefficient of friction and the amount of reduction.

Sol-70: (a)

Fullering is an operation in which material is drawn out the material. The length of rod also increases.



Sol-71: (a)

The coefficient of friction though constant, does not act in one direction. The direction of friction force changes direction before and

after neutral point. The arc of contact is always greater than radius of roll and material behaves as plastic.

Sol-72: (a)

Maximum draft = $\Delta h = \mu^2 R$

$$\mu = \sqrt{\frac{\Delta h}{R}} = \sqrt{\frac{15}{150}} = \sqrt{0.1} = 0.32 \approx 0.35$$

Sol-73: (d)

Hydrostatic extrusion is especially used for extruding brittle and high strength alloys as no direct ram pressure is applied to billet rather pressure is transferred from ram through a suitable fluid.

Sol-74: (b)

Best position of crank is 20° degrees below the top dead center.

Sol-75: (d)

Base with stand : Casting

Blade : Stamping and pressing

Armature coil wire : Wire drawing

Armature shaft : Turning

Sol-76: (d)

Annealing is must between successive deformation stages. Otherwise strain hardening will be so much that material will crack under stress. Also, cold working is carried below recrystallization temperature.

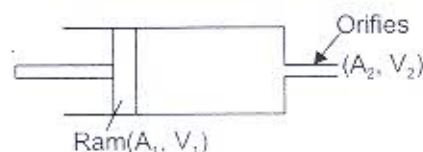
Sol-77: (a)

Roll separating force can be decreased by

- (i) Reducing roll diameter
- (ii) Reducing friction between roll and work
- (iii) Introducing back tension

Sol-78: (c)

In forward extrusion, the ram and product travel in same direction. The speed of extruded product is higher than speed of ram due to reduction in area.



Applying equation of continuity

$$A_1 \times V_1 = A_2 \times V_2$$

Since $A_1 > A_2$

$$V_2 = \frac{A_1}{A_2} \times V_1$$

$$V_2 > V_1$$

Sol-79: (c)

Lubricants are essential to improve Die life, drawing forces improve finish and control temperatures in wire drawing. Type of lubrication are

- (i) **Wet lubrication** : Rod and die are completely immersed in oils and emulsions containing chlorinated additive to sustain high pressures.
- (ii) **Dry lubrication** : Here rods are seated with either a lime or soap powder. Lime or soap are basic in nature and they neutralize the acid retained on surface during pickling process.
- (iii) Sometimes rod is coated with a softer material, that act as a lubricant (either copper or tin).
- (iv) Sometimes, ultrasonic vibrations are also used to induce vibrations between rod and die.

Sol-80: (d)

Drawing : Ironing (to obtain final size).

Rolling : Roll camber (to negating bending of rolls).

Wire drawing : Soap solution (used as lubricant).

Sheet metal operations : Pilots (to guide upper portion of die with progressive dies exactly over lower part).

Sol-81: (a)

Correct sequence of operation to produce hexagonal bolt is

Upsetting → Flattering → Swaging → Cambering

Sol-82: (c)

For aluminium the temperature range in hot extrusion is 430 – 480°C. For other commonly exuded metals the temperature range are

Copper & Alloys → 650°C – 900°C

Lead → 200° – 250°C

Steels are generally not extruded.

Sol-83: (b)

In metal forming there is always a limit beyond which if area reduction is done, cracks may appear an workplace.

Also, area reduction goes on decreasing in successive passes.

Sol-84: (b)

Main reason for earing in a drawn cup is due to anisotropy i.e. variation in material properties in different directions.

Sol-85: (d)

In blanking operation, clearance is provided on the punch and not on the die.

Sol-86: (c)

Closed die press forging is used to produce bolt heads of hexagonal shape as it gives better dimensional accuracy.

Sol-87: (a)

Ratio of bending force in V bending, U bending and edge bending is 1 : 2 : 0.5.

Sol-88: (a)

Gutter is provided in dies to curve that flash flows into gutter, thereby providing resistance to metal flow. This resistance ensure complete filling of die.

Sol-89: (c)

Three number of deduction are necessary.

Sol-90: (c)

Wiredrawing : Tensile force

Extrusion : Compressive force

Blanking : Shear force

Bending : Spring back force

Sol-91: (d)

Bright surface in wire drawing is obtained by using a thin fluid lubricant.

Sol-92: (d)

Forging improves physical properties (like strength including both fatigue properties).

CHAPTER : 02
MECHANICAL FORMING PROCESSES

SHORT TYPE QUESTIONS AND ANSWERS

QUESTIONS WITH ANSWERS

1. What are the factors affect the plastic deformation in material?

Ans. (1) Types of material
(2) Manner of loading
(3) Strain rate
(4) Temperature
(5) Surface treatment
(6) Stress distribution.

2. State TRESCA'S YIELDING CRITERION?

Ans. Plastic flow initiates when maximum shear stress reaches a limiting value. The limiting values is defined as shear yield stress 'k'. If the principal stresses at a point in the material are σ_1, σ_2 & σ_3 . Then the maximum shear stress τ_{\max} is given by
$$\tau_{\max} = \frac{\sigma_1 - \sigma_3}{2}$$
 Plastic deformation occurs when τ_{\max} is equal to 'K'.

3. State Van mise's yielding criterion.

Ans. Plastic flow occurs when the shear strain energy reaches a critical value. The shear strain energy per unit volume can be expressed as

$$\Delta = \frac{1}{12G} \left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2 \right]$$

G - Modules of rigidity

4. Why Van mises criterion is more acceptable one?

Ans. Among the 2 yield criterion von mises's is more appropriate because it considering all the 3 values of principal stress i.e., σ_1, σ_2 & σ_3 , but on TRESCA's criterion it is silent about intermediate value of principal stress.

5. Differentiate between normal strain and natural strain.

Ans. Normal strain is the change in length with respect to original length where as natural strain is the change on length with respect to constant a news length.

6. What is recrystallization temperature.

Ans. It is the temperature at which the new grains are starts to forms by eliminating the previous grain structure of the metal. It is always less than the melting point of the metal. Ex- For steel of is nearly 800°C.

7. Differentiate between cold working and hot working processes.

Ans. Cold working

- (1) It is carried out below recrystallization temperature.
- (2) The metal gets hanened because working is below recrystallization temperature.
- (3) Residual stresses are developed on this process.
- (4) It decreases elongation reduction of area and toughrun.
- (5) Force required for deformation is more.
- (6) Better surface finish is achieved.

Hot working

- (1) It is carried out above the recrystallization temperature but below melting point.
- (2) Due to recrystallization no handening of metal takes place.
- (3) No residual stresses are set up in the metal.
- (4) Mechanical properties such as toughous.
- (5) Very less deforming force is required
- (6) Poor surface finish is obtained.

8. Write the types of P metal forming process basing upon the deforming forces.

Ans. There are 5 types basic metal forming process basing upon the nature of deforming forces.

(1) Direct forming process

(2) Indirect forming process

(3) Tension type forming process

(4) Bending type forming process

(5) Shearing type process

9. What is the principle of rolling in planetary rolling mills?

Ans. In this rolling mills rolling action is performed by number of small rollers which are equispaced in the periphery of a large back up rolls. Small rolls revolve about the axis of the larger rolls as the planet revolves and the sun.

10. What is cambering?

Ans. Process of providing convexity to the rolls along its longitudinal axis is known as cambering, this helps to avoid roll bending by the action of roll separating force.

11. Why camber is provided?

Ans. Cambering is done on the rolls to prevent different defects on rolling component like zippen breaks and wavy edges etc.

12. What is flash in the forging?

Ans. The excess metal is added to the stock to ensure complete filling of the die cavity on the finishing impression is called flash.

13. What is flakes?

Ans. It is a forging defects fund on the forging component i.e., internal rupture caused by the improper cooling rate.

14. In which process collapsible metallic tubes for toothpastes are produced?

Ans. Collapsible metallic tubes for toothpastes are produced through impact extrusion.

15. Write different tube making processes.

Ans. (1) Direct extrusion

(i) Using double action process

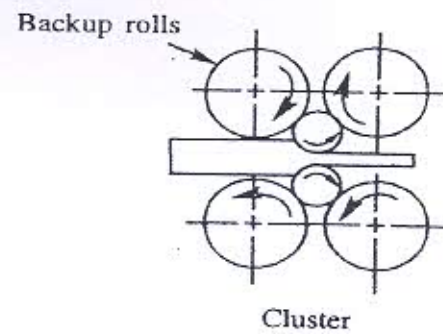
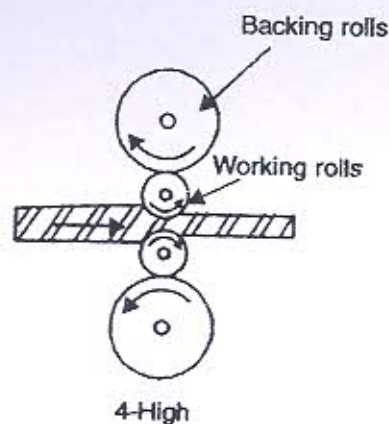
(ii) Using spider die

(2) Rolling (Hot piercing)

(3) Bending and Seam welding of sheet

16. How cluster rolling mill is more effective than 4 high rolling mill?

Ans. In cluster rolling mill one working roll is supported by 2 back up rolls due to which cluster rolling milling is rigid type and same time reduction is also comparatively higher on the other hand 4 high rolling mill having one back up roll for each working roll so it is less rigid.



17. What are the advantages of Hydrostatic extrusion?

Ans. The major advantages of hydrostatic extrusion over other extrusion process are:

- (1) No special lubrication is required for the process though liquid is the medium of load transmission.
- (2) Due to presence of liquid medium uniform distribution of deforming load throughout the billet cross section.
- (3) Very negligible co-efficient of friction.
- (4) Highly brittle material can also be extruded.

ASSIGNMENT

1. Calculate:
 - (i) True stress at fracture
 - (ii) Engineering stress at fracture
 - (iii) True strain at fracture
 - (iv) Engineering strain at fractureFrom the given experimental observation
 - (1) Specimen diameter - 36 mm
 - (2) Gauge length 300 mm
 - (3) maximum load - 130 kNFracture at 110 kN
Minimum diameter at fracture - 30.6 mm
2. Establish relation between true strain and engineering strain.
3. What is alligating?
4. Describe the following forging operations
 - (i) Drawing out (ii) upsetting
5. What is the basic difference between press forging and drop forging?
6. State different defects of forging?
7. Differentiate fillet and corner radius.
8. Write the 4 applications of hydrostatic extrusion.

SOLVED PROBLEMS

- 4.1. A steel cup of height 12.5 mm and 40 mm internal dia is to be drawn from a sheet of 1 mm thick. Determine the dia of the blank draw ratio and drawing force.

Yield point $y_t = 150 \text{ MPa}$, ultimate strength = 350 MPa

Soln. Internal dia $d = 40 \text{ mm}$

height = $h = 12.5 \text{ mm}$

yield point $y_t = 150 \text{ Mpa}$

Blank dia $D = \sqrt{d^2 + 4dh}$

$$= \sqrt{40^2 + 4(40)(12.5)} = \sqrt{1600 + 2000} = 60 \text{ mm}$$

$$\text{Draw force} = \sigma_t \pi d t \left[\frac{D}{d} - 1 \right]$$

$$= 150 \times 10^6 \times \pi \times \frac{40}{1000} \times \frac{1}{1000} (1.5 - 1) = 9424.7 \text{ N} \quad (\text{Ans.})$$

- 4.2. A 2 mm thick sheet is bend as per given drawing. Calculate its develop blank length.

Soln. Stretch factor constant = 0.33

Total develop length = $\ell_1 + \ell_2 + \ell_3$

$$\ell_1 = 20 - (2 + 3) = 15 \text{ mm}$$

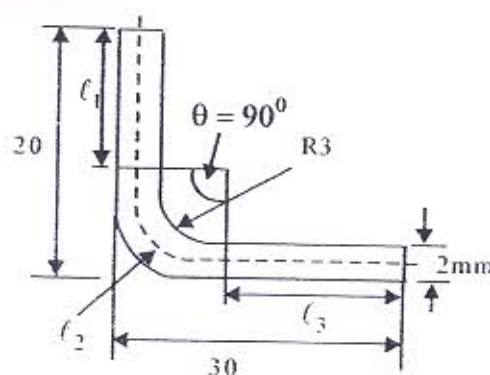
$$\ell_3 = 30 - (2 + 3) = 25 \text{ mm}$$

as the $R < 2t$ so value of $K = 0.33$

$$\ell_2 = \frac{\pi}{180} \times \theta \times (R + Kt)$$

$$= \frac{\pi}{180} \times 90 \times (3 + 0.33 \times 2)$$

$$= 5.749 \cong 5.75 \text{ mm}$$



$$L = 15 + 25 + 5.75 = 45.75 \text{ mm} \quad (\text{Ans.})$$

- 4.3. Calculate the diameter of punch and press capacity for 50 mm diameter disc to be punched out from a carbon steel sheet 1.0 mm thick. Also calculate the punch size and die size (ultimate shear stress $S = 42 \text{ kgf/mm}^2$).

Soln. Data given

$$D = 50 \text{ mm}, t = 1 \text{ mm}$$

$$\text{Shear length} = \pi D = 157.05$$

$$\text{Shear area} = \pi Dt = 157.05 \text{ mm}^2$$

Press capacity in tonnage required

$$= \frac{\pi Dt \times S}{1000} = \frac{157.05 \times 42}{1000} = 6.596 \text{ Ton} \approx 6.6 \text{ Ton}$$

Empirical formula for Clearance

$$= 0.0032 \times t \times \sqrt{\tau} \text{ mm}$$

$$\tau = \text{mat l. shear stress in MPa } 42 \text{ kgf/mm}^2 = 412 \text{ N/mm}^2$$

$t =$ sheet thickness mm

$$= 0.0032 \times 1 \times \sqrt{412} = 0.064 \text{ mm / side}$$

For blanking component size = Die size clearance will be on the punch

Die size = 50 mm

punch size = $50 - 2 \times (\text{clearance})$

$$50 - 2 \times (0.064) = 50 - 0.13 = 49.87 \text{ mm} \quad (\text{Ans.})$$

- 4.4. A 10 mm diameter holes to be punched in a steel sheet of 3 mm thickness. Shear strength of the material is 400 N/mm^2 and penetration is 40%. Shear provided on the punch is 2 mm. Calculate the blanking force during the operation will be

Soln. Data given

$$\text{Shear strength } \tau = 400 \text{ N/mm}^2$$

$$\text{Sheet thickness } t = 3 \text{ mm}$$

$$\text{Diameter of hole } d = 10 \text{ mm}$$

$$\text{Shear on punch } t_f = 2 \text{ mm}$$

Penetration of punch on fraction $p = 0.4$

Blanking force when shear is applied on the punch

$$= \pi dt \left(\frac{t_p}{t_l} \right) \tau$$

$$= \pi \times 10 \times 3 \times \left(\frac{3 \times 0.4}{2} \right) \times 400 = 22.615 \text{ kN} \quad (\text{Ans.})$$

4.5. Calculate the piercing punch size and die size to pierce a hole of $\phi 24 \text{ mm}$ on a steel sheet of 2 mm thickness (considering 5% clearance)

Soln. As per the given data

$$d = 24 \text{ mm}, t = 2 \text{ mm}$$

assumption 5% of sheet thickness as clearance per side

$$= 2 \times \frac{5}{100} = 0.1 \text{ mm / side}$$

In piercing hole size = punch size and clearance is provided on the die

So die size = $d + 2C$

$$= 24 + 2(0.1) = 24.2 \text{ mm}$$

Punch size = 24.0 mm

(Ans.)

4.6. A shell of 100 mm internal dia and 100 mm height with the corner radius of 0.4 mm is to be produced by cup drawing. Calculate its blank dia and draw ratio, can it be done by single draw if limiting draw ratio is 1.8.

Soln. Data given

d = diameter of shell = 100 mm

h = height of shell = 100 mm

r = corner radius = 0.4 mm

Since $d \geq 20r$

$$\text{Blank diameter} = \sqrt{d^2 + 4dh}$$

$$= \sqrt{(100)^2 + 4(100)(100)} = 2236 \text{ mm} \approx 224 \text{ mm}$$

$$\text{Its draw ratio} = \frac{224}{100} = 2.24 > 1.8$$

(Ans.)

So it can not be produced by single draw.

QUESTION WITH ANSWERS

1. What are the properties to be considered during selection of material for wire drawing dies?

Ans. The selection of die material generally depends upon

- (1) the composition of wire material.
- (2) size of the wire.
- (3) Finish required to produce on the wire.
- (4) Economy, life span and speed of wire drawing operation.

2. Write the name of the commonly used wire drawing die material.

Ans. Chilled cast iron, hardened alloy steel and cemented tungsten carbide, are commonly used die material for wire drawing but in some case diamond also used as wire drawing dies.

3. What are the types of bending operations generally performed on sheet metal?

Ans. There are generally 3 types of bending operation performed

- (1) L-bending
- (2) V- bending
- (3) U -bending

4. Why there is always a distortion on component shape during forming operation?

Ans. The distortion on component shape is a common phenomenon due to spring back effect of material.

5. What is the basic difference between the Embossing and coining?

Ans. During embossing operation material is deformed by the plastic flow of material through out section. So front side shape is necessarily related with rear side shape. During coining operation material is formed by the plastic flow of material only from top layers. So front side shape is not necessarily related with rear side shape.

6. What are the 3 stages of shearing in sheet metal working?

Ans. The stages of shearing action in sheet metal operation is

- (1) Plastic deformation
- (2) Penetration
- (3) Fracture

7. Differentiate between Blanking and piercing operations

Ans.	Blanking	Piercing
	(1) In this operation cut-off part is the required component	(1) In this operation cut-off part is the scrap and remaining part is useful.
	(2) Clearance is provided on the punch	(2) Clearance is provided on the die.
	(3) Burr direction is towards punch (up ward)	(3) Burr direction is towards die (down ward)
	(4) In Blanking operation normally shear is provided on the die.	(4) In piercing operation normally shear is provided on the punch face.

8. What is the effect of sheet thickness on cutting clearance?

Ans. Generally cutting clearance is expressed as % of sheet thickness but it can be calculated from the formula $C = 0.0032t\sqrt{\tau}$. So when sheet thickness increases clearance increases.

9. Why angular clearance is provided on the die?

Ans. Angular clearance is provided on the rear side of die profile for easy removal of cut-off parts from the die block.

10. What are the types of ejection technique used in deepdrawing process to remove component from die.

Ans. There are generally 4 types of ejection techniques is used of die

- (1) Spring
- (2) Rubber pad
- (3) Air ejection
- (4) Creating a contour on the backside.

11. What do mean by G.I. sheets how its quality is measured?

Ans. Stands for Galvanised Iron, It is a commercial term used to designate a process by which zinc coating is produced on a carbon steel component. Its quality is measured in terms of Kg/m² that means amount of zinc deposited over the surface area of 1 m².

12. Why 'Explosive forming' is used in aero space industry for forming?

Ans. Explosive forming is used in aerospace industry due to the forming stress is uniformly distributed over the surface and there is no chance of stress concentration upon the material, which is subject to repeated cyclic load. This forming process increases the life span of the component.

13. Why coating is done over a material?

Ans. Due to the below mentioned reason coating is provided over the material

- (1) It protects the material from corrosion and rusting.
- (2) It gives good appearance.
- (3) It increases wear resistance of the materials.
- (4) Sometimes coating is given to avoid toxic effect of materials.

14. What are the types of coating applied to metal products?

Ans. There are 4 principal types of coating/finishes applied to metal products

- (1) metallic coatings
- (2) plastic coatings
- (3) organic finishes
- (4) Inorganic finishes.

15. What is perkerising?

Ans. Perkerising is a process for placing a thin phosphate coating which serves as a base on primer, for enamels and paints on iron and steel.

16. What is 'hot dipping'?

Ans. It is a rapid, inexpensive process which allows to form coating of corrosion resistant metals into base metals by dipping in molten bath at less cost than by electroplating. Galvanizing, perkerising and tin coating are good examples of hot dipping process.

17. What is 'Diffusion-coating'?

Ans. Diffusion coating or metallic cementation is the process of impregnating the surface of steel with aluminium, chromium and berillium etc.

It is accomplished by heating and holding steel parts in direct contact with one of the above elements which may be in the solid, liquid or gaseous state.

This process imparts a number of valuable mechanical properties to steel, among which corrosion resistance wear resistance. It is also used as substitutive for alloy steel.

18. What do mean by 'metallising' and state different methods of metallising?

Ans. Metallising or metal spraying means to coat with a metal to impregnate with a metal or metallic compound. It generally includes the preparation of base metals through the spraying on the metals.

There are 2 methods of metallising commonly used.

(1) Using spray gun which uses coating material in form of wires.

(2) Metallizing equipment using powder form of coating material.

ASSIGNMENT

1. Define 'bending' operation.
2. What do mean by 'spring back effect' during sheet metal working?
3. Explain briefly with neat sketch the process of wire drawing.
4. Write short notes upon the following
 - (a) Nibbling
 - (b) Notching
5. Describe the spinning process with a neat sketch.
6. What is the basic difference between drawing and deep drawing operation?
7. Why 'shear' is provided on a punch or a die during shearing operation of sheet metal working?
8. How the punch dimension and die dimension are determined during blanking and piercing operation?
9. Briefly describe the 'Explosive forming' process.
10. Write short note on the following
 - (a) Metallizing
 - (b) Electroplating
11. Describe briefly about 'ANODIZING'.
12. Define 'Clearance' on press tool.