QP, Set A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1301 Set-A **Time: 2 Hours**

Course Name: CNC Bending **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

Q1. Which of the following is not the fabrication process?

a) Machining
b) Shearing
c) Punching
d) All of above

Q2. In forming process the physical shape is-

a) Partially deformed
b) Permanently deformed
c) Un-deformed
d) B&C

Q3. One centimeter is equivalent to

a) 10 mm
b) 1 mm
c) 0.1 mm
d) 100 mm

Q4. Metal forming is a process in which the metal is deformed plastically to get into the desired shape.

a) True
c) cannot say
b) False
d) All of the above

Q.5 which type of shape can be produced by using bending process?

a) V-Shape
b) U-Shape
c) Channel shape
d) all of the above

Q6. Which type of metal, is used in bending process?

a.) Ductile
b.) Brittle
c.) ferritic only
d.) None of these

Q7. What thing allows bent metal to come back towards its original shape?

a.) spring back
b.) bend allowance
c.) bend deduction
d.) this is not the case of bending

Q8. In which bending the distance between the punch and the side-wall of the V is greater than the material thickness (T)?

a.) Air bending
b.) bottom bending
c.) Coining
d.) rolling

Q9. Which one is the right value for K- factor?

a.) T/t
b.) t/T
c.) 2t/T
d.) 2T/t

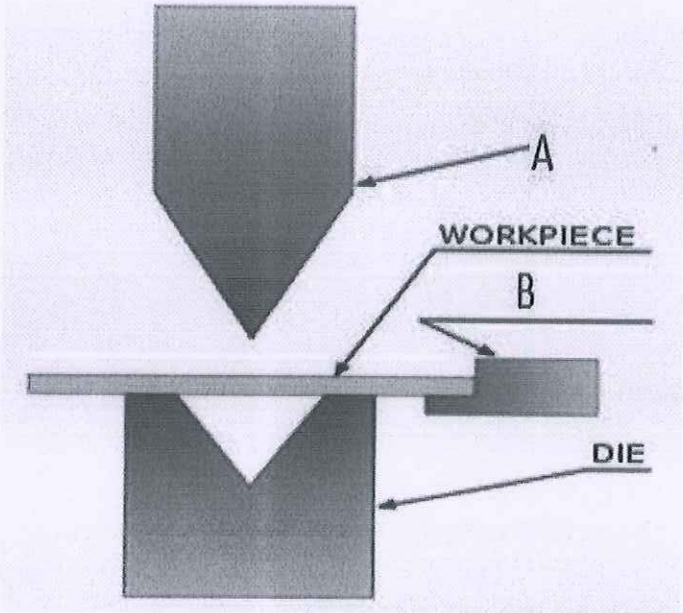
Q10. Which method is used to calculate the flat length of sheet?

a.) bend deduction
b.) bend allowance
c.) spring back
d.) a& b

Section – B

04X04 = 16 Marks

Q.11 Write the name of A and B in the given image.



Q12. What is the sheet metal?

Q13. Why bend allowance is used in bending?

Q14. Name the punches used in V bending.

Section – C

04X06 = 24 Marks

Q15. Draw a neat sketch of bent part with nomenclature.

Q16. What is the spring back? Give the reasons for its occurring.

Q17. Write the safety measures taken during bending process.

Q18. What is the bend allowance and bend deduction.

AS, Set A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1301 **Time: 2 Hours**

Course Name: CNC Bending **Max. Marks: 50**

Instruction: Answer key

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

Q.1 Which of the following is not the fabrication process?

a) Machining
b) Shearing
c) Punching
d) All of above

Ans. d)

Q.2 In forming process the physical shape is-

a) Partially deformed
b) Permanently deformed
c) Un-deformed
d) B&C

Ans. b)

Q3. One centimeter is equivalent to

a) 10 mm
b) 1 mm
c) 0.1 mm
d) 100 mm

Ans. a)

Q4. Metal forming is a process in which the metal is deformed plastically to get into the desired shape.

a) True
c) cannot say
b) False
d) All of the above

Ans. a)

Q.5 which type of shape can be produced by using bending process?

a) V-Shape
b) U-Shape
c) Channel shape
d) all of the above

Ans. d)

Q.6 Which type of metal, is used in bending process?

a. Ductile
b. Brittle

Ans. a

Q.7 What thing allows bent metal to come back towards its original shape?

a. Spring back
b. bend allowance
c. bend deduction
d. this is not the case of bending

Ans. a

Q.8 In which bending the distance between the punch and the side-wall of the V is greater than the material thickness (T)?

a. Air bending
b. bottom bending
c. Coining
d. rolling

Ans. a

Q.9 Which one is the right value for K- factor?

a T/t
b. t/T
c. 2t/T
d. 2T/t

Ans. b

Q.10 Which method is used to calculate the flat length of sheet?

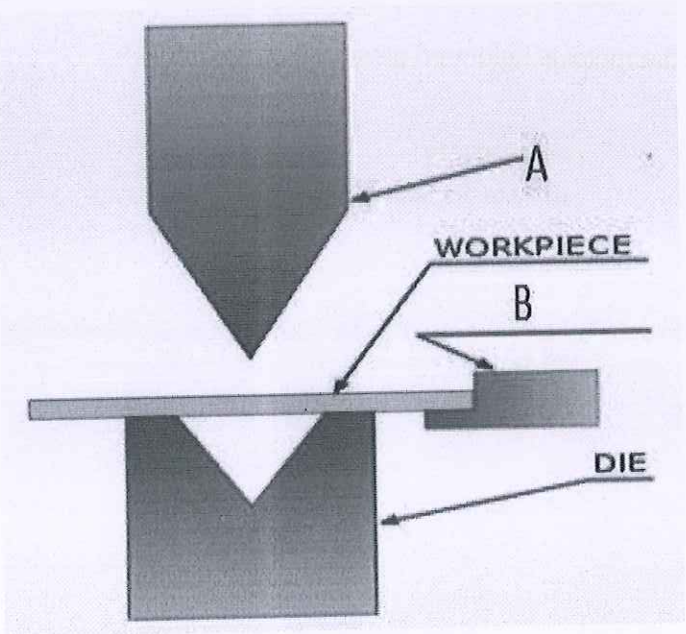
a. bend deduction
b. bend allowance
c. Spring back
d. a& b

Ans. d

Section – B

04X04 = 16 Marks

Q.11 Write the name of A and B in the given image.



Ans. A is the Punch

B is the back gauge

Q12. What is the sheet metal?

Ans. Sheet metal is any metal in the sheet form, which is thicker than 0.4 mm and thinner than 6mm.

Sheet metal is metal formed by an industrial process into thin, flat pieces. Sheet metal is one of the fundamental forms used in metalworking, and it can be cut and bent into a variety of shapes. Countless everyday objects are fabricated from sheet metal. Thicknesses can vary significantly; extremely thin sheets are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate steel or "structural steel".

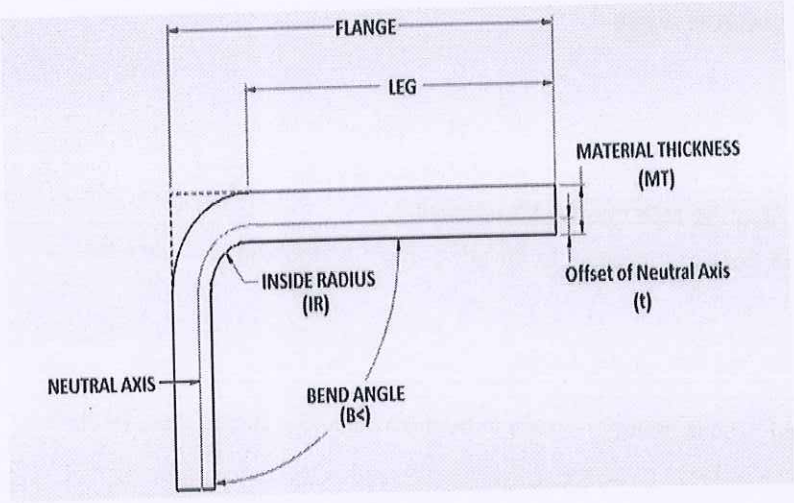
Sheet metal is available in flat pieces or coiled strips. The coils are formed by running a continuous sheet of metal through a roll slitter.

Q13. Why bend allowance is used in bending?

Ans. Bend allowance is used in bending to calculate the flat length of the bent sheet.

The bend allowance defines the material you will need to add to the actual leg lengths of the part in order to get the flat pattern cut to a correct size.

The legs of the part are the sides outside of the bend which you can see on the image below.



Q14. Name the punches used in V bending.

Ans. Normally there are three types of punches, which are used in v-bending

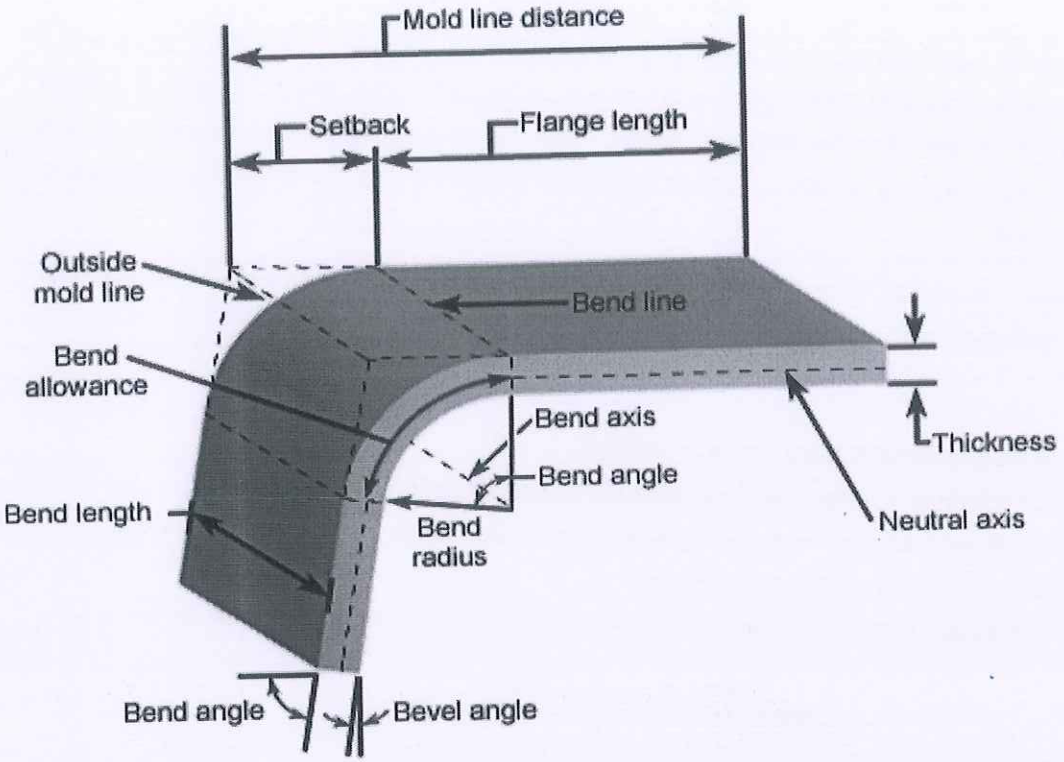
1. Straight punch
2. Gooseneck punch
3. Radius punch
4. Acute punch

Section – C

04X06 = 24 Marks

Q.15 draw a neat sketch of bent part with nomenclature.

Ans.



Q.16 What is the spring back? Give the reasons for its occurring.

Ans. Increase in included angle of bent part relative to included angle of forming tool after tool is removed is called spring back.

Reasons of spring back:

When bending pressure is removed, elastic energy remains in bent part, causing it to recover partially toward its original shape

The tensile strength and thickness of the material, type of tooling, and the type of bending all greatly influence spring back.

Q.17 Write the safety measures taken during bending process.

Ans.

- Always wear protective safety equipment such as safety gloves, safety goggles and work boots. These will protect your hands, eyes and feet from any scrap metal or sharp equipment.
- Keep your work surface clean and clear of metal scrap to avoid injury.

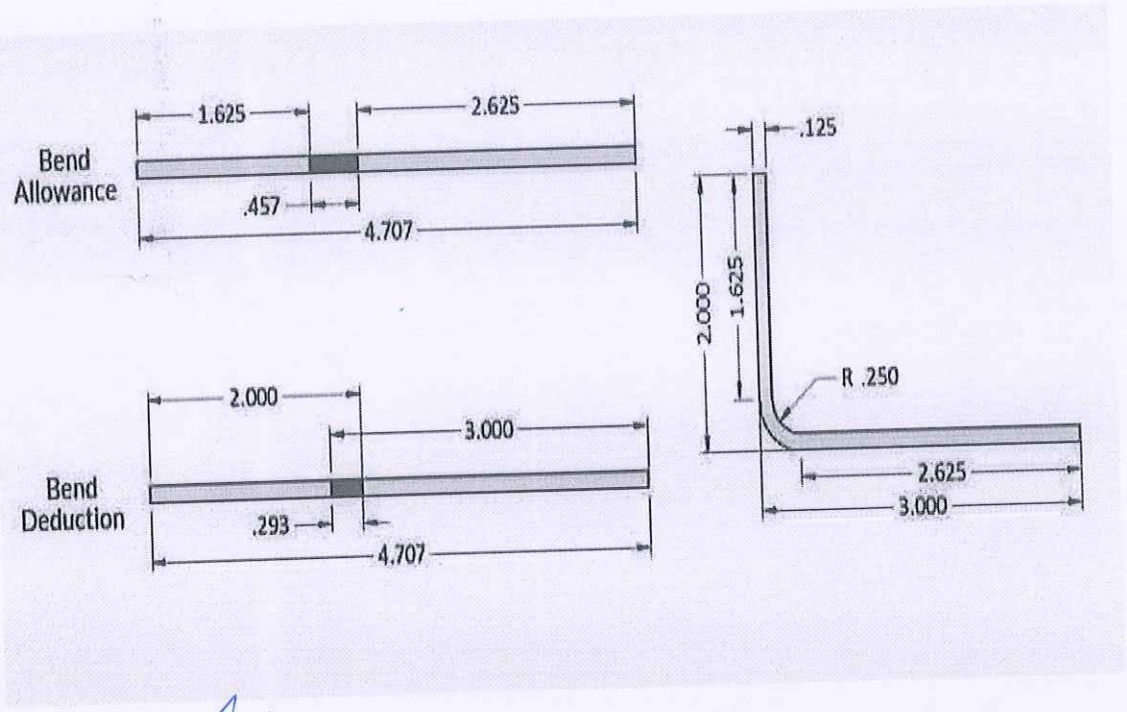
Don't run your hands over a sharp cut, even when wearing gloves, and ensure metal burrs are always filed properly to avoid injury.

- Always be careful when handling wet metal sheets as they can be very slippery and hard to grip onto.

Q.18 What is the bend allowance and bend deduction.

Ans. Bend allowance: - The *bend allowance* (BA) is the length of the arc of the neutral line between the tangent points of a bend in any material.

Bend deduction:- The *bend deduction* BD is defined as the difference between the sum of the flange lengths (from the edge to the apex) and the initial flat length.



Verified.

QP. Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1301 Set-B **Time: 2 Hours**

Course Name: CNC Bending **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

Q1. Bending stress is

a) Neither tensile nor compressive stress
b) Tensile or compressive but cannot be added algebraically with direct tensile stress
c) Tensile or compressive and can also be added algebraically with direct tensile stress
d) None of the above

Q2. What is the expression of the bending equation?

a) $M/I = \sigma/y = E/R$
b) $M/R = \sigma/y = E/I$
c) $M/y = \sigma/R = E/I$
d) $M/I = \sigma/R = E/y$

Q3. In which bending the distance between the punch and the side-wall of the V is greater than the material thickness (T)?

a.) Air bending
b.) Bottom bending
c.) Coining
d.) Rolling

Q4. Which one is the right value for K- factor?

a.) T/t
b.) t/T
c.) 2t/T
d.) 2T/t

Q5. Which method is used to calculate the flat length of sheet?

a.) bend deduction
b.) Bend allowance
c.) spring back
d.) a& b

Q6. Metal forming is a process in which the metal is deformed plastically to get into the desired shape.

a) True
b) False
c) cannot say
d) All of the above

Q7. What thing allows bent metal to come back towards its original shape?

a.) spring back
b.) Bend allowance
c.) bend deduction
d.) This is not the case of bending

Q8. The bend deduction BD is defined as the difference between the sum of the

a.) flange lengths & initial flat length
b.) Initial length
c.) flange width only
d.) None of the above

Q9. Sheet metal thickness is up to…

a.) 10mm
b.) 6mm
c.) 100mm
d.) 2mm

Q10. Spring back is due to stored ….

a.) Heat energy
b.) Current
c.) Elastic energy
d.) None of the above

Section – B

04X04 = 16 Marks

Q11. What is the difference between the fabrication and manufacturing?

Q12. Write the safety measures taken during bending process.

Q13. What is the K-factor?

Q14. Why bend allowance is used in bending?

Section – C

04X06 = 24 Marks

Q15. Write the advantages of bending process.

Q16. Draw a neat sketch of bent part with nomenclature.

Q17. What is the bend allowance and bend deduction.

Q18. Make a neat sketch of bending machine.

Vetted

AS, Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1301 **Time: 2 Hours**

Course Name: CNC Bending **Max. Marks: 50**

Answer key

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Section – A

10X01 = 10 Marks

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a) Neither tensile nor compressive stress
b) Tensile or compressive but cannot be added algebraically with direct tensile stress
c) Tensile or compressive and can also be added algebraically with direct tensile stress
d) None of the above

Ans: c

Q2. What is the expression of the bending equation?

a) $M/I = \sigma/y = E/R$
b) $M/R = \sigma/y = E/I$
c) $M/y = \sigma/R = E/I$
d) $M/I = \sigma/R = E/y$

Ans: a

Q3. In which bending the distance between the punch and the side-wall of the V is greater than the material thickness (T)?

a.) Air bending
b.) bottom bending
c.) Coining
d.) rolling

Ans. a

Q4. Which one is the right value for K- factor?

a.) T/t
b.) t/T
c.) 2t/T
d.) 2T/t

Ans. b

Q5. Which method is used to calculate the flat length of sheet?

a.) bend deduction
b.) bend allowance
c.) spring back
d.) a& b

Ans. d

Q6. Metal forming is a process in which the metal is deformed plastically to get into the desired shape.

a) True
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d) All of the above

Ans. a)

Q7. What thing allows bent metal to come back towards its original shape?

a.) spring back
b.) bend allowance
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d.) This is not the case of bending

Ans. a

Q8. The bend deduction BD is defined as the difference between the sum of the

a.) flange lengths & initial flat length
b.) Initial length
c.) flange width only
d.) None of the above

Ans. a

Q9. Sheet metal thickness is up to...

a.) 10mm
b.) 6mm
c.) 100mm
d.) 2mm

Ans. b

Q10. Spring back is due to stored ....

a.) Heat energy
b.) Current
c.) Elastic energy
d.) None of the above

Ans. c

Section – B

04X04 = 16 Marks

Q11. What is the difference between the fabrication and manufacturing?

Ans. The key difference between manufacturing and fabrication is how much of the process a job involves. Fabrication involves the assembly of standard or specialized parts to form parts of a product to be used in the manufacture of the finished piece. Manufacturing, however, is a start to finish movement, from the creation of parts through to the final assembly to produce a finished product, often using areas of fabrication within the manufacturing process.

Q12. Write the safety measures taken during bending process.

Ans.

AS, Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1301 **Time: 2 Hours**

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Section – A

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b) Tensile or compressive but cannot be added algebraically with direct tensile stress
c) Tensile or compressive and can also be added algebraically with direct tensile stress
d) None of the above

Ans: c

Q2. What is the expression of the bending equation?

a) $M/I = \sigma/y = E/R$
b) $M/R = \sigma/y = E/I$
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d) $M/I = \sigma/R = E/y$

Ans: a

Q3. In which bending the distance between the punch and the side-wall of the V is greater than the material thickness (T)?

a.) Air bending
b.) bottom bending
c.) Coining
d.) rolling

Ans. a

Q4. Which one is the right value for K- factor?

a.) T/t
b.) t/T
c.) 2t/T
d.) 2T/t

Ans. b

Q5. Which method is used to calculate the flat length of sheet?

a.) bend deduction
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d.) a& b

Ans. d

Q6. Metal forming is a process in which the metal is deformed plastically to get into the desired shape.

a) True
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Ans. a)

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a.) spring back
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Ans. a

Q9. Sheet metal thickness is up to…

a.) 10mm
b.) 6mm
c.) 100mm
d.) 2mm

Ans. b

Q10. Spring back is due to stored ….

a.) Heat energy
b.) Current
c.) Elastic energy
d.) None of the above

Ans. c

Section – B

04X04 = 16 Marks

Q11. What is the difference between the fabrication and manufacturing?

Ans. The key difference between manufacturing and fabrication is how much of the process a job involves. Fabrication involves the assembly of standard or specialized parts to form parts of a product to be used in the manufacture of the finished piece. Manufacturing, however, is a start to finish movement, from the creation of parts through to the final assembly to produce a finished product, often using areas of fabrication within the manufacturing process.

Q12. Write the safety measures taken during bending process.

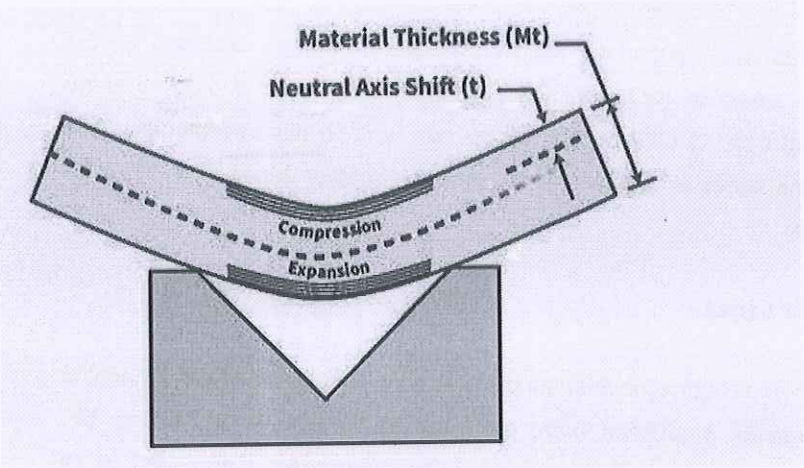
Ans.

- Always wear protective safety equipment such as safety gloves, safety goggles and work boots. These will protect your hands, eyes and feet from any scrap metal or sharp equipment.
- Keep your work surface clean and clear of metal scrap to avoid injury.
- Don't run your hands over a sharp cut, even when wearing gloves, and ensure metal burrs are always filed properly to avoid injury.
- Always be careful when handling wet metal sheets as they can be very slippery and hard to grip onto.

Q13. What is the K-factor?

Ans. *K-factor* is a ratio of location of the neutral line to the material thickness as defined by t/T where t = location of the neutral line and T = material thickness.

In flat metal, this boundary evenly bisects the material's thickness, but it shifts when you bend the metal. The K-factor comes from the ratio of the neutral radius divided by the thickness of the material on prepared charts and has a value between 0.3 and 0.5.

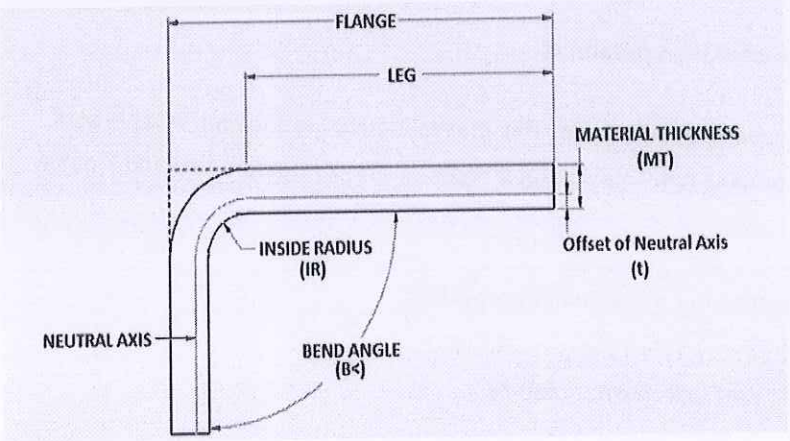


Q14. Why bend allowance is used in bending?

Ans. Bend allowance is used in bending to calculate the flat length of the bent sheet.

The bend allowance defines the material you will need to add to the actual leg lengths of the part in order to get the flat pattern cut to a correct size.

The legs of the part are the sides outside of the bend which you can see on the image below.



Section – C

04X06 = 24 Marks

Q15. Write the advantages of bending process.

Ans. 1. High cost-effectiveness

A single Robosoft control steers both the press brake and the robot with just 1 production program. This means you need less staff to operate the machine. Furthermore, you can run more shifts, both at night and in the weekend.

2. Maximum productivity

Synchronized production processes, automated setup, programming while the machine is running,... the robot can process everything much faster and doesn't need to be stopped so often. This way you can maximize your output.

3. Superfast software

The powerful Robosoft software ensures a superfast, all-in-1 production process. Based on a 3D drawing, the robot 'brain' simulates a solution for the folding sequence of the metal and at the same time it programs the machine. What used to take several hours, can now be done in minutes. This allows you to switch easily from one series to another and to produce smaller series from 30 to 80 pieces in a way that is still profitable.

4. Profitable production of smaller series

A robot bending cell can efficiently complete one job after another. No time is lost preparing the machine or installing the materials. This makes production more profitable, even for smaller orders. For exceptionally heavy or complex parts, even a single piece can be automatically produced in an economic way.

5. Constant quality

Automated bending cells are productive non-stop at a constant and high quality. Even after several hours, the machine still delivers precise results. Built-in sensors make sure angles are folded accurately and side lengths are measured correctly.

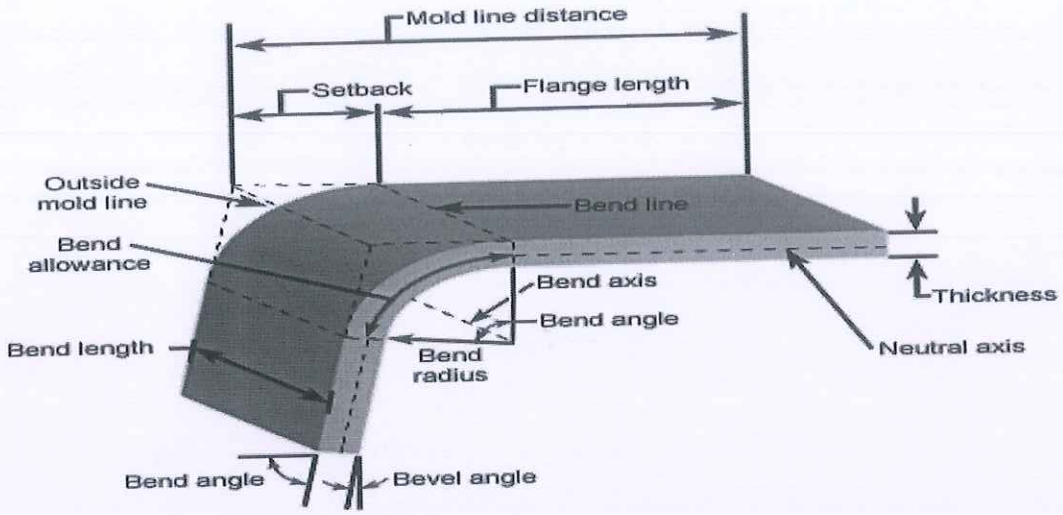
6. Compensation for the shortage of skilled personnel

Press brake operators need a very specific set of skills. This makes it quite hard to find suitable staff. Automated bending cells deliver top-notch results, even for complex parts, 24 hours a day and 7 days a week.

7. Parts usually are lightweight with good mechanical properties.

Q16. Draw a neat sketch of bent part with nomenclature.

Ans.



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Ans. Bend allowance: - The *bend allowance* (BA) is the length of the arc of the neutral line between the tangent points of a bend in any material.

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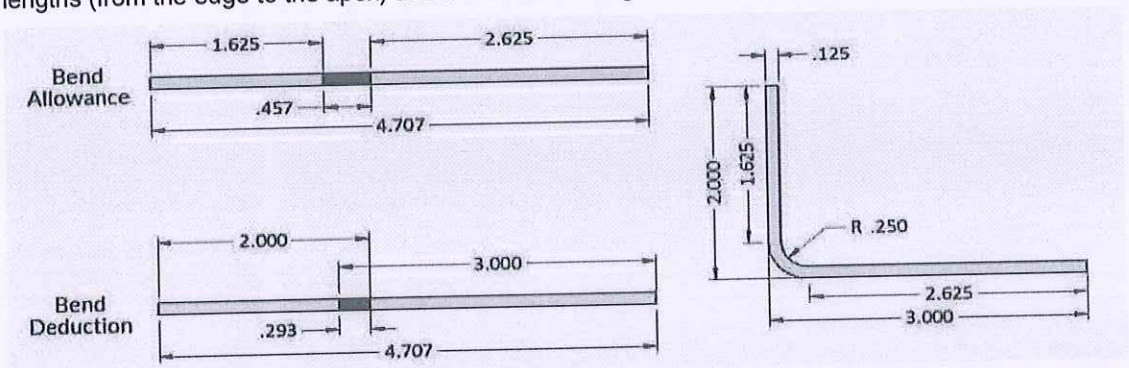
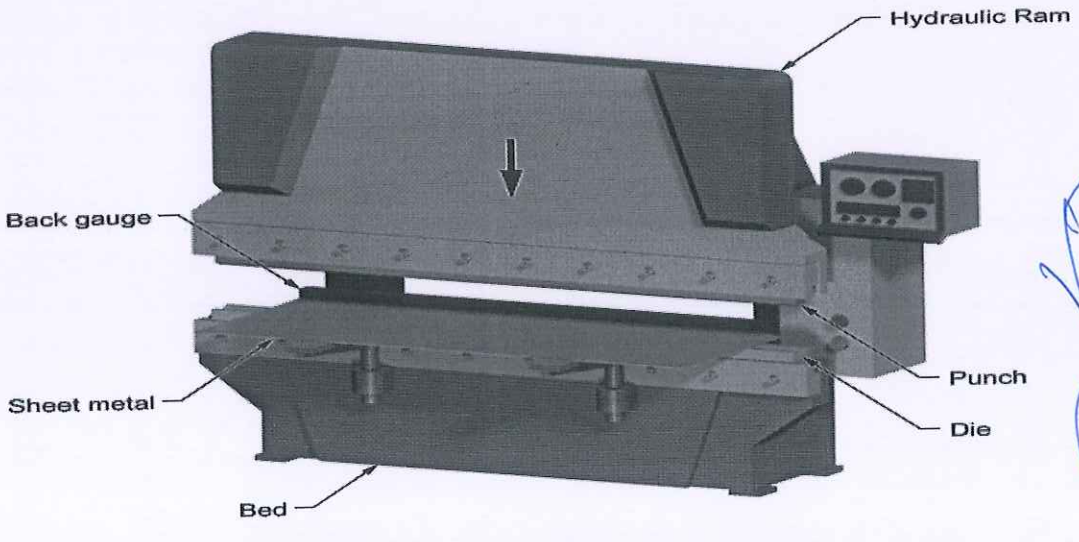


Q18. Make a neat sketch of bending machine.

Ans.



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1302 Sct A **Time: 2 Hours**

Course Name: CNC Punching **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

Q1. Cluster tools can be used to reduce CNC punching time for multiple holes

(a) Reduces

(b) Increases

(c) Remains same

(d) First increases and then decreases

Q2. As the thickness of sheet is increased the clearance needed will also?

a) Increase

b) Decrease

c) No effect

d) First decreases and then increase

Q3. The cutting force in punching and blanking operations mainly depends on

a) Yield strength of material

b) Shear strength of material

c) Fracture point

d) Bending strength of material

Q4. Cnc stands for

(a) Control numeric center

(b) Computer numeric center

(c) Computer numeric control

(d) None of the above

Q5. In CNC machine tool, the part program entered into the computer memory

a.) Can be used only once

b.) Can be used again and again

c) Can be used again but it has to be modified every time

d) Cannot say

Q6. Arrange the below operations in operator controlled machine tool in correct order.

(A) Operator

(B) Process planning

(C) Machine tool

(D) Component drawing

(E) Completed component

(a.) (A) – (D) – (B) – (C) – (E)

(c.) (B) – (D) – (C) – (A) – (E)

(b.) (D) – (B) – (C) – (A) – (E)

(d.) (D) – (B) – (A) – (C) – (E)

Q7. Cluster tools can be used to reduce CNC punching time for multiple holes

a) Reduces

b) Increases

c) Remains same

d) First increases and then decreases

Q8. When elongation reaches a limiting value

(a) Rupture occurs
(b) Elongation continues
(c) Nothing change
(d) Permanent deformation

Q9. In piercing operation, the clearance is provided on.....

(a) Die
(b) Punch
(c) Half on die and half on punch
(d) Die or punch depending on material and thickness of sheet

Q10. Lathe bed is usually made of.....

(a) Structural steel
(b) Stainless steel
(c) Cast iron

(d) Mild steel

Section – B

04×04 = 16 Marks

Q11. What is punching?

Q12. Write applications of cnc punching?

Q13. What is nibbling process?

Q14. Explain trimming and notching process.

Section – C

04×06 = 24 Marks

Q15. What are advantages and disadvantages of cnc punching?

Q16. Write difference between punching and blanking with diagram?

Q17. Write history of cnc punching?

Q18. Define the following terms-
a. Lancing
b. Slitting

AS, Sol A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1302 **Time: 2 Hours**

Course Name: CNC Punching **Max. Marks: 50**

Answer key

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
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Section – A

10X01 = 10 Marks

Q1. Cluster tools can be used to reduce CNC punching time for multiple holes

(a) **Reduces**

(b) Increases

(c) Remains same

(d) First increases and then decreases

Q2. As the thickness of sheet is increased the clearance needed will also?

a) **Increase**

b) Decrease

c) No effect

d) First decreases and then increase

Q3. The cutting force in punching and blanking operations mainly depends on

a) Yield strength of material

b) **Shear strength of material**

c) Fracture point

d) Bending strength of material

Q4. Cnc stands for

(a) Control numeric center

(b) Computer numeric center

(c) **Computer numeric control**

(d) None of the above

Q5. In CNC machine tool, the part program entered into the computer memory

a.) Can be used only once

b.) **Can be used again and again**

c) Can be used again but it has to be modified every time

d) Cannot say

Q6. Arrange the below operations in operator controlled machine tool in correct order.

(A) Operator

(B) Process planning

(C) Machine tool

(D) Component drawing

(E) Completed component

(a.) (A) – (D) – (B) – (C) – (E)

(c.) (B) – (D) – (C) – (A) – (E)

(b.) (D) – (B) – (C) – (A) – (E)

(d.) **(D) – (B) – (A) – (C) – (E)**

Q7. Cluster tools can be used to reduce CNC punching time for multiple holes

a) **Reduces**

b) Increases

c) Remains same

d) First increases and then decreases

Q8. When elongation reaches a limiting value

(a) Rupture occurs

(b) Elongation continues

(c) Nothing change

(d) Permanent deformation

Q9. In piercing operation, the clearance is provided on.....

(a) **Die**

(b) Punch

(c) Half on die and half on punch

(d) Die or punch depending on material and thickness of sheet

Q10. Lathe bed is usually made of.....

(a) Structural steel

(b) Stainless steel

(c) Cast iron

(d) Mild steel

Section – B

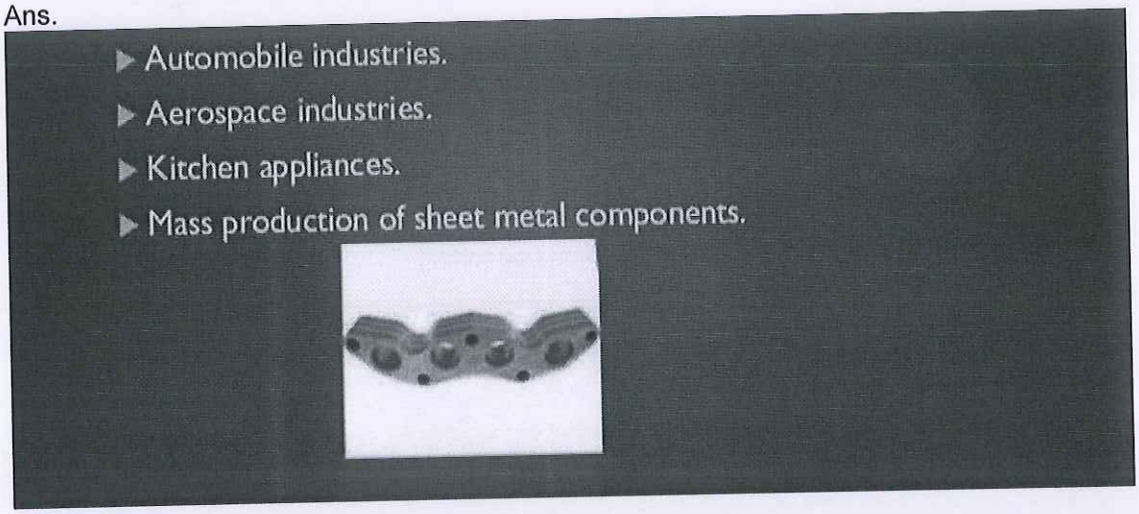
04×04 = 16 Marks

Q11. What is punching?

Ans. Punching is a forming process that uses a punch press to force a tool, called a punch, through the work piece to create a hole via shearing. Punching is applicable to a wide variety of materials that come in sheet form, including sheet metal, paper, vulcanized fiber and some forms of plastic sheet. The punch often passes through the work into a die.

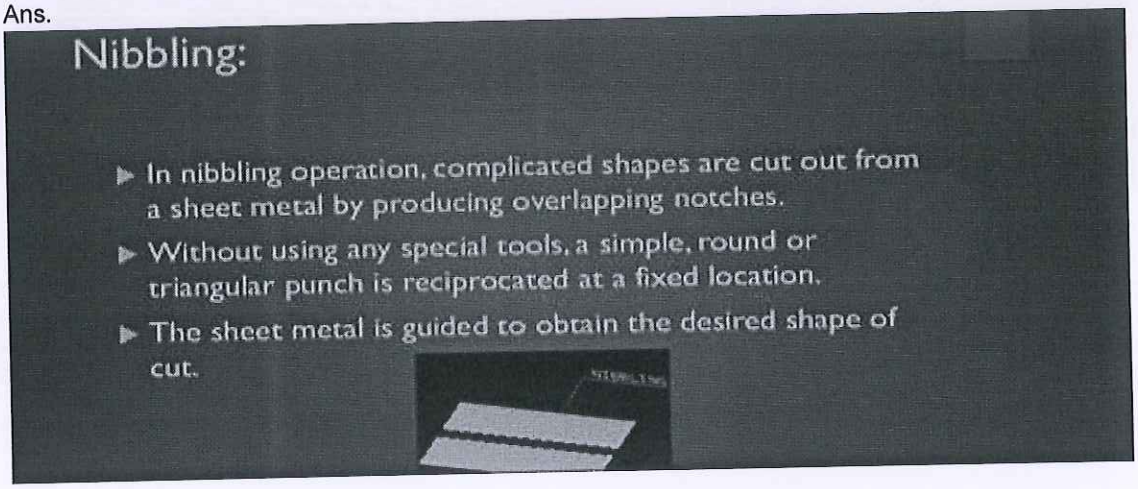
Q12. Write applications of cnc punching?

Ans.



Q13. What is nibbling process?

Ans.



Q14. Explain trimming and notching process.

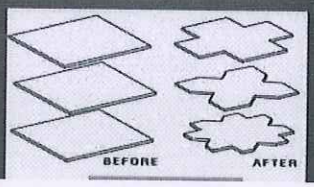
Ans.

Trimming:

- Trimming process refers to the removal of excess material in a flange or flash.

Notching:

- In notching, material is removed from the side of a sheet material.



Section – C

04×06 = 24 Marks

Q15. What are advantages and disadvantages of cnc punching?

Ans.

Advantages:

- Punching and blanking are quick processes.
- The slug produced may be reused or recycled(depending on material).
- It is often the cheapest and most cost effective method for medium to high volume of production.
- It can create multiple shaped holes or same shaped holes very fast.

Disadvantages:

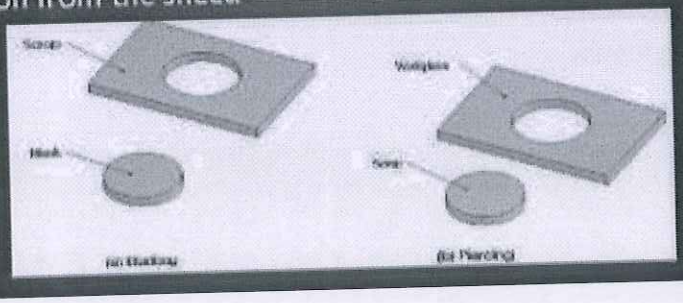
- Equipment and tooling costs are high.
- Often needs secondary finishing operations to smooth out burrs along the bottom edge.
- Fine blanking process is a slow process.

Q16. Write difference between punching and blanking with diagram?

Ans.

Difference:

- In the punching process the final product is the metal sheet from which metal is removed.
- In blanking process the final product is the removed portion from the sheet.



Q17. Write history of cnc punching?

Ans. German scientist Friedrich Soennecken filed a patent for the punching machine on November 14, 1886. The son of a blacksmith, Soennecken also invented binder and a special nib for ink pens that was suitable for calligraphy. He also founded his own company F Soennecken Verilog in 1875.

The history of the hole puncher is fairly unknown or at least its origins are. Historians note two early patents given to men that called for a metal tool capable of putting holes in paper. The traditional hole punch has changed throughout history to include products for larger stacks of paper, smaller punches with shaped holes and hole punchers that place three holes in a sheet of paper at one time.

Charles Brooks created a different version of the paper punch in 1893, which he called a ticket punch.

20th Century Advances

Throughout the 20th century the traditional hole punch retained much of the same look of the early models including the metal construction. After some work, hole punches took on the look of pliers and

were easier to carry. Toward the end of the century there were even a few plastic versions released, though with the cutter itself still made of metal. It was during this time that manufacturers also released versions that used a shape in the cutter other than a circle, such as a square, star or heart design.

21st Century

The United States Patent Office has recorded several patents for new hole punches since 2000. One of these uses a pressure plate and stacked rings, which allow the hole punch to punch through stacks of paper easier, without the user exerting a lot of force.

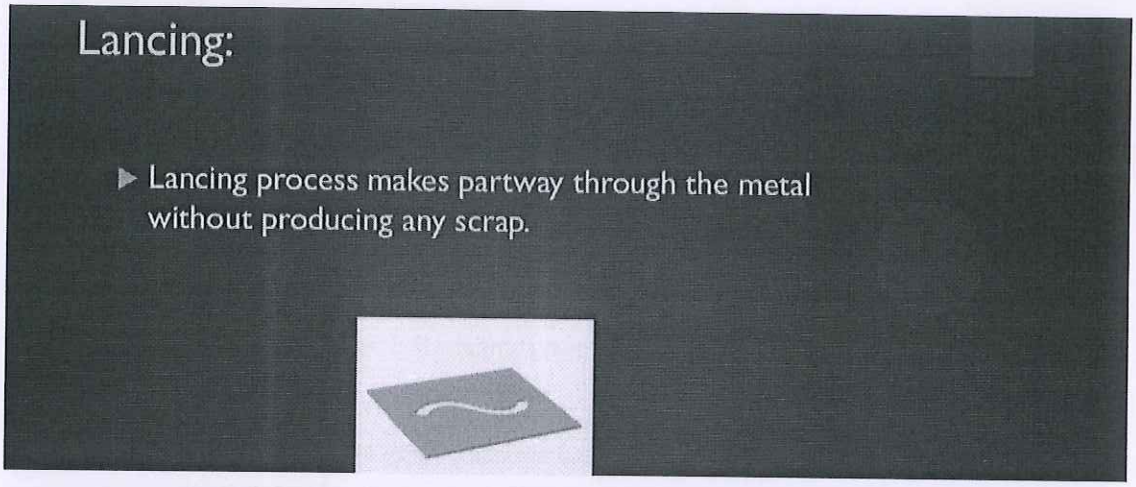
Foreign Inventions. A German inventor designed the first ever hole puncher (also known as hole punch) of its kind in 1886. Frederich Soennecken created a type of office tool capable of punching small holes in paper. He applied for a patent in Germany and was awarded one on Nov. 14, 1886. He called the machine Papierlocher fur Sammelmappen and the device was simply called a hole punch.

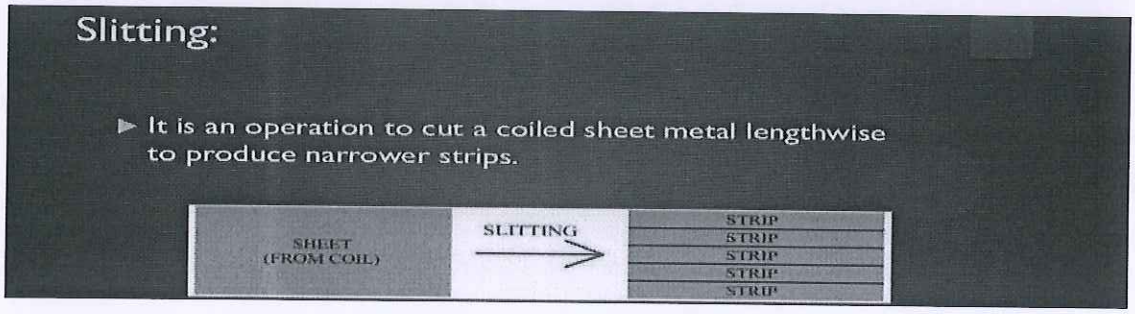
First U.S. Patent

The first patent for a hole puncher in the United States was given to Benjamin Smith, a man working in Massachusetts. His design used two metal pieces with a hole in the bottom piece and a sharp cutting implement on the other end. The two pieces were attached using a spring that gave the punch strength to work through a piece of paper. Smith referred to the punch as a conductor's punch when he was granted patent number 313027.

Q18. Define the following terms-

a. Lancing
b. Slitting





QP, Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1302 Set-B **Time: 2 Hours**

Course Name: CNC Punching **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

Q1. Arrange the below operations in operator controlled machine tool in correct order.

(A) Operator

(B) Process planning

(C) Machine tool

(D) Component drawing

(E) Completed component

(a.) (A) – (D) – (B) – (C) – (E)

(c.) (B) – (D) – (C) – (A) – (E)

(b.) (D) – (B) – (C) – (A) – (E)

(d.) (D) – (B) – (A) – (C) – (E)

Q2. Cluster tools can be used to reduce CNC punching time for multiple holes

a) Reduces

b) Increases

c) Remains same

d) First increases and then decreases

Q3. When elongation reaches a limiting value

(a) Rupture occurs

(b) Elongation continues

(c) Nothing change

(d) Permanent deformation

Q4. Cluster tools can be used to reduce CNC punching time for multiple holes

(a) Reduces

(b) Increases

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(d) First increases and then decreases

Q5. As the thickness of sheet is increased the clearance needed will also?

a) Increase

b) Decrease

c) No effect

d) First decreases and then increase

Q6. The cutting force in punching and blanking operations mainly depends on

a) Yield strength of material

b) Shear strength of material

c) Fracture point

d) Bending strength of material

Q7. Cnc stands for

(a) Control numeric center

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a.) Can be used only once

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Q9. Lathe bed is usually made of.....

(a) Structural steel
(b) Stainless steel
(c) Cast iron
(d) Mild steel

Q10. In piercing operation, the clearance is provided on.....

(a) Die
(b) Punch
(c) Half on die and half on punch
(d) Die or punch depending on material and thickness of sheet

Section – B

04×04 = 16 Marks

Q11. What are advantages of cnc punching?

Q12. Explain trimming and notching process.

Q13. What is nibbling process?

Q14. Explain fine blanking process

Section – C

04×06 = 24 Marks

Q15. Write note on Striping force

Q16. Calculate striping force for the sheet to be punched as hole of diameter 10 mm length of cut is 200 mm thickness of sheet is 1mm.

Q17. Write history of cnc punching?

Q18. What are the different zones of blanked parts show with diagram?

AS, Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1302 **Time: 2 Hours**

Course Name: CNC Punching **Max. Marks: 50**

Answer key

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
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Section – A

10X01 = 10 Marks

Q1. Arrange the below operations in operator controlled machine tool in correct order.

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(C) Machine tool

(D) Component drawing

(E) Completed component

(a.) (A) – (D) – (B) – (C) – (E)

(b.) (D) – (B) – (C) – (A) – (E)

(c.) (B) – (D) – (C) – (A) – (E)

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d) First increases and then decreases

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(b) Punch
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Section – B

04×04 = 16 Marks

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Ans.

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- It is often the cheapest and most cost effective method for medium to high volume of production.
- It can create multiple shaped holes or same shaped holes very fast.

Q12. Explain trimming and notching process.

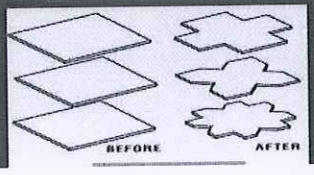
Ans.

Trimming:

- Trimming process refers to the removal of excess material in a flange or flash.

Notching:

- In notching, material is removed from the side of a sheet material.



Q13. What is nibbling process?

Ans.

Nibbling:

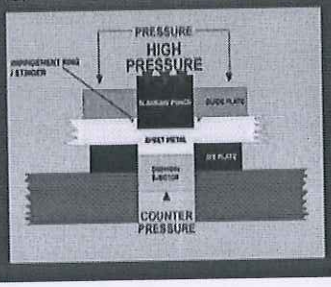
- In nibbling operation, complicated shapes are cut out from a sheet metal by producing overlapping notches.
- Without using any special tools, a simple, round or triangular punch is reciprocated at a fixed location.
- The sheet metal is guided to obtain the desired shape of cut.

Q14. Explain fine blanking process

Ans.

Fine Blanking Process:

- A special type of blanking process.
- Fracture zone does not form while shearing.
- Very tight tolerance is achieved by this process.
- Aluminium , brass, copper ,stainless steels are the metals that can be fine blanked.



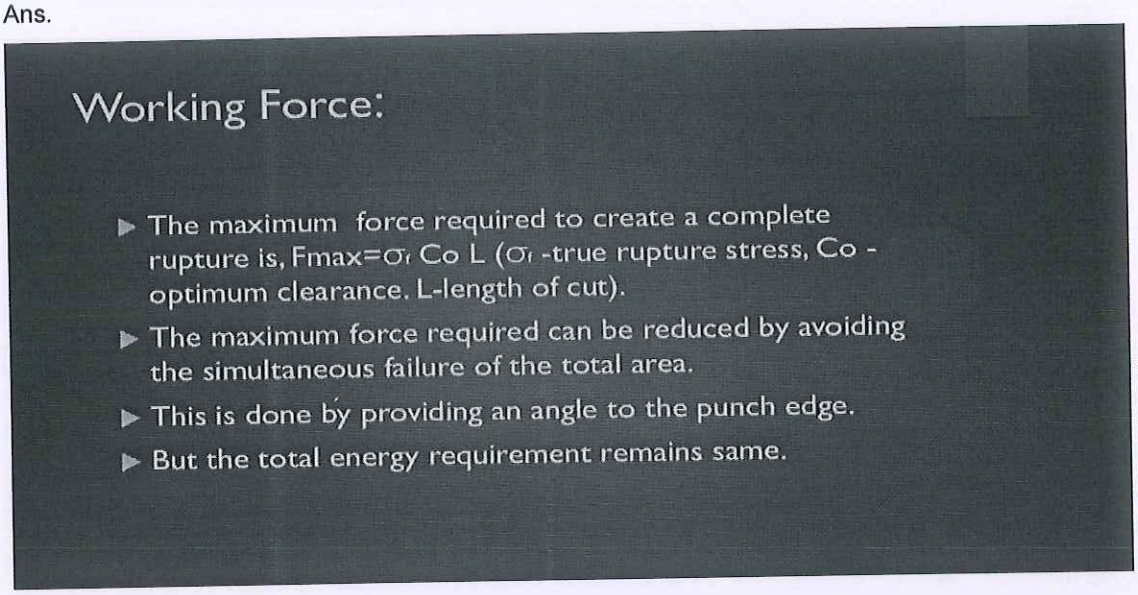
BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Section – C

04×06 = 24 Marks

Q15. Write note on Striping force

Ans.



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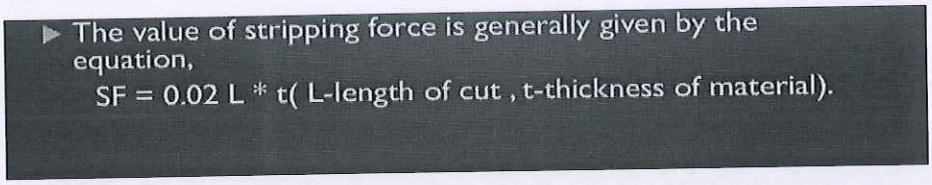
Ans.



= 0.02*200*1

=4 (standard unit)

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First U.S. Patent

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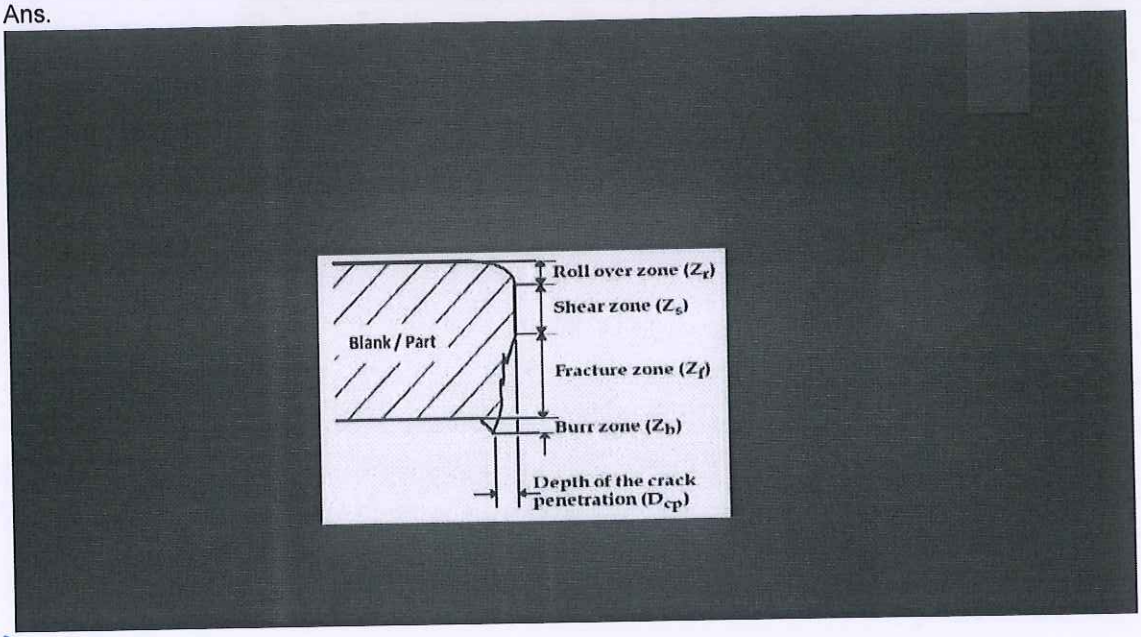
Q18. What are the different zones of blanked parts show with diagram?

Ans.



Vetted

QP Set A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1303 Set-A **Time: 2 Hours**

Course Name: CNC Laser cutting **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

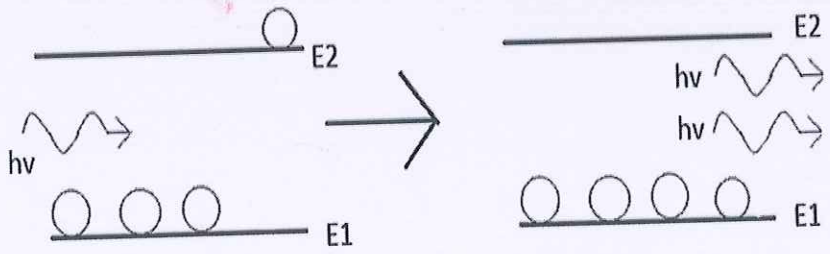
Q1. What is the full form of LASER?

a) Light Absorbent and Stimulated Emission of Radiations
b) Light Absorbing Solar Energy Resource
c) Light Amplification by Stimulated Emission of Radiations
d) Light Amplification of Singular Emission of Radiations

Q2. Which of the following is not a characteristic of LASERS?

a) Monochromatic
b) Coherent
c) Divergent
d) Intense

Q3. The following graph is pictorial representation of _____



a) Spontaneous emission
b) Spontaneous Absorption
c) Stimulated emission
d) Stimulated Absorption

Q4. Which is not gas laser

a) Co2 laser
b) He-ne laser
c) Ruby laser
d) None of the above

Q5. Nd: YAG is-

a) Solid state laser
b) Gas laser
c) Chemical laser
d) All of the above

Q6. Advantage of Nd: YAG laser-

a) Low power consumption
b) Nd: YAG laser offers high gain.
c) Nd: YAG laser has good thermal properties.
d) All of the above

Q7. What is the general lifetime of an atom in an exited state?

a) 10^{-10}
b) 10^{-8}
c) 10^{-6}
d) 10^{-4}

Q8. In Stimulated emission, the emitted photons are _____

a) Coherent and Monochromatic
b) Non-coherent and monochromatic
c) Coherent and Non-Monochromatic
d) Non-Coherent and Non-monochromatic

Q9. What is the relationship between E_1 and E_2?
Where E_1 is ground state and E_2 is excited state

a) $E_2 > E_1$
b) $E_2 < E_1$
c) $E_2 = E_1$
d) No specific relation

Q10. During pumping, the atoms are excited to _____

a) Higher Exited States
b) Lower Energy states
c) Meta Stable states
d) Not Excited

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Section – B

04X04 = 16 Marks

Q11. What do you understand by laser?

Q12. Write short notes on the types of laser on the basis of medium?

Q13. Explain the laser or gain medium in ruby laser with diagram.

Q14. What do understand by optical resonator in Nd: YAG laser?

Section – C

04X06 = 24 Marks

Q15. What is He-Ne laser? Explain gain medium and working in detail.

Q16. What are the Applications of laser?

Q17. What are the advantages and disadvantages of Nd: YAG laser?

Q18. What are the applications of Nd: YAG laser?

As, SetA

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1303 **Time: 2 Hours**

Course Name: CNC Laser cutting **Max. Marks: 50**

Answer key

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

Q1. What is the full form of LASER?

a) Light Absorbent and Stimulated Emission of Radiations

b) Light Absorbing Solar Energy Resource

c) Light Amplification by Stimulated Emission of Radiations

d) Light Amplification of Singular Emission of Radiations

Ans. C

Q2. Which of the following is not a characteristic of LASERS?

a) Monochromatic

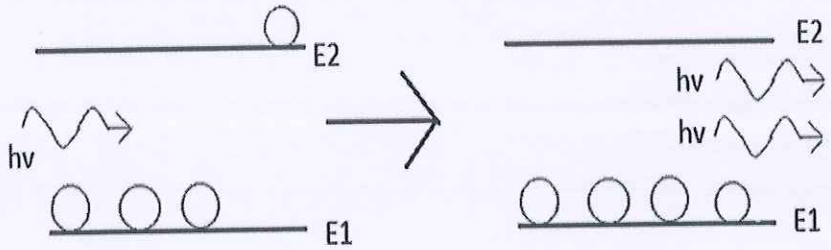
b) Coherent

c) Divergent

d) Intense

Ans. C

Q3. The following graph is pictorial representation of _____



a) Spontaneous emission

b) Spontaneous Absorption

c) **Stimulated emission**

d) Stimulated Absorption

Ans. C

Q4. Which is not gas laser

a) Co2 laser

b) He-ne laser

c) Ruby laser

d) None of the above

Ans. C

Q5. Nd: YAG is-

a) Solid state laser

b) Gas laser

c) Chemical laser

d) All of the above

Ans. A

Q6. Advantage of Nd: YAG laser-

a) Low power consumption

b) Nd: YAG laser offers high gain.

c) Nd: YAG laser has good thermal properties.

d) All of the above

Ans. D

Q7. What is the general lifetime of an atom in an exited state?

a) 10^{-10}

b) 10^{-8}

c) 10^{-6}

d) 10^{-4}

Ans. B

Q8. In Stimulated emission, the emitted photons are _____

a) **Coherent and Monochromatic**

b) Non-coherent and monochromatic

c) Coherent and Non-Monochromatic

d) Non-Coherent and Non-monochromatic

Ans. A

Q9. What is the relationship between E_1 and E_2?

Where E_1 is ground state and E_2 is excited state

a) $E_2 > E_1$

b) $E_2 < E_1$

c) $E_2 = E_1$

d) No specific relation

Ans. A

Q10. During pumping, the atoms are excited to _____

a) Higher Exited States

b) Lower Energy states

c) Meta Stable states

d) Not Excited

Ans. C

Section – B

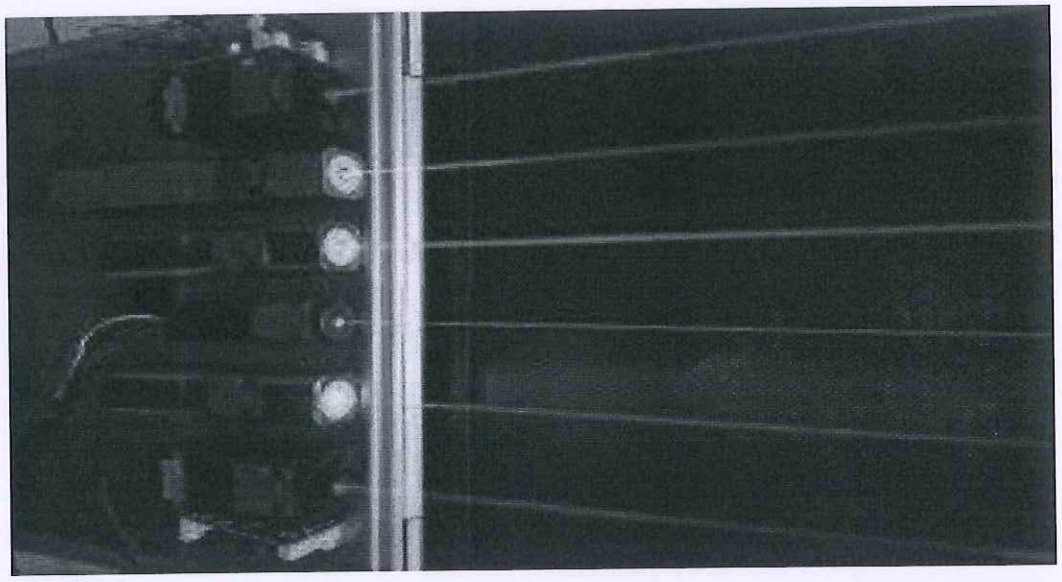
04X04 = 16 Marks

Q11. What do you understand by laser?

Ans.

Definition of Laser : A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. The term "laser" originated as an acronym for "light amplification by stimulated emission of radiation.

A laser is produces a very narrow beam of light that is useful in many technologies and instruments. A laser is an unusual light source. It is quite different from a light bulb or a flash light. The emission generally covers an extremely limited range of visible, infrared, or ultraviolet wavelengths



Q12. Write short notes on the types of laser on the basis of medium?

Ans. Types of lasers

Lasers are classified into 4 types based on the type of laser medium used:

- Solid-state laser
- Gas laser
- Liquid laser
- Semiconductor laser

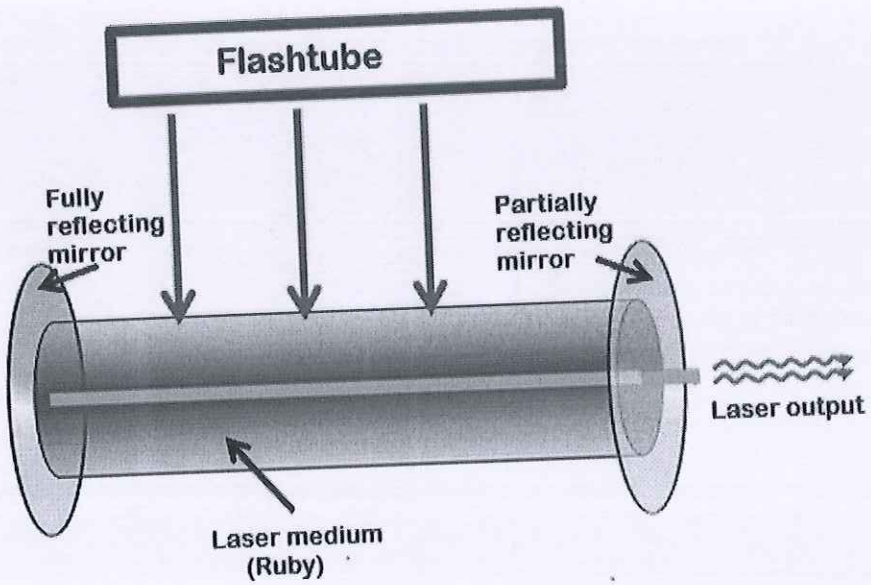
Solid-state laser

A solid-state laser is a laser that uses solid as a laser medium. In these lasers, glass or crystalline materials are used.

Ions are introduced as impurities into host material which can be a glass or crystalline. The process of adding impurities to the substance is called doping. Rare earth elements such as cerium (Ce), erbium (Eu), terbium (Tb) etc are most commonly used as dopants.

Materials such as sapphire (Al_2O_3), neodymium-doped yttrium aluminum garnet (Nd:YAG), Neodymium-doped glass (Nd:glass) and ytterbium-doped glass are used as host materials for laser medium. Out of these, neodymium-doped yttrium aluminum garnet (Nd:YAG) is most commonly used.

The first solid-state laser was a ruby laser. It is still used in some applications. In this laser, a ruby crystal is used as a laser medium.

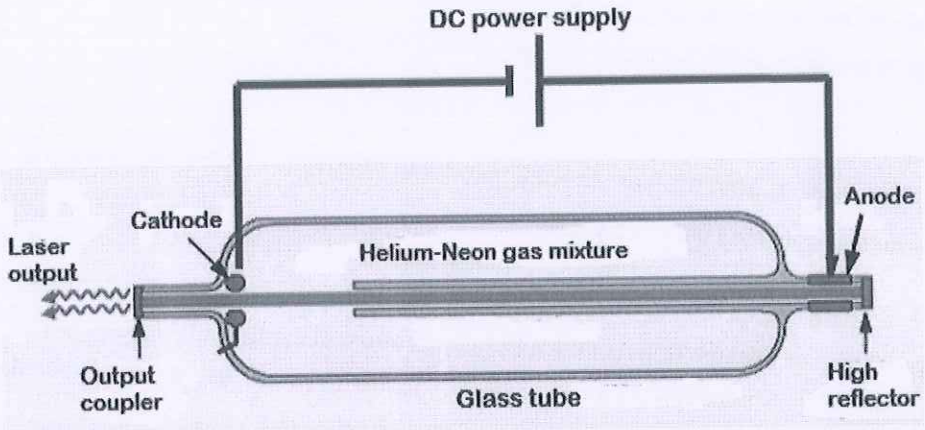


In solid-state lasers, light energy is used as pumping source. Light sources such as flashtube, flash lamps, arc lamps, or laser diodes are used to achieve pumping.

Semiconductor lasers do not belong to this category because these lasers are usually electrically pumped and involve different physical processes.

Gas laser

A gas laser is a laser in which an electric current is discharged through a gas inside the laser medium to produce laser light. In gas lasers, the laser medium is in the gaseous state.



Gas lasers are used in applications that require laser light with very high beam quality and long coherence lengths.

In gas laser, the laser medium or gain medium is made up of the mixture of gases. This mixture is packed up into a glass tube. The glass tube filled with the mixture of gases acts as an active medium or laser medium.

A gas laser is the first laser that works on the principle of converting electrical energy into light energy. It produces a laser light beam in the infrared region of the spectrum at 1.15 μm.

Gas lasers are of different types: they are, Helium (He) – Neon (Ne) lasers, argon ion lasers, carbon dioxide lasers (CO_2 lasers), carbon monoxide lasers (CO lasers), excimer lasers, nitrogen lasers, hydrogen lasers, etc. The type of gas used to construct the laser medium can determine the lasers wavelength or efficiency.

Liquid laser

A liquid laser is a laser that uses the liquid as laser medium. In liquid lasers, light supplies energy to the laser medium.

A dye laser is an example of the liquid laser. A dye laser is a laser that uses an organic dye (liquid solution) as the laser medium.

A dye laser is made up of an organic dye mixed with a solvent. These lasers generate laser light from the excited energy states of organic dyes dissolved in liquid solvents. It produces laser light beam in the near ultraviolet (UV) to the near infrared (IR) region of the spectrum.

Semiconductor laser

Semiconductor lasers play an important role in our everyday life. These lasers are very cheap, compact size and consume low power. Semiconductor lasers are also known as laser diodes.

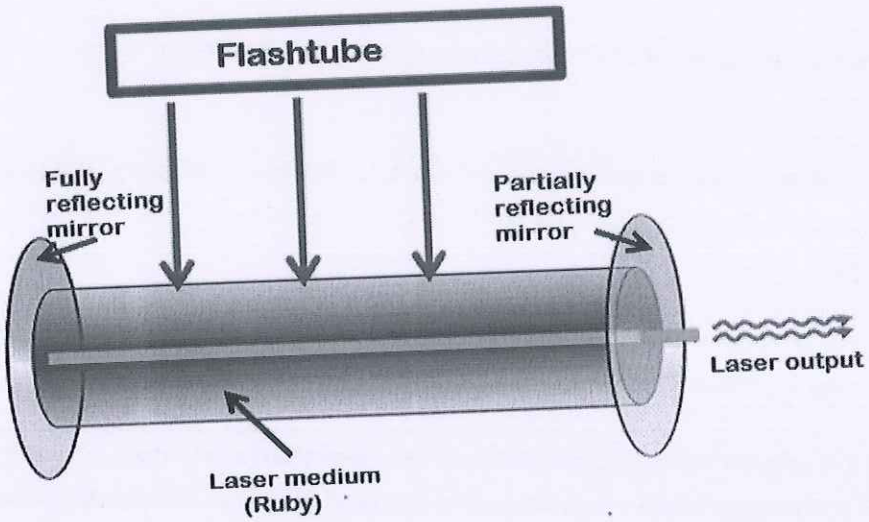
Semiconductor lasers are different from solid-state lasers. In solid-state lasers, light energy is used as the pump source whereas, in semiconductor lasers, electrical energy is used as the pump source.

In semiconductor lasers, a p-n junction of a semiconductor diode forms the active medium or laser medium. The optical gain is produced within the semiconductor material.

Q13. Explain the laser or gain medium in ruby laser with diagram.

Ans. Laser medium or gain medium in ruby laser

In a ruby laser, a single crystal of ruby ($Al_2O_3 : Cr^{3+}$) in the form of cylinder acts as a laser medium or active medium. The laser medium (ruby) in the ruby laser is made of the host of sapphire (Al_2O_3) which is doped with small amounts of chromium ions (Cr^{3+}). The ruby has good thermal properties.



Q14. What do understand by optical resonator in Nd: YAG laser?

Ans. **Optical resonator**

The Nd: YAG crystal is placed between two mirrors. These two mirrors are optically coated or silvered.

Each mirror is silvered or coated differently. One mirror is fully silvered whereas, another mirror is partially silvered. The mirror, which is fully silvered, will completely reflect the light and is known as fully reflecting mirror.

On the other hand, the mirror which is partially silvered will reflect most part 9of the light but allows a small portion of light through it to produce the laser beam. This mirror is known as a partially reflecting mirror.

Section – C

04X06 = 24 Marks

Q15. What is He-Ne laser? Explain gain medium and working in detail.

Ans. At room temperature, a ruby laser will only emit short bursts of laser light, each laser pulse occurring after a flash of the pumping light. It would be better to have a laser that emits light continuously. Such a laser is called a continuous wave (CW) laser.

The helium-neon laser was the first continuous wave (CW) laser ever constructed. It was built in 1961 by Ali Javan, Bennett, and Herriot at Bell Telephone Laboratories.

Helium-neon lasers are the most widely used gas lasers. These lasers have many industrial and scientific uses and are often used in laboratory demonstrations of optics.

In He-Ne lasers, the optical pumping method is not used instead an electrical pumping method is used. The excitation of electrons in the He-Ne gas active medium is achieved by passing an electric current through the gas.

The helium-neon laser operates at a wavelength of 632.8 nanometers (nm), in the red portion of the visible spectrum.

Gain medium (discharge glass tube or glass envelope)

The gain medium of a helium-neon laser is made up of the mixture of helium and neon gas contained in a glass tube at low pressure. The partial pressure of helium is 1 mbar whereas that of neon is 0.1 mbar.

The gas mixture is mostly comprised of helium gas. Therefore, in order to achieve population inversion, we need to excite primarily the lower energy state electrons of the helium atoms.

In He-Ne laser, neon atoms are the active centers and have energy levels suitable for laser transitions while helium atoms help in exciting neon atoms.

Electrodes (anode and cathode) are provided in the glass tube to send the electric current through the gas mixture. These electrodes are connected to a DC power supply.

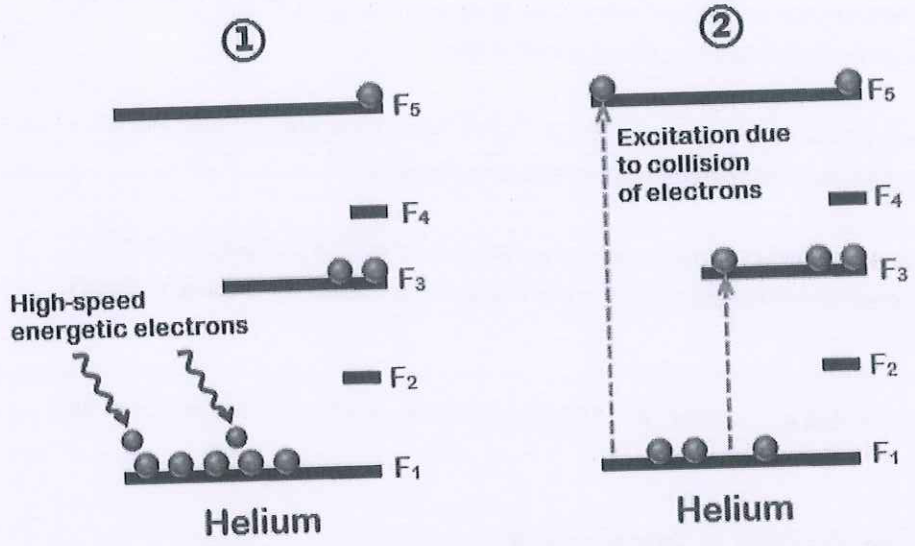
Working of helium-neon laser

In order to achieve population inversion, we need to supply energy to the gain medium. In helium-neon lasers, we use high voltage DC as the pump source. A high voltage DC produces energetic electrons that travel through the gas mixture.

The gas mixture in helium-neon laser is mostly comprised of helium atoms. Therefore, helium atoms observe most of the energy supplied by the high voltage DC.

When the power is switched on, a high voltage of about 10 kV is applied across the gas mixture. This power is enough to excite the electrons in the gas mixture. The electrons produced in the process of discharge are accelerated between the electrodes (cathode and anode) through the gas mixture.

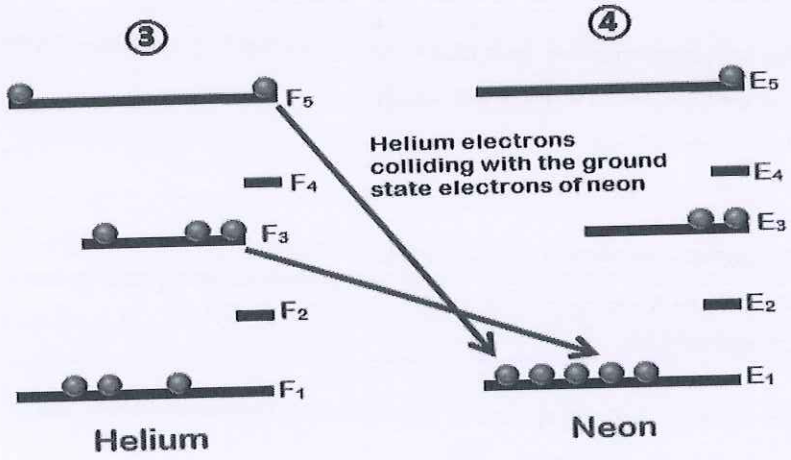
In the process of flowing through the gas, the energetic electrons transfer some of their energy to the helium atoms in the gas. As a result, the lower energy state electrons of the helium atoms gain enough energy and jumps into the excited states or metastable states. Let us assume that these metastable states are F_3 and F_5.



Physics and Radio-Electronics

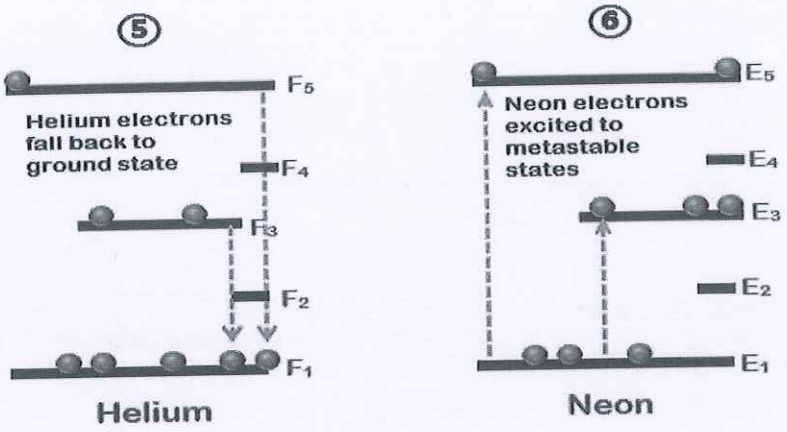
The metastable state electrons of the helium atoms cannot return to ground state by spontaneous emission. However, they can return to ground state by transferring their energy to the lower energy state electrons of the neon atoms.

The energy levels of some of the excited states of the neon atoms are identical to the energy levels of metastable states of the helium atoms. Let us assume that these identical energy states are $F_3 = E_3$ and $F_5 = E_5$. E_3 and E_5 are excited states or metastable states of neon atoms.



Physics and Radio-Electronics

Unlike the solid, a gas can move or flow between the electrodes. Hence, when the excited electrons of the helium atoms collide with the lower energy state electrons of the neon atoms, they transfer their energy to the neon atoms. As a result, the lower energy state electrons of the neon atoms gain enough energy from the helium atoms and jumps into the higher energy states or metastable states (E_3 and E_5) whereas the excited electrons of the helium atoms will fall into the ground state. Thus, helium atoms help neon atoms in achieving population inversion.

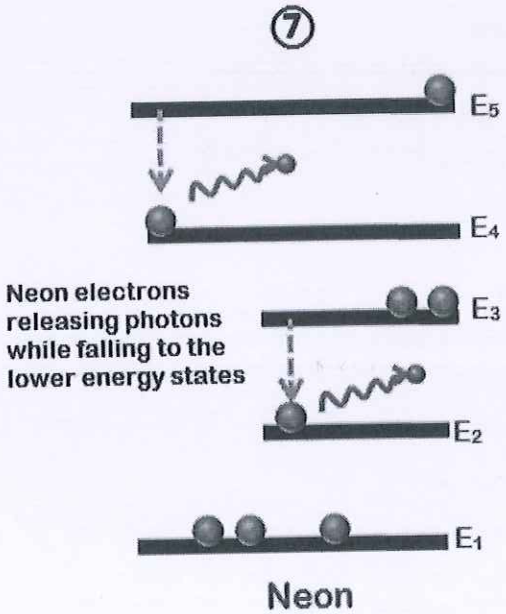


Physics and Radio-Electronics

Likewise, millions of ground state electrons of neon atoms are excited to the metastable states. The metastable states have the longer lifetime. Therefore, a large number of electrons will remain in the metastable states and hence population inversion is achieved.

After some period, the metastable states electrons (E_3 and E_5) of the neon atoms will spontaneously fall into the next lower energy states (E_2 and E_4) by releasing photons or red light. This is called spontaneous emission.

The neon excited electrons continue on to the ground state through radiative and non-radiative transitions. It is important for the continuous wave (CW) operation.



The light or photons emitted from the neon atoms will moves back and forth between two mirrors until it stimulates other excited electrons of the neon atoms and causes them to emit light. Thus, optical gain is achieved. This process of photon emission is called stimulated emission of radiation.

The light or photons emitted due to stimulated emission will escape through the partially reflecting mirror or output coupler to produce laser

Q16. What are the Applications of laser?

Ans. Applications of Lasers

Laser is an optical device that generates intense beam of coherent monochromatic light by stimulated emission of radiation.

Laser light is different from an ordinary light. It has various unique properties such as coherence, monochromacity, directionality, and high intensity. Because of these unique properties, lasers are used in various applications.

The most significant applications of lasers include:

- Lasers in medicine
- Lasers in communications
- Lasers in industries
- Lasers in science and technology
- Lasers in military

Lasers in Medicine

1. Lasers are used for bloodless surgery.
2. Lasers are used to destroy kidney stones.
3. Lasers are used in cancer diagnosis and therapy.
4. Lasers are used for eye lens curvature corrections.
5. Lasers are used in fiber-optic endoscope to detect ulcers in the intestines.
6. The liver and lung diseases could be treated by using lasers.
7. Lasers are used to study the internal structure of microorganisms and cells.
8. Lasers are used to produce chemical reactions.
9. Lasers are used to create plasma.
10. Lasers are used to remove tumors successfully.
11. Lasers are used to remove the caries or decayed portion of the teeth.
12. Lasers are used in cosmetic treatments such as acne treatment, cellulite and hair removal.

Lasers in Communications

1. Laser light is used in optical fiber communications to send information over large distances with low loss.
2. Laser light is used in underwater communication networks.

3. Lasers are used in space communication, radars and satellites.

Lasers in Industries

1. Lasers are used to cut glass and quartz.
2. Lasers are used in electronic industries for trimming the components of Integrated Circuits (ICs).
3. Lasers are used for heat treatment in the automotive industry.
4. Laser light is used to collect the information about the prefixed prices of various products in shops and business establishments from the bar code printed on the product.
5. Ultraviolet lasers are used in the semiconductor industries for photolithography. Photolithography is the method used for manufacturing printed circuit board (PCB) and microprocessor by using ultraviolet light.
6. Lasers are used to drill aerosol nozzles and control orifices within the required precision.

Lasers in Science and Technology

1. A laser helps in studying the Brownian motion of particles.
2. With the help of a helium-neon laser, it was proved that the velocity of light is same in all directions.
3. With the help of a laser, it is possible to count the number of atoms in a substance.
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9. Lasers are used for producing three-dimensional pictures in space without the use of lens.
10. Lasers are used for detecting earthquakes and underwater nuclear blasts.
11. A gallium arsenide diode laser can be used to setup an invisible fence to protect an area.

Lasers in Military

1. Laser range finders are used to determine the distance to an object.
2. The ring laser gyroscope is used for sensing and measuring very small angle of rotation of the moving objects.
3. Lasers can be used as a secretive illuminators for reconnaissance during night with high precision.
4. Lasers are used to dispose the energy of a warhead by damaging the missile.
5. Laser light is used in LIDAR's to accurately measure the distance to an object.

Q17. What are the advantages and disadvantages of Nd: YAG laser?

Ans. Benefits or advantages of Nd-YAG laser

Following are the benefits or advantages of Nd-YAG laser:

➡It is very useful for thin materials for quick processing.

➡It offers high DPI capabilities.

➡It is also useful for applications which need high power density such as metal marking.

➡It offers higher energy output and very high repetition rate.

➡It is very easy to attain population inversion.

➡It can be Q-switched for CW or pulse mode of operations. This helps in minor laser ablation process.

➡Nd: YAG laser machine can cut very high reflecting materials e.g. aluminium, copper, non-ferrous metals which can't be cut by other laser cutting machines.

➡It is easy to operate and maintain.

➡Purchasing cost is relatively lower.

Drawbacks or disadvantages of Nd-YAG laser

Following are the drawbacks or disadvantages of Nd-YAG laser:

➡It is not ideal to be used for materials which have moderate thickness.

➡Slow production is possible for thicker materials using this laser type. Hence it offers lower efficiency.

➡It has low absorption of radiation of lighter materials very close to visible spectrum.

➡It will not allow for larger scan gap in spite of high engraving resolutions. This makes the process slower.

➡Electron energy level structure of Nd^{3+} in YAG is complex.

Q18. What are the applications of Nd: YAG laser?

Ans. Applications of Nd: YAG laser

Military

Nd: YAG lasers are used in laser designators and laser rangefinders. A laser designator is a laser light source, which is used to target objects for attacking. A laser rangefinder is a rangefinder, which uses a laser light to determine the distance to an object.

Medicine

Nd: YAG lasers are used to correct posterior capsular opacification (a condition that may occur after a cataract surgery).

Nd: YAG lasers are used to remove skin cancers.

Manufacturing

Nd: YAG lasers are used for etching or marking a variety of plastics and metals.

Nd: YAG lasers are used for cutting and welding steel.

Vetted

QP. Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1303 Set B **Time: 2 Hours**

Course Name: CNC Laser cutting **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

Q1. What type of laser is used in Metal Cutting?

a) Semiconductor
b) YAG
c) Alexandrite
d) Ruby

Q2. Which color of light has the shortest wave-length?

a) Yellow
b) Blue
c) Red
d) Green

Q3. What is the type of laser used most widely in industrial materials processing applications?

a) Dye Laser
b) YAG laser
c) He-Ne laser
d) Semiconductor laser

Q4. Why are lasers used for cutting materials?

a) Repeatability
b) It has a small "heat affected zone"
c) Accuracy
d) All of the above

Q5. What does the acronym MASER stand for?

a) Microwave Amplification by Stimulated Emission of Radiation

b) Molecular Absorption by Stimulated Emission of Radiation

c) The name of Albert Einstein's dog

d) None of the Above

Q6. What is one way to describe a Photon?

a) Solid as a rock

b) A wave packet

c) A torpedo

d) A color

Q7. What determines the color of light?

a) Its intensity

b) Its wavelength

c) Its source

d) Its Frequency

Q8. Chemical lasers use____ to produce their beams.

a) Excessive amounts of electrical power

b) Small amounts of electrical power

c) No electrical power

d) None of the Above

Q9. What is the need to achieve population inversion?

a) To achieving more electrons in the higher energy
b) To bring most of the atoms to ground state
c) To achieve stable condition
d) To reduce the time of production of laser

Q10. Which of the following is an example of optical pumping?

a) Ruby laser
b) Helium-Neon laser
c) Semiconductor laser
d) Dye laser

Section – B

04X04 = 16 Mark

Q11. Define the following terms-

a. Absorption
b. Spontaneous emission

Q12. What is pumping system and which type of pumping system is used in Ruby laser?

Q13. Define the gas laser?

Q14. Define the population inversion and also draw the diagram?

Section – C

04X06 = 24 Marks

Q15. Write the application of laser

Q16. Describe the Nd: YAG laser?

Q17. What are the advantages and disadvantages of he-Ne Laser?

Q18. What is Ruby Laser? Elaborate its working.

AS, Sol B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

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B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

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Answer key

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Section – A

10X01 = 10 Marks

Q1. What type of laser is used in Metal Cutting?

a) Semiconductor

b) YAG

c) Alexandrite

d) Ruby

Ans. B

Q2. Which color of light has the shortest wave-length?

a) Yellow

b) Blue

c) Red

d) Green

Ans. C

Q3. What is the type of laser used most widely in industrial materials processing applications?

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b) YAG laser

c) He-Ne laser

d) Semiconductor laser

Ans. B

Q4. Why are lasers used for cutting materials?

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b) It has a small "heat affected zone"

c) Accuracy

d) All of the above

Ans. D

Q5. What does the acronym MASER stand for?

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Ans. A

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Ans. B

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Ans. B

Q8. Chemical lasers use____ to produce their beams.

a) Excessive amounts of electrical power

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Ans. C

Q9. What is the need to achieve population inversion?

a) **To achieving more electrons in the higher energy**
b) To bring most of the atoms to ground state
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Ans. A

Q10. Which of the following is an example of optical pumping?

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Ans. A

Section – B

04X04 = 16 Mark

Q11. Define the following terms-
a. Absorption
b. Spontaneous emission

Ans a. Absorption of radiation is the process by which electrons in the ground state absorbs energy from photons to jump into the higher energy level.

The electrons orbiting very close to the nucleus are at the lower energy level or lower energy state whereas the electrons orbiting farther away from the nucleus are at the higher energy level. The electrons in the lower energy level need some extra energy to jump into the higher energy level. This extra energy is provided from various energy sources such as heat, electric field, or light.

Ans. b

Spontaneous emission is the process by which electrons in the excited state return to the ground state by emitting photons.

The electrons in the excited state can stay only for a short period. The time up to which an excited electron can stay at higher energy state (E_2) is known as the lifetime of excited electrons. The lifetime of electrons in excited state is 10^{-8} second.

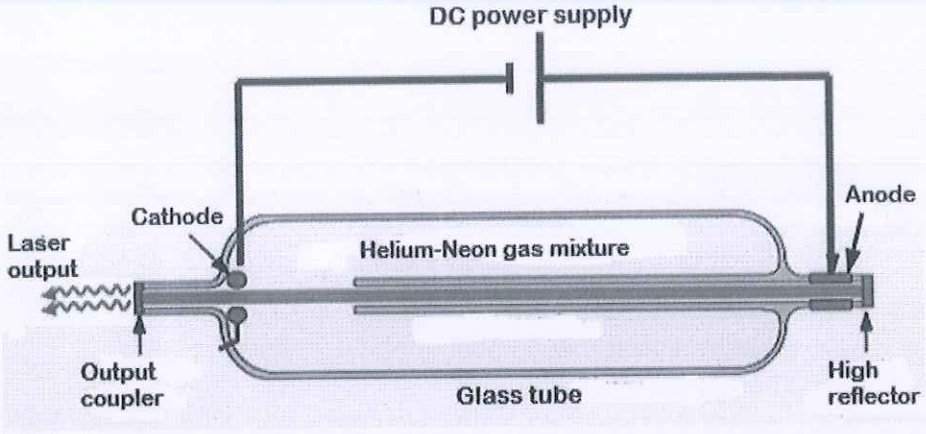
Q12. What is pumping system and which type of pumping system is used in Ruby laser?
Ans.
The pumping system imparts energy to the atoms or molecules of the lasing medium enabling them to be raised to an excited "metastable state" creating a population inversion. Optical pumping uses photons provided by a source such as a Xenon gas flash lamp or another laser to transfer energy to the lasing material. The optical source must provide photons which correspond to the allowed transition levels of the lasing material.

Collision pumping relies on the transfer of energy to the lasing material by collision with the atoms (or molecules) of the lasing material. Again, energies which correspond to the allowed transitions must be provided. This is often done by electrical discharge in a pure gas or gas mixture in a tube.

Chemical pumping systems use the binding energy released in chemical reactions to state. Optical pumping system is used in ruby laser

Q13. Define the gas laser?

Ans. A gas laser is a laser in which an electric current is discharged through a gas inside the laser medium to produce laser light. In gas lasers, the laser medium is in the gaseous state.



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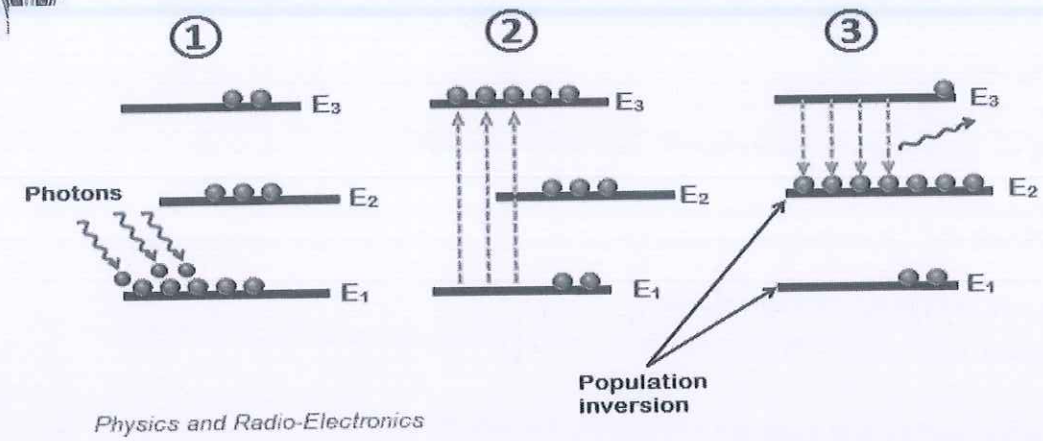
Q14. Define the population inversion and also draw the diagram?

Ans. **Population Inversion:**

Practically speaking, the process of stimulated emission will not produce a very efficient or even noticeable amplification of light unless a condition called "population inversion" occurs. If only a few atoms of several million are in an excited state, the chances of stimulated emission occurring are small. The greater the percentage of atoms in an excited state, the greater the probability of stimulated emission. In the normal state of matter the population of electrons will be such that most of the electrons reside in the ground or lowest levels, leaving the upper levels somewhat depopulated. When electrons are excited and fill these upper levels to the extent that there are more atoms excited than not excited, the population is said to be inverted



Physics and Radio-Electronics

Section – C

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Ans. Laser is an optical device that generates intense beam of coherent monochromatic light by stimulated emission of radiation.

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Q16. Describe the Nd:YAG laser?

Ans. Nd: YAG laser definition

Neodymium-doped Yttrium Aluminum Garnet (Nd: YAG) laser is a solid state laser in which Nd: YAG is used as a laser medium.

These lasers have many different applications in the medical and scientific field for processes such as Lasik surgery and laser spectroscopy.

Nd: YAG laser is a four-level laser system, which means that the four energy levels are involved in laser action. These lasers operate in both pulsed and continuous mode.

Nd: YAG laser generates laser light commonly in the near-infrared region of the spectrum at 1064 nanometers (nm). It also emits laser light at several different wavelengths including 1440 nm, 1320 nm, 1120 nm, and 940 nm.

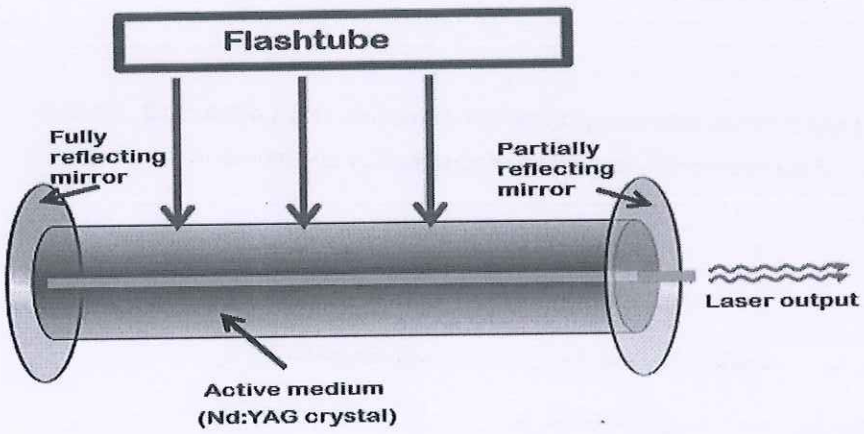
Nd: YAG laser construction

Nd: YAG laser consists of three important elements: an energy source, active medium, and optical resonator.

Energy source

The energy source or pump source supplies energy to the active medium to achieve population inversion. In Nd: YAG laser, light energy sources such as flashtube or laser diodes are used as energy source to supply energy to the active medium.

In the past, flashtubes are mostly used as pump source because of its low cost. However, nowadays, laser diodes are preferred over flashtubes because of its high efficiency and low cost.



Active medium

The active medium or laser medium of the Nd:YAG laser is made up of a synthetic crystalline material (Yttrium Aluminum Garnet (YAG)) doped with a chemical element (neodymium (Nd)). The lower energy state electrons of the neodymium ions are excited to the higher energy state to provide lasing action in the active medium.

Optical resonator

The Nd: YAG crystal is placed between two mirrors. These two mirrors are optically coated or silvered.

Each mirror is silvered or coated differently. One mirror is fully silvered whereas, another mirror is partially silvered. The mirror, which is fully silvered, will completely reflect the light and is known as fully reflecting mirror.

On the other hand, the mirror which is partially silvered will reflect most part 9of the light but allows a small portion of light through it to produce the laser beam. This mirror is known as a partially reflecting mirror.

Working of Nd: YAG laser

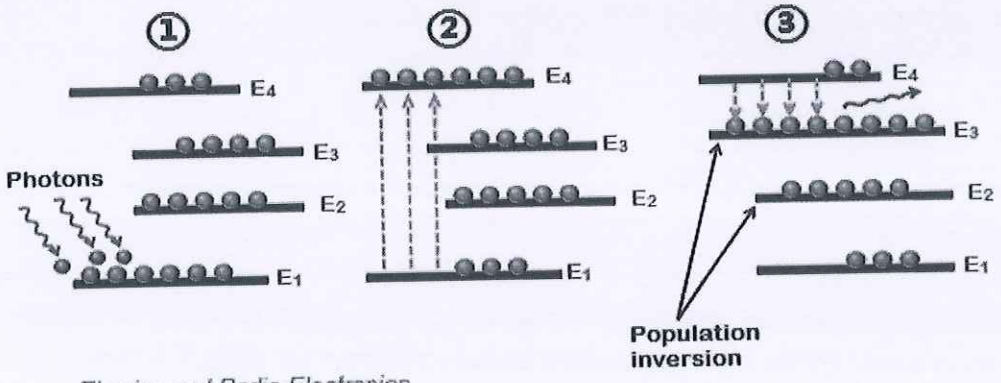
Nd: YAG laser is a four-level laser system, which means that the four energy levels are involved in laser action. The light energy sources such as flashtubes or laser diodes are used to supply energy to the active medium.

In Nd: YAG laser, the lower energy state electrons in the neodymium ions are excited to the higher energy state to achieve population inversion.

Consider an Nd: YAG crystal active medium consisting of four energy levels E_1, E_2, E_3, and E_4 with N number of electrons. The number of electrons in the energy states E1, E_2, E_3, and E_4 will be N_1, N_2, N_3, and N_4.

Let us assume that the energy levels will be $E_1 < E_2 < E_3 < E_4$. The energy level E_1 is known as ground state, E_2 is the next higher energy state or excited state, E_3 is the metastable state or excited state and E_4 is the pump state or excited state. Let us assume that initially, the population will be $N_1 > N_2 > N_3 > N_4$.

When flashtube or laser diode supplies light energy to the active medium (Nd:YAG crystal), the lower energy state (E_1) electrons in the neodymium ions gains enough energy and moves to the pump state or higher energy state E_4.

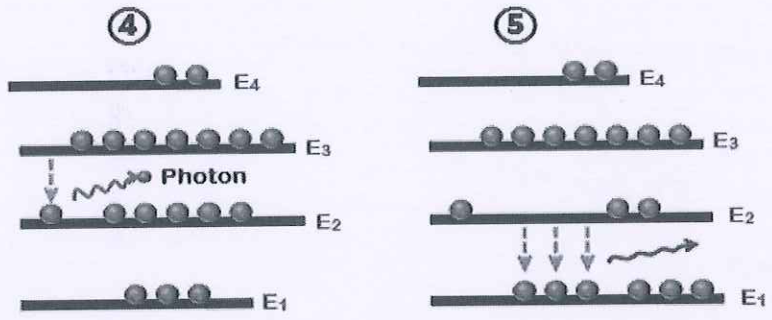


Physics and Radio-Electronics

The lifetime of pump state or higher energy state E_4 is very small (230 microseconds (Âµs)) so the electrons in the energy state E_4 do not stay for long period. After a short period, the electrons will fall into the next lower energy state or metastable state E_3 by releasing non-radiation energy (releasing energy without emitting photons).

The lifetime of metastable state E_3 is high as compared to the lifetime of pump state E_4. Therefore, the electrons reach E_3 much faster than they leave E_3. This results in an increase in the number of electrons in the metastable E_3 and hence population inversion is achieved.

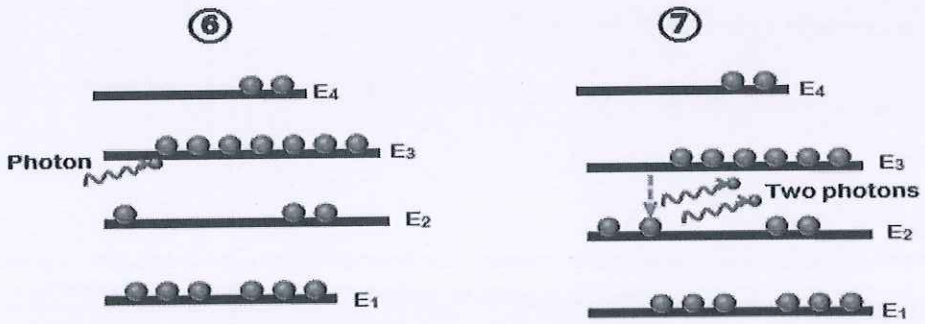
After some period, the electrons in the metastable state E_3 will fall into the next lower energy state E_2 by releasing photons or light. The emission of photons in this manner is called spontaneous emission.



Physics and Radio-Electronics

The lifetime of energy state E_2 is very small just like the energy state E_4. Therefore, after a short period, the electrons in the energy state E_2 will fall back to the ground state E_1 by releasing radiation less energy.

When photon emitted due to spontaneous emission is interacted with the other metastable state electron, it stimulates that electron and makes it fall into the lower energy state by releasing the photon. As a result, two photons are released. The emission of photons in this manner is called stimulated emission of radiation.



Physics and Radio-Electronics

When these two photons again interacted with the metastable state electrons, four photons are released. Likewise, millions of photons are emitted. Thus, optical gain is achieved.

Spontaneous emission is a natural process but stimulated emission is not a natural process. To achieve stimulated emission, we need to supply external photons or light to the active medium.

The Nd: YAG active medium generates photons or light due to spontaneous emission. The light or photons generated in the active medium will bounce back and forth between the two mirrors. This stimulates other electrons to fall into the lower energy state by releasing photons or light. Likewise, millions of electrons are stimulated to emit photons.

The light generated within the active medium is reflected many times between the mirrors before it escapes through the partially reflecting mirror.

Q17. What are the advantages and disadvantages of he-Ne Laser?

Ans. Advantages of helium-neon laser

- Helium-neon laser emits laser light in the visible portion of the spectrum.
- High stability
- Low cost
- Operates without damage at higher temperatures

Disadvantages of helium-neon laser

- Low efficiency
- Low gain
- Helium-neon lasers are limited to low power tasks

Applications of helium-neon lasers

- Helium-neon lasers are used in industries.
- Helium-neon lasers are used in scientific instruments.
- Helium-neon lasers are used in the college laboratories.

Q18. What is Ruby Laser? Elaborate its working.

Ans. A ruby laser is a solid-state laser that uses the synthetic ruby crystal as its laser medium. Ruby laser is the first successful laser developed by Maiman in 1960.

Ruby laser is one of the few solid-state lasers that produce visible light. It emits deep red light of wavelength 694.3 nm.

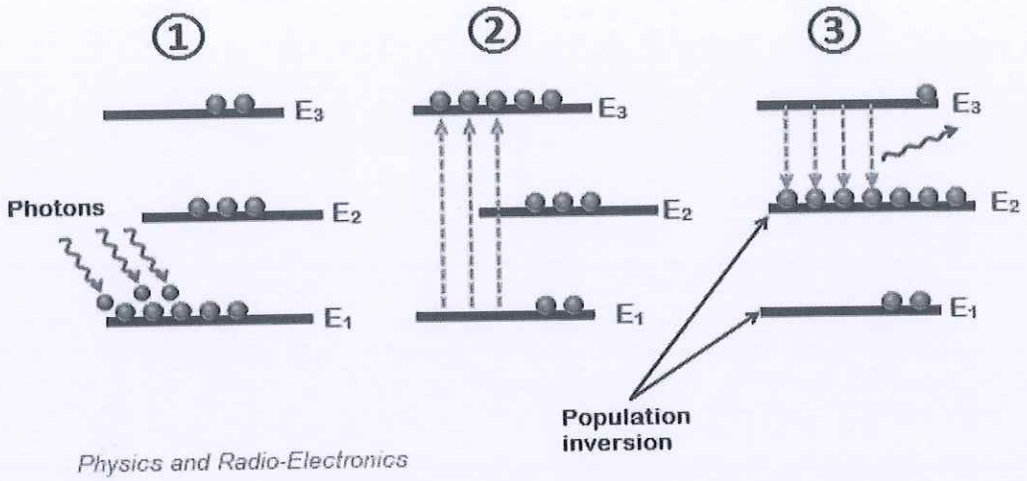
Working of ruby laser

The ruby laser is a three level solid-state laser. In a ruby laser, optical pumping technique is used to supply energy to the laser medium. Optical pumping is a technique in which light is used as energy source to raise electrons from lower energy level to the higher energy level.

Consider a ruby laser medium consisting of three energy levels E_1, E_2, E_3 with N number of electrons.

We assume that the energy levels will be $E_1 < E_2 < E_3$. The energy level E_1 is known as ground state or lower energy state, the energy level E_2 is known as metastable state, and the energy level E_3 is known as pump state.

Let us assume that initially most of the electrons are in the lower energy state (E_1) and only a tiny number of electrons are in the excited states (E_2 and E_3)



Physics and Radio-Electronics

When light energy is supplied to the laser medium (ruby), the electrons in the lower energy state or ground state (E_1) gains enough energy and jumps into the pump state (E_3).

The lifetime of pump state E_3 is very small (10^{-8} sec) so the electrons in the pump state do not stay for long period. After a short period, they fall into the metastable state E_2 by releasing radiation less energy. The lifetime of metastable state E_2 is 10^{-3} sec which is much greater than the lifetime of pump state E_3. Therefore, the electrons reach E_2 much faster than they leave E_2. This results in an increase in the number of electrons in the metastable state E_2 and hence population inversion is achieved.

After some period, the electrons in the metastable state E_2 falls into the lower energy state E_1 by releasing energy in the form of photons. This is called spontaneous emission of radiation.

When the emitted photon interacts with the electron in the metastable state, it forcefully makes that electron fall into the ground state E_1. As a result, two photons are emitted. This is called stimulated emission of radiation.

When these emitted photons again interacted with the metastable state electrons, then 4 photons are produced. Because of this continuous interaction with the electrons, millions of photons are produced.

In an active medium (ruby), a process called spontaneous emission produces light. The light produced within the laser medium will bounce back and forth between the two mirrors. This stimulates other electrons to fall into the ground state by releasing light energy. This is called stimulated emission. Likewise, millions of electrons are stimulated to emit light. Thus, the light gain is achieved.

The amplified light escapes through the partially reflecting mirror to produce laser light.

Verified

QP, Set A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Set B

Course Code: MCS1304 **Time: 2 Hours**

Course Name: Advanced welding **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

1. What is the correct identification number for the welding process submerged arc welding with solid wire as per ISO 4063?

a) 122
b) 185
c) 121
d) 142

2. What is the correct identification number for the welding process explosive welding as per ISO 4063?

a) 441
b) 121
c) 311
d) 52

3. What information does WPS contains?

a) Welding current
b) Heat input
c) Welding process
d) All of the above

4. Which of the following is a NDT process?

a) Radiographic test
b) Bend test
c) Tensile test
d) Macro examination

5. Which of the following is not a quantitative type DT process?

a) Tensile test
b) Impact test
c) Bend test
d) Hardness test

6. Which of the following welding process doesn't belong to arc welding family?

a) TIG
b) LBW
c) MMA
d) FCAW

7. What is 6G position is called as per ISO 6947?

a) HLO 45
b) PJ
c) PA
d) PC

8. What is PB position is called as per AWS?

a) 2F
b) 5G
c) 4F
d) 1G

9. Laser beam welding is a _____ joining process.

a) fission
b) fusion
c) coherent
d) plastic

10. CO2 lasers employs gas mixture of _____

a) nitrogen and helium
b) hydrogen and helium
c) argon and xenon
d) oxygen and nitrogen

Section – B

04X04 = 16 Marks

Q11. Write a short note on the importance of welding aluminum and its alloys.

Q12. Write short note on FSW?

Q13. Name any four alloying elements and their effect on stainless steel.

Q14. What is pWPS?

Section – C

04X06 = 24 Marks

Q15. Write down the process of saw. Give the advantages and limitations for the same.

Q16. Give the differences between TIG & PAW.

Q17. Give the introduction and principal of EBW.

Q18. What is clad steel? Write down the process of welding of clad steel.

AS., Set A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1304 Answer key **Time: 2 Hours**

Course Name: Advanced welding **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

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(A) 122
(B) 185
(C) 121
(D) 142

2. What is the correct identification number for the welding process explosive welding as per ISO 4063?

(A) 441
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(D) FCAW

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(A) HLO 45
(B) PJ
(C) PA
(D) PC

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(B) 5G
(C) 4F
(D) 1G

9. Laser beam welding is a _____ joining process.

a) fission
b) fusion
c) coherent
d) plastic

10. CO2 lasers employs gas mixture of _____

a) **nitrogen and helium**
b) hydrogen and helium
c) argon and xenon
d) oxygen and nitrogen

Section – B

04X04 = 16 Marks

Q11. Write a short note on the importance of welding aluminum and its alloys.

Ans. Low relative density (~2.7)

Reasonably high tensile strength and ductility

High strength to weight ratio

Excellent electrical and thermal conductivity

Corrosion resistance

Easy fabrication

Favorable economics

Q12. Write short note on FSW?

Ans. Friction is the force resisting the relative motion of solid surfaces, fluid layers, and material elements sliding against each other

Welding using friction as the major resource is called friction stir welding.

Welds created by,

(A) Frictional heating

(B) Mechanical deformation

Q13. Name any four alloying elements and their effect on stainless steel.

Ans. Effects of alloying elements and impurities in stainless steels

Carbon (c) - A strong austenite former.

- Added to some high-strength alloys for hardening and strengthening effects

Manganese (Mn) - Austenite former

Silicon (Si) - A ferrite former

- Used to increase the corrosion resistance of austenitic steels
- Used to improve high-temperature scaling resistance
- Used to improve resistance of high-temperature steels to carburization
- Promotes wetting by weld metal at 0.8–1.0%

Chromium (cr) - A ferrite former

- Primary contributor to resistance to scaling and corrosion
- 12% chromium minimum essential for passivation

Nickel (ni) - An austenite former

- Provides good low temperature toughness
- Used to improve the general corrosion resistance against non- oxidizing liquids
- Sometimes added in small amounts to straight chromium grades to improve the mechanical properties

Molybdenum (Mo) - A ferrite former

- Used to improve high-temperature strength and creep resistance
- Used to improve general corrosion resistance of steels in non- oxidizing media, and resistance to pitting corrosion in all media

Copper (cu)

- Used to improve corrosion resistance of stainless steel in environments that are reducing rather than oxidizing

Niobium (nb)

- A strong carbide former. used to stabilize austenitic stainless steels against the harmful precipitation of chromium carbides in the range 480–820°C
- A strong ferrite former
- Added to some high strength alloys for hardening and strengthening effects
- Added to some martensitic straight chromium stainless steels to tie up the carbon and hence reduce the hardening tendency of the steels

Titanium (ti)

- A strong carbide former. Used to stabilize austenitic stainless steels against the harmful precipitation of chromium carbides in the range 480–820°C
- A strong ferrite former

- Added to some high-strength heat resisting alloys for its hardening and strengthening effects
- Cobalt (co)
- Added to various alloys to impart strength and creep resistance at high temperatures

Tungsten (W)

- Improves the high-temperature strength and creep resistance of some high-temperature alloys

Nitrogen (n)

- A strong austenite former
- Used to minimize grain grown in high chromium, straight chromium steels at high temperatures

Q14. What is pWPS?

Ans. **PRELIMINARY (PROPOSED) WELDING PROCEDURE SPECIFICATIONS (WPS)**

pWPS is essentially a guide for the person that is going to weld the PQR test coupon and it can also be used as a document to get in principal approval from the client. You give the client the change to review what you intend to do, i.e. If I run the test like this and do this testing, will you be happy with it.

This is not always required, but it is specified in some standards. It can save heartache buy ensuring the client is happy with the WPS at the end.

Section – C

04X06 = 24 Marks

Q15. Write down the process of saw. Give the advantages and limitations for the same.

Ans. The molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under a blanket of granular fusible flux.

- Flux consists of lime, silica, manganese oxide, calcium fluoride, and other compounds.
- When molten, the flux becomes conductive, and provides a current path between the electrode and the work.
- This thick layer of flux completely covers the molten metal thus preventing spatter and sparks as well as suppressing the intense ultraviolet radiation and fumes that are a part of the shielded metal arc welding (SMAW) process

Advantages of SAW

- High quality
- Little risk of undercut and porosity
- No spatter
- Very little risk of lack of fusion due to deep and safe penetration
- High deposition rate
- High thermal efficiency
- No radiation
- High welding speeds are possible

- Deep penetration rate
- Low distortion

Limitations of SAW

- Precise joint preparation required
- No observation of arc and process during welding is possible
- High operational effort
- It cannot be used for plates less than 5mm thickness
- Flux is subjected to contamination and adsorption of moisture.
- Solidification cracking.
- Irregular wire feed.

Q16. Give the differences between TIG & PAW.

Ans.

Difference between TIG & PAW

PAW	TIG
Two gases are used, One for Plasma Gas and as well as shields the arc and molten weld pool.	Only one gas used, which forms plasma other for Shielding Gas.
Uses Constricted Arc.	Uses Non-Constricted Arc.
Temp. of about 11000°C is achieved.	Temp. of about 4000°C is achieved.
Deep Penetration is achieved.	Penetration obtained is not so deeper.
No Filler Material is required.	More Filler Material is required.
Fast Metal Deposition Rate.	Metal Deposition Rate is not so faster.
Inert Gas Consumption is very high.	Inert Gas Consumption is very low.
Costly welding equipment.	Less costly welding equipment.
Cutting of Hard and Brittle Material is possible.	Cutting of Hard and Brittle Material is not possible.

Q17. Give the introduction and principal of EBW.

Ans. Introduction

It is fusion welding process in which a beam of high- velocity electrons is applied to two materials to be joined.

Free electrons in vacuum can be accelerated, with their paths controlled by electric and magnetic fields.

In this way narrow beams of electrons carrying high kinetic energy can be formed, which upon collision with atoms in solids transform their kinetic energy into heat.

Principal

Electron beams are composed of electrons that are charged particles having a rest **mass of 9.1×10^{-31} kg and** can be accelerated in electron guns to relativistic velocities, giving them high kinetic energies.

At 10 kV (13 hp), electrons travel at approximately 20% of the speed of light, while at 200 kV (270 hp) they travel at approximately 70% the speed of light.

Electron beam welding process is carried out in vacuum. In this process, electrons are emitted from the heated filament called electrode.

These electrons are accelerated by applying high potential difference (30 kV to 175 kV) between cathode and anode.

The higher the potential difference, the higher would be the acceleration of the electrons. The electrons get the speed in the range of 50,000 to 200,000 km/s.

When high kinetic energy electron beam strikes the work piece, high heat is generated resulting in melting of the work material. Molten metal fills into the gap between parts to be joined.

Q18. What is clad steel? Write down the process of welding of clad steel.

Ans. The use of a clad-material, consisting of a mild or low alloy steel backing faced with stainless steel, usually from 10 to 20% of

The total thickness, combines the mechanical properties of an economic backing material with the corrosion resistance of the more expensive stainless steel facing. This facing usually consists of austenitic stainless steel of the 18% chromium 8% nickel or 18% chromium 10% nickel types, with or without additions of

Molybdenum, titanium and niobium, or a martensitic stainless steel of the 13% chromium type.

The backing should be welded first, while making sure that the root run of the mild steel electrode does not come into contact with the alloyed cladding. This can be achieved in two ways, either by cutting the cladding away from both sides of the root, or welding with a closed butt preparation and a sufficiently large root-face.

After welding the mild steel side, the root run should be back grooved and the stainless clad side welded with a stainless electrode of matching composition. The use of a more highly alloyed electrode (e.g. Smooth arc S309) for the initial root run on the clad side is advisable. This applies particularly to preparations in which the back- cutting of the cladding makes pick-up from the mild steel difficult

To avoid. For the best resistance to corrosion, at least two layers of stainless weld metal on the clad side are recommended.

The welding of material that is clad or lined with 13% chromium (martensitic) steels usually requires a preheat of 250°C and the use of austenitic electrodes of appropriate type. Welding should be followed by a post-weld heat treatment, though satisfactory results can be obtained without these precautions if, during welding, heat dissipation is kept to a minimum. This will help to temper the heat-

Affected zone by utilizing the heat build-up from adjacent weld runs.

QP, Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1304 **Time: 2 Hours**

Course Name: Advanced welding **Max. Marks: 50**

Set=B

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

Q1. Which of the following welding process uses non-consumable electrode?

a.) Gas tungsten arc welding (TIG)

b.) Shielded metal arc welding

c.) CO2 shielded welding

d.) Gas metal arc welding (MIG)

Q2. The resistance of the arc

a) Decrease with an increase of the current -

b) Increases with increases of the current

c) Does not depends on current

d) None of the above

Q3. In arc welding, the voltage on A.C supply system is in the range

a) 1000-1200 V

b) 400-500 V

c) 200-250 V

d) 70-100V

Q4. Which of the following is not a quantitative type DT process?

(A) Tensile test

(B) Impact test

(C) Bend test

(D) Hardness test

Q5. Which of the following welding process doesn't belong to arc welding family?

(A) TIG
(B) LBW
(C) MMA
(D) FCAW

Q6. In arc welding by dc supply, the voltage required is

6. 10 to 20 V
7. 50 to 60 V
8. 100 to 120 V
9. 200 to 250 V

Q7. What is PB position is called as per AWS?

(A) 2F
(B) 5G
(C) 4F
(D) 1G

Q8. CO2 lasers employs gas mixture of _____

a) Nitrogen and helium
b) hydrogen and helium
c) argon and xenon
d) oxygen and nitrogen

Q9. The Polarity of A.C welding sets is

a) Positive
b) Negative
c) No polarity
d) Infinite

Q10. Chipping hammers are used

a) To remove slag from welding
b) To align the pieces to be welded
c) For tack welding
d) For marking spots to be welded

Section – B

04X04 = 16 Marks

Q11. What is PQR?

Q12. Name any four alloying elements and their effect on stainless steel.

Q13. Write Short note on stainless steel and its types.

Q14. Write short note on FSW?

Section – C

04X06 = 24 Marks

Q15. Write down the Procedure for welding stainless steels to mild or low alloy steels.

Q16. What is aluminum bronze? What to avoid while welding aluminum bronze

Q17. What is clad steel? Write down the process of welding of clad steel.

Q18. Give the differences between TIG & PAW.

AS, Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1304 **Time: 2 Hours**

Course Name: Advanced welding **Max. Marks: 50**

Answer key

Instruction:

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Section – A

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a) **Decrease with an increase of the current** -

b) Increases with increases of the current

c) Does not depends on current

d) None of the above

Q3. In arc welding, the voltage on A.C supply system is in the range

a) 1000-1200 V

b) 400-500 V

c) 200-250 V

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Q10. Chipping hammers are used

a) To remove slag from welding

b) To align the pieces to be welded

c) For tack welding

d) For marking spots to be welded

Section – B

04X04 = 16 Marks

Q11. What is PQR?

Ans. PROCEDURE QUALIFICATION RECORDS (PQR)

All WPSs start with a PQR. It is a record of the test. It **DOES NOT have any ranges**. It lists the actual values recorded during the welding of a test piece. It proves the welding process.

Then using the essential variables (ranges) from the relevant code/standard a WPS can be generated from this record of actual values.

PQR is essentially the 'actual' method that is used to create and test the welds to ensure they meet all applicable requirements.

The test procedures and final results are documented in the PQR. If the PQR meets the set standards of the welding world, then it will serve as the foundation on which one or more WPSs are drafted.

Even though a PQR eventually leads to a WPS, it is important for welders to have knowledge of both documents. In critical applications and in mechanized and automatic welds welders can refer to the PQR and replicate the actual values used in the test weld, this removes all the variation.

On face value, these documents look very similar but serve completely different purposes.

The best way to think of it is;

- PQR is an office document
- WPS is a workshop document

Both are necessary in most cases. The PQR supports the WPS as evidence of qualification.

Q12. Name any four alloying elements and their effect on stainless steel.

Ans. Effects of alloying elements and impurities in stainless steels

Carbon (c) - A strong austenite former.

- Added to some high-strength alloys for hardening and strengthening effects

Manganese (Mn) - Austenite former

Silicon (Si) - A ferrite former

- Used to increase the corrosion resistance of austenitic steels
- Used to improve high-temperature scaling resistance
- Used to improve resistance of high-temperature steels to carburization
- Promotes wetting by weld metal at 0.8–1.0%

Chromium (cr) - A ferrite former

- Primary contributor to resistance to scaling and corrosion
- 12% chromium minimum essential for passivation

Nickel (ni) - An austenite former

- Provides good low temperature toughness
- Used to improve the general corrosion resistance against non- oxidizing liquids
- Sometimes added in small amounts to straight chromium grades to improve the mechanical properties

Molybdenum (Mo) - A ferrite former

- Used to improve high-temperature strength and creep resistance
- Used to improve general corrosion resistance of steels in non- oxidizing media, and resistance to pitting corrosion in all media

Copper (cu)

- Used to improve corrosion resistance of stainless steel in environments that are reducing rather than oxidizing

Niobium (nb)

- A strong carbide former. used to stabilize austenitic stainless steels against the harmful precipitation of chromium carbides in the range 480–820°C
- A strong ferrite former
- Added to some high strength alloys for hardening and strengthening effects
- Added to some martensitic straight chromium stainless steels to tie up the carbon and hence reduce the hardening tendency of the steels

Titanium (ti)

- A strong carbide former. Used to stabilize austenitic stainless steels against the harmful precipitation of chromium carbides in the range 480–820°C
- A strong ferrite former
- Added to some high-strength heat resisting alloys for its hardening and strengthening effects
- Cobalt (co)
- Added to various alloys to impart strength and creep resistance at high temperatures

Tungsten (W)

- Improves the high-temperature strength and creep resistance of some high-temperature alloys

Nitrogen (n)

- A strong austenite former
- Used to minimize grain grown in high chromium, straight chromium steels at high temperatures

Q13. Write Short note on stainless steel and its types.

Ans. Stainless steels are a group of high alloy steels that contain at least 12% chromium. In general, they are alloyed with a number of other elements that make them resistant to a variety of different environments. These elements also modify the microstructure of the alloy, which in turn has a distinct influence on their mechanical properties and weld ability. Stainless steels can be broadly classified into five groups as detailed below:

Austenitic stainless steels, which contain 12–27% chromium and 7–25% nickel.

- Ferritic stainless steels, which contain 12–30% chromium with a carbon content below 0.1%.
- Martensitic stainless steels, which have chromium content between 12 and 18% with 0.15–0.30% carbon.
- Ferritic-austenitic (Duplex) stainless steels, which contain 18– 25% chromium, 3–5% nickel and up to 3% molybdenum.
- Martensitic-austenitic steels, which have 13–16% chromium, 5–6% nickel and 1–2% molybdenum.

Q14. Write short note on FSW?

Ans. Friction is the force resisting the relative motion of solid surfaces, fluid layers, and material elements sliding against each other

Welding using friction as the major resource is called friction stir welding.

Welds created by,

(A) Frictional heating

(B) Mechanical deformation

Section – C

04X06 = 24 Marks

Q15. Write down the Procedure for welding stainless steels to mild or low alloy steels.

Ans. Situations frequently arise in which it becomes necessary to weld an austenitic stainless steel to a mild or low alloy ferritic steel. In

Selecting a suitable electrode, the effect of dilution of the weld metal by the base material must be considered. The weld metal may be diluted from 20 to 50% depending on the welding technique used, root runs in butt joints being the most greatly affected since all subsequent runs are only in partial contact with the base material and share dilution with neighboring runs. If a mild or low alloy steel electrode is used to weld stainless to mild steel, the pickup of chromium and nickel from the stainless steel side to the joint could enrich the weld metal by up to 5 percent chromium and 4% nickel. This would result in a hard enable, crack-sensitive weld.

Austenitic stainless steel electrodes are therefore used for joining dissimilar metal combinations of stainless materials to mild and low alloy ferritic steels. However, the correct type, which has sufficient alloying to overcome the effects of dilution from the mild or low alloy steel side of the joint, must be selected because, if the weld metal does not start with an adequate alloy content, the final weld may contain less than 17% chromium and 7% nickel. Weld metal with lower chromium and nickel contents are crack sensitive. Also, if as a result of dilution the weld metal is incorrectly balanced with nickel and chromium, there may not be sufficient ferrite present in the weld metal to prevent fissuring and subsequent cracking.

For these reasons, the austenitic stainless steel electrodes such as S309L etc. should be used, as their composition has been specially balanced to ensure that the total alloy content is

Adequate to accommodate dilution effects and their ferrite content is sufficient to provide high resistance to hot cracking.

Q16. What is aluminum bronze? What to avoid while welding aluminum bronze

Ans. Aluminum bronze

There are essentially two types of aluminum bronzes; single phase alloys containing between 5 to 10% aluminum, with a small amount of iron or nickel, and more complex, two phase alloys containing up to 12% aluminum and about 5%of iron with specific alloys also containing nickel, manganese and silicon. Gas shielded welding processes are preferred for welding this group of alloys. In TIG welding, the presence of a tenacious, refractory oxide film requires AC (argon), or DC with a helium shielding gas. Due to its low thermal conductivity, a preheat is not normally required except when welding thick section components. Avoiding weld imperfections Rigorous cleaning of the material surface is essential, both before and after deposition of each welding pass, to avoid porosity. Single phase alloys can be susceptible to weld metal and HAZ cracking under highly restrained conditions. It is often necessary to use matching filler metals to maintain corrosion resistance but a non-matching, two phase, filler can also reduce the risk of cracking. Two phase alloys are easier to weld. For both types, preheat and inter pass temperatures should be controlled carefully to prevent cracking.

Q17. What is clad steel? Write down the process of welding of clad steel.

Ans. The use of a clad-material, consisting of a mild or low alloy steel backing faced with stainless steel, usually from 10 to 20% of

The total thickness, combines the mechanical properties of an economic backing material with the corrosion resistance of the more expensive stainless steel facing. This facing usually consists of austenitic stainless steel of the 18% chromium 8% nickel or 18% chromium 10% nickel types, with or without additions of

Molybdenum, titanium and niobium, or a martensitic stainless steel of the 13% chromium type.

The backing should be welded first, while making sure that the root run of the mild steel electrode does not come into contact with the alloyed cladding. This can be achieved in two ways, either by cutting the cladding away from both sides of the root, or welding with a closed butt preparation and a sufficiently large root-face.

After welding the mild steel side, the root run should be back grooved and the stainless clad side welded with a stainless electrode of matching composition. The use of a more highly alloyed electrode (e.g. Smooth arc S309) for the initial root run on the clad side is advisable. This applies particularly to preparations in which the back- cutting of the cladding makes pick-up from the mild steel difficult

To avoid. For the best resistance to corrosion, at least two layers of stainless weld metal on the clad side are recommended.

The welding of material that is clad or lined with 13% chromium (martensitic) steels usually requires a preheat of 250°C and the use of austenitic electrodes of appropriate type. Welding should be followed by a post-weld heat treatment, though satisfactory results can be obtained without these precautions if, during welding, heat dissipation is kept to a minimum. This will help to temper the heat-

Affected zone by utilizing the heat build-up from adjacent weld runs.

Q18. Give the differences between TIG & PAW.

Ans.

Difference between TIG & PAW

PAW	TIG
❑ Two gases are used, One for Plasma Gas and	❑ Only one gas used, which forms plasma other for Shielding Gas. as well as shields the arc and molten weld pool.
❑ Uses Constricted Arc.	❑ Uses Non-Constricted Arc.
❑ Temp. of about 11000°C is achieved.	❑ Temp. of about 4000°C is achieved.
❑ Deep Penetration is achieved.	❑ Penetration obtained is not so deeper.
❑ No Filler Material is required.	❑ More Filler Material is required.
❑ Fast Metal Deposition Rate.	❑ Metal Deposition Rate is not so faster.
❑ Inert Gas Consumption is very high.	❑ Inert Gas Consumption is very low.
❑ Costly welding equipment.	❑ Less costly welding equipment.
❑ Cutting of Hard and Brittle Material is possible.	❑ Cutting of Hard and Brittle Material is not possible.

Vetted

QP, Set A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1306 Set-A **Time: 2 Hours**

Course Name: Material Science **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

1. What is the composition of medium carbon steels?
   a. (0.5-1) %
   b. (03.-0.6) %
   c. More than 1 %
   d. None of the above

2. Which of the following hardening process occurs during plastic deformation (Cold working) in metals?
   a. Solid solution hardening
   b. Precipitation hardening
   c. Work hardening
   d. Grain boundary hardening

3. When welding stainless steel, a problem called sensitization occurs due to formation of ____ carbide.
   a. Chromium carbide
   b. Tantalum carbide
   c. Niobium carbide
   d. All the above

4. Cold worked specimens are often heat treated due to which of the following reasons.
   a. Soften the material to make it ductile.
   b. Increase the strength of the material.
   c. Increase the life-time of the material.

d. Increase the grain size of the material.

5. The kind of failure observed in FCC materials
   a. Ductile
   b. Brittle
   c. Mix
   d. none of the above

6. Fine (small) grain size in materials increase the ____.
   a. Ductility in the material.
   b. Melting of the material.
   c. Strength of the material.
   d. Corrosion resistance.

7. After welding the stresses generated in the weld metal are relieved by
   a. Annealing
   b. Salt water bath
   c. Tempering
   d. All of the above

8. Jominy end quench test is used for testing
   a. Hardenability
   b. Machinability
   c. Weldability
   d. Forge ability

9. The stainless steel grades are best used for applications that require high _____.
   a. Strength
   b. Thermal resistance
   c. Wear Resistance
   d. Corrosion resistance

10. Which class of steels are used as cutting tool material?
   a. High strength steels (HSS)
   b. Alloy steels
   c. Plain carbon steel
   d. Stainless steel

Section – B

04X04 = 16 Marks

Q11. Explain the process of sensitization and how can it be prevented in welding.

Q12. Why is spheroidizing adopted in hyper-eutectoid steels?

Q13. Write briefly about the properties of stainless steel grades 304 and 316.

Q14. Why are hot working of steels easy than cold working?

Section – C

04X06 = 24 Marks

Q15. Calculate the atomic packing factor of BCC material with a neat sketch.

Q16. Explain why the phenomena of hydrogen embrittlement is less observed in FCC materials than bcc materials.

Q17. Although BCC has more number of slip systems than FCC, but BCC is much harder. Explain with proper reasoning.

Q18. With neat diagram show the stress-strain characteristics of brittle and ductile material and indicate important points on the curve and explain briefly about these characteristic points.

A.S. Set A

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1306 **Time: 2 Hours**

Course Name: Material Science **Max. Marks: 50**

Answer key

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

1. What is the composition of medium carbon steels?
   a. (0.5-1) %
   b. (03.-0.6) %
   c. More than 1 %
   d. None of the above

2. Which of the following hardening process occurs during plastic deformation (Cold working) in metals?
   a. Solid solution hardening
   b. Precipitation hardening
   c. Work hardening
   d. Grain boundary hardening

3. When welding stainless steel, a problem called sensitization occurs due to formation of ____ carbide.
   a. Chromium carbide
   b. Tantalum carbide
   c. Niobium carbide
   d. All the above

4. Cold worked specimens are often heat treated due to which of the following reasons.
   a. Soften the material to make it ductile.
   b. Increase the strength of the material.
   c. Increase the life-time of the material.

d. Increase the grain size of the material.

5. The kind of failure observed in FCC materials
   - **a. Ductile**
   - b. Brittle
   - c. Mix
   - d. none of the above

6. Fine (small) grain size in materials increase the ____.
   - a. Ductility in the material.
   - b. Melting of the material.
   - **c. Strength of the material.**
   - d. Corrosion resistance.

7. After welding the stresses generated in the weld metal are relieved by
   - **a. Annealing**
   - b. Salt water bath
   - c. Tempering
   - d. All of the above

8. Jominy end quench test is used for testing
   - **a. Hardenability**
   - b. Machinability
   - c. Weldability
   - d. Forge ability

9. The stainless steel grades are best used for applications that require high _____.
   - a. Strength
   - b. Thermal resistance
   - c. Wear Resistance
   - **d. Corrosion resistance**

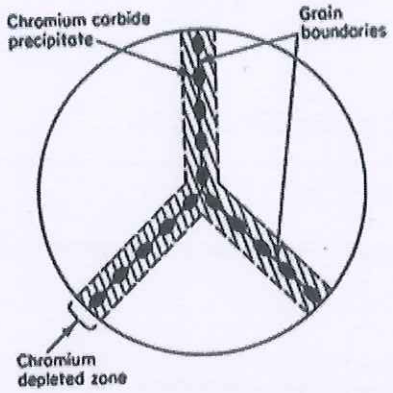
10. Which class of steels are used as cutting tool material?
    - **a. High strength steels (HSS)**
    - b. Alloy steels
    - c. Plain carbon steel
    - d. Stainless steel

Section – B

04X04 = 16 Marks

Q11. Explain the process of sensitization and how can it be prevented in welding.

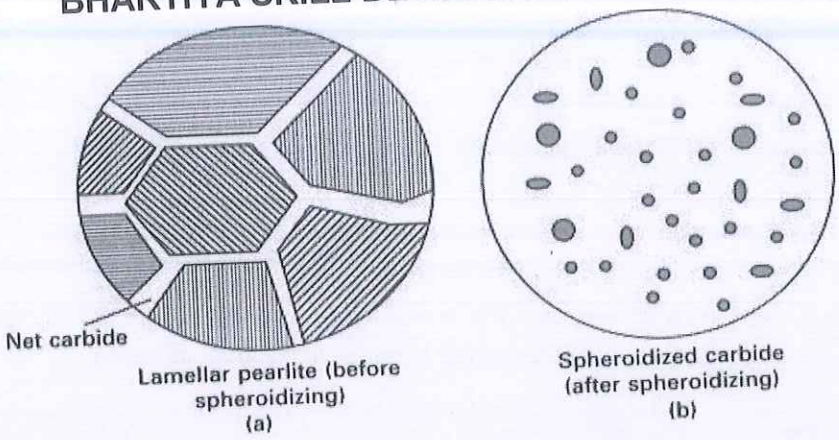
Ans. Sensitization refers to the precipitation of carbides at grain boundaries in a stainless steel or alloy, causing the alloy to be susceptible to intergranular corrosion. Certain alloys, when exposed to a temperature characterized as a sensitizing temperature, become particularly susceptible to intergranular corrosion. Sensitization involves the precipitation of chromium carbides at grain boundaries, which results in a narrow zone of chromium depletion at the grain boundary.



- Material that has been sensitized can be solution annealed by heating to a temperature where the carbides dissolved and the chromium-depleted regions are eliminated. The recommended solution anneal temperature depends on the alloy and is typically done in the range of 1000 to 1200 °C followed by rapid cooling.
- Resistance to sensitization can also be achieved by reducing the carbon content to below 0.030% level. The low carbon grades such as Types 304L, 316L, and 317L have been designed to resist sensitization during typical welding operations.
- The addition of stabilizing elements such as Ti, Nb (Cb), and Ta can also provide increased resistance to sensitization, especially for long-term exposures in the critical range in service. These stabilizing elements tend to form carbides that are more stable than chromium carbide in the temperature range of 2250 to 1450°F.

Q12. Why is spheroidizing adopted in hyper-eutectoid steels?

Ans. In hyper-eutectoid steels, the cementite forms a continuous hard network that reduce the machinability in steels. Spheroidizing of hyper-eutectoid (high carbon steel) is a method of prolonged heating at a temperature below the eutectoid temperature. By heating at this temperature the cementite network assumes a spheroidal shape. Therefore, a continuous distribution of spheroids in the microstructure is observed. The ductility of the hyper-eutectoid steels increases. The machinability of these steels is also increased. The process of spheroidizing does consume a lot of energy.



Q13. Write briefly about the properties of stainless steel grades 304 and 316.

Ans. Stainless steel grades 304 and 316 are austenitic stainless steel.

- The Chromium percentage in these steels vary between (16-30) % and Ni percentage vary between (2-20) %.
- They are non-hard enable and non-magnetic
- Used in cookware, beverages and food equipment, heat exchanger, piping, chemical equipment.

Chromium increases the resistance to corrosion. But at the same time chromium tends to increase ferromagnetism in these steels. Ni compensates that.

Q14. Why are hot working of steels easy than cold working?

Ans. The steels at high temperatures exhibit austenite phase that has a fcc structure. FCC materials are easy to deform because of closed packed slip systems than BCC materials. This is the reason why steels are worked at higher temperatures in the austenite phase. Furthermore, hot working does not lead to work hardening which is a common problem in cold working. Therefore, there is no need for intermediate annealing treatments. Hot working can be carried out continuously to carry out the shape deformation.

Section – C

04X06 = 24 Marks

Q15. Calculate the atomic packing factor of BCC material with a neat sketch.

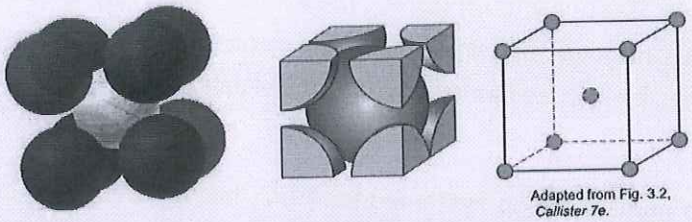
Ans.

Body Centered Cubic Structure (BCC)

- Atoms touch each other along cube diagonals.
  --Note: All atoms are identical; the center atom is shaded differently only for ease of viewing.

ex: Cr, W, Fe (α), Tantalum, Molybdenum

- Coordination # = 8

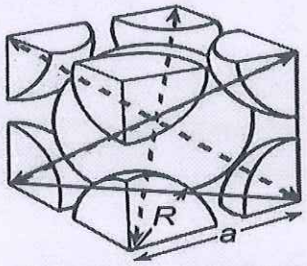


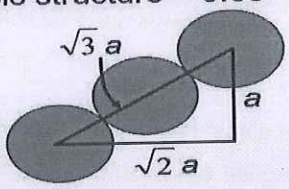
Adapted from Fig. 3.2, *Callister 7e.*

2 atoms/unit cell: 1 center + 8 corners x 1/8

Atomic Packing Factor: BCC

- APF for a body-centered cubic structure = 0.68





Close-packed directions:
length = $4R = \sqrt{3}\,a$

$$APF = \frac{\text{atoms}}{\text{unit cell}} \times \frac{\text{volume}}{\text{atom}} \Big/ \frac{\text{volume}}{\text{unit cell}} = \frac{2\left(\frac{4}{3}\pi(\sqrt{3}a/4)^3\right)}{a^3}$$

Ch

Q16. Explain why the phenomena of hydrogen embrittlement is less observed in FCC materials than bcc materials.

Ans. First we have to understand what Hydrogen embrittlement is.

Hydrogen can enter and diffuse through a metal alloy surface at ambient or elevated temperatures. At room temperature, hydrogen atoms can be absorbed into the crystal lattice and diffuse through the grains. Typical industry processes that can lead to hydrogen embrittlement include: galvanic zinc coating, phosphating, acid pickling, electroplating and arc welding. During these processes, there is a possibility of absorption of hydrogen by the material. Hydrogen tends to be attracted to regions of high tensile residual stresses mainly, thus, it is drawn to the regions ahead of cracks or notches that are ALREADY under stress. Regardless of the form (molecular or atomic), the atoms or molecules combine to form small bubbles at metal grain boundaries. These bubbles can act as pressure-concentrators,

building up pressure between the metal grains. The pressure can increase to levels where the metal has reduced ductility, causing the formation of minute cracks inside the material. The cracking is intergranular. That is, the crack grows along the metal grain boundaries.

The bcc (body-centered cubic) crystal structure of ferritic iron has relatively small holes between the metal atoms, but the channels between these holes are relatively wide. Consequently, hydrogen has a relatively low solubility in ferritic iron, but a relatively high diffusion coefficient. In contrast the holes in the FCC (face-centered cubic) austenite lattice are larger, but the channels between them are smaller, so materials such as austenitic stainless steel have a higher hydrogen solubility and a lower diffusion coefficient. Consequently, it usually takes very much longer (years rather than days) for austenitic materials to become embrittled by hydrogen diffusing in from the surface than it does for ferritic materials, and austenitic alloys are often regarded as immune from the effects of hydrogen.

Q17. Although BCC has more number of slip systems than FCC, but BCC is much harder. Explain with proper reasoning.

Ans.

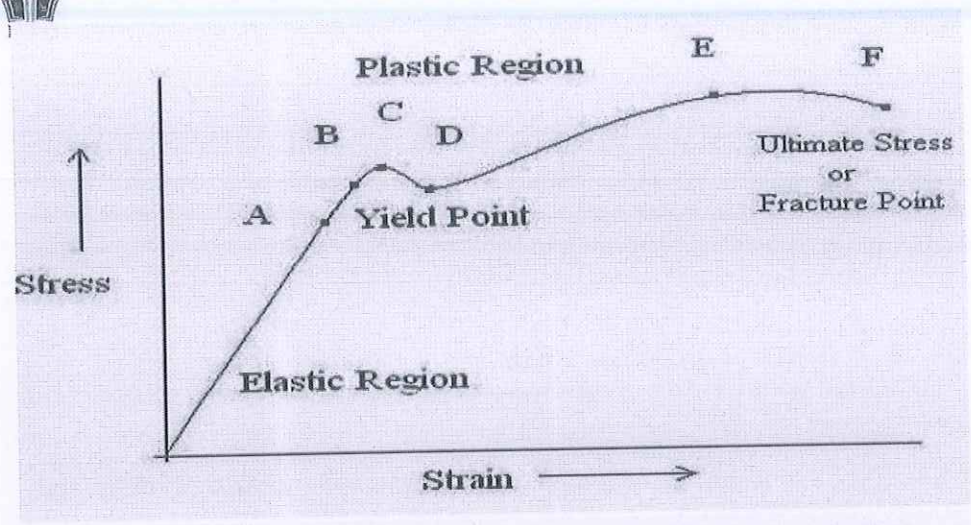
Although BCC has 48 numbers of slip systems and FCC has 12 number of slip systems, it is found that BCC is harder than FCC. In other words, FCC is more ductile than BCC.

The reason is the 48 numbers of slip systems in BCC are not close packed slip systems (Slip planes and Slip Directions. Dislocations glide easily on closed pack planes and closed pack directions. Easy mobility of dislocations introduces plastic deformation or ductility in materials.

Q18. With neat diagram show the stress-strain characteristics of brittle and ductile material and indicate important points on the curve and explain briefly about these characteristic points.

Ans.

Stress-Strain Curves for Ductile Materials If a ductile bar of uniform cross-sectional area is subjected to gradually increasing axial tensile force (generally is done in Universal Testing Machine) till failure of the bar occurs, when the stress-strain curve plots the curve may be divided into following parts:



Stress-Strain curve in ductile materials

Portion OA: This portion is absolutely straight, where the stress is proportional to strain and the material obeys Hooke's law ($\sigma = E \epsilon$). The value of stress at point A is called proportional limit.

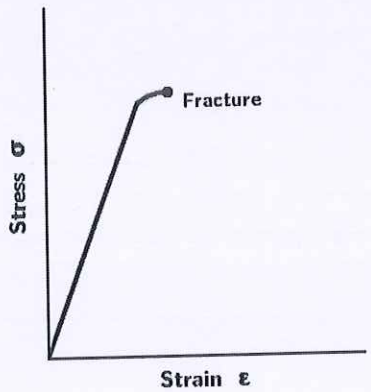
Portion AB: In this portion, Hook's law is not obeyed, although the material may still be elastic. The point B indicates the elastic limit.

Portion BC: In this portion, the metal shows a strain even without increase in stress and the strain is not fully return when load is removed.

Portion CD: Yielding start in this portion and there is a drop of stress at the point D directly after yielding begins at C. The point D is termed as lower yield point and C is called upper yield point.

Portion DE: After yielding has taken place at D, further straining takes place at this portion by increasing the stress and the stress–strain curve continues to rise up to the point E. Strain in this portion is about 100 times that of portion O-A. At the point E, the bar begins to form a local neck. The point E is termed as ultimate tensile stress point.

Portion EF: In this portion, the load is falling off from the maximum and fracture at F takes place. The point F is termed as fracture or breaking point and the identical stress is called breaking stress.



Stress Strain Curves for Brittle Materials: Materials which show very small elongation before they fracture are called brittle materials. The shape of curve for high carbon steel, concrete and high strength light alloys or any brittle materials is shown in fig. 3. For most brittle materials the permanent elongation (i.e. increase in length) is less than

Q P, Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

End-Sem. Examination

Course Code: MCS1306 Set-B **Time: 2 Hours**

Course Name: Material Science **Max. Marks: 50**

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
4. Section B contain 04 Questions. Each question carries 4 Marks.
5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

1. What is the composition of high carbon steels?
   a. (0.6-1) %
   b. (03.-0.6) %
   c. More than 1 %
   d. Less than 0.2 %

2. The heat treatment used for relieving stress in steel is—
   a. Tempering
   b. Annealing
   c. Carburizing
   d. All

3. Which of the following hardening process occurs during plastic deformation (Cold working) in metals?
   a. Solid solution hardening
   b. Precipitation hardening
   c. Work hardening
   d. Grain boundary hardening

4. Welded specimens are often heat treated due to which of the following reasons.
   a. Soften the material to make it ductile.
   b. Increase the strength of the material.
   c. Increase the life-time of the material.
   d. Relieve the residual stresses in the weld metal.

5. Toughness of materials refer to
   a. Ability of material to absorb energy before fracture
   b. It is the area under stress-strain curve
   c. Ability of material to undergo plastic deformation
   d. All of the above

6. Fine (small) grain size in materials increase the ____.
   a. Ductility in the material.
   b. Melting of the material.
   c. Strength of the material.
   d. Corrosion resistance.

7. Hardening in steels introduces martensite transformation, that is done by
   a. Quenching (Fast cooling)
   b. Slow cooling in furnace
   c. Normal cooling in air
   d. None of the above

8. Case hardening introduces
   a. Soft Case and hard core
   b. Hard case and soft core
   c. Overall hardness of the material
   d. Overall softness of the material

9. The stainless steel grades are best used for applications that require high _____.
   a. Strength
   b. Thermal resistance
   c. Wear Resistance
   d. Corrosion resistance

10. Body centered cubic (BCC) materials are harder than face centered cubic (FCC) materials. Which of the following reasons look appropriate?
    a. BCC has less number of slip systems
    b. BCC has more slip systems, but slip systems are not as closed pack as FCC
    c. BCC unit cells have less atoms than FCC
    d. None of the above.

Section – B

04X04 = 16 Marks

Q11. Compare between hot and cold working?

Q12. Which of the two processes is better between forging and casting for a particular component in terms of good properties? Please explain.

Q13. The solidification process in pure metals takes place at a constant temperature, while in alloys it occurs over a temperature range. Please explain.

Q14. Write briefly about the properties of stainless steel grades 304 and 316.

Section – C

04X06 = 24 Marks

Q15. Calculate the atomic packing factor of FCC material with a neat sketch.

Q16. What is hardening processes in steel and why tempering needs to be done after hardening?

Q17. Explain the different case hardening processes in steels.

Q18. With neat diagram show the stress-strain characteristics of brittle and ductile material and indicate important points on the curve and explain briefly about these characteristic points.

Vetted

AS, Set B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Metal Construction Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, III Semester

Answer sheet End-Sem. Examination

Course Code: MCS1306 **Time: 2 Hours**

Course Name: Material Science **Max. Marks: 50**

Answer key

Instruction:

1. Attempt all questions.
2. Use of Calculators is prohibited.
3. Section A contain 10 Questions. Each question carries 1 Marks.
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5. Section C contain 04 Questions. Each question carries 6 Marks.

Section – A

10X01 = 10 Marks

1. What is the composition of high carbon steels?
   - **a. (0.6-1) %**
   - b. (03.-0.6) %
   - c. More than 1 %
   - d. Less than 0.2 %

2. The heat treatment used for relieving stress in steel is—
   - a. Tempering
   - **b. Annealing**
   - c. Carburizing
   - d. All

3. Which of the following hardening process occurs during plastic deformation (Cold working) in metals?
   - a. Solid solution hardening
   - b. Precipitation hardening
   - **c. Work hardening**
   - d. Grain boundary hardening

4. Welded specimens are often heat treated due to which of the following reasons.
   - a. Soften the material to make it ductile.
   - b. Increase the strength of the material.
   - c. Increase the life-time of the material.
   - **d. Relieve the residual stresses in the weld metal.**

5. Toughness of materials refer to
   a. Ability of material to absorb energy before fracture
   b. It is the area under stress-strain curve
   c. Ability of material to undergo plastic deformation
   d. All of the above

6. Fine (small) grain size in materials increase the ____.
   a. Ductility in the material.
   b. Melting of the material.
   c. Strength of the material.
   d. Corrosion resistance.

7. Hardening in steels introduces martensite transformation, that is done by
   a. Quenching (Fast cooling)
   b. Slow cooling in furnace
   c. Normal cooling in air
   d. None of the above

8. Case hardening introduces
   a. Soft Case and hard core
   b. Hard case and soft core
   c. Overall hardness of the material
   d. Overall softness of the material

9. The stainless steel grades are best used for applications that require high _____.
   a. Strength
   b. Thermal resistance
   c. Wear Resistance
   d. Corrosion resistance

10. Body centered cubic (BCC) materials are harder than face centered cubic (FCC) materials. Which of the following reasons look appropriate?
    a. BCC has less number of slip systems
    b. BCC has more slip systems, but slip systems are not as closed pack as FCC
    c. BCC unit cells have less atoms than FCC
    d. None of the above.

Section – B

04X04 = 16 Marks

Q11. Compare between hot and cold working?

Ans. H• Hot rolling involves steel at a temperature (1700* F) above the steel's recrystallization temperature C• Cold rolled steel is manufactured at temperature below its recrystallization temperature

H• It is cheaper to make

C• It is not as cheaper as hot rolled steel

H• Hot rolled steel will shrink while cooling process and the shape and size are predictable, unlike cold rolled steel.

C• There is no worry about the steel shrinking or changing shape of steel.

H• Hot rolled finishing is not as smooth as Cold Rolled steel

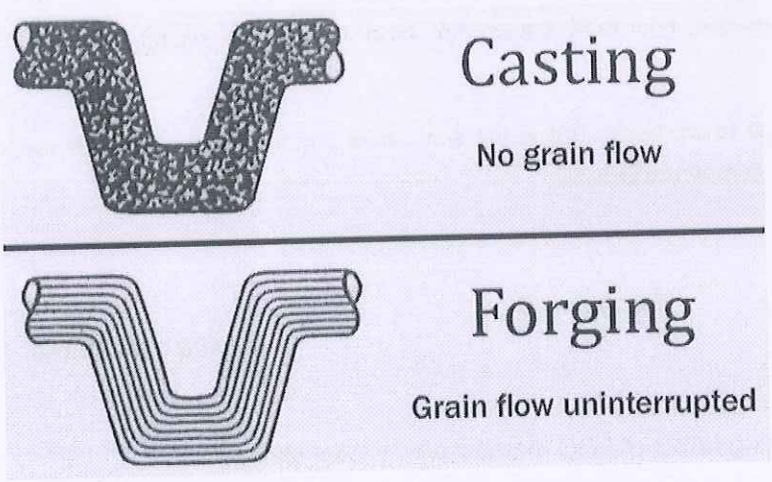
C• Cold rolled steel has smoother finishing and has a square corner and more accurate in dimension

H• It is used for welding purpose and construction trades such as making rail road tracks, I-beams, etc.

C• It is used for the purpose where quality of steel matters like steel used for the suspension bridge

Q12. Which of the two processes is better between forging and casting for a particular component in terms of good properties? Please explain.

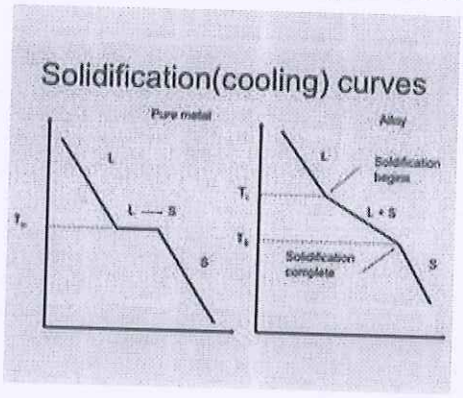
Ans.



Forged steel is generally stronger and more reliable than castings because Forging offers uniformity of composition and structure. There is a continuous grain flow in forging, while in casting there is no grain flow. This strengthens the forged product particularly in terms of impact and shear strength.

Q13. The solidification process in pure metals takes place at a constant temperature, while in alloys it occurs over a temperature range. Please explain.

Ans. The reason why the alloy of two or more metals solidifies over a range of temperatures is that each temperature during cooling corresponds to the solubility limit of a particular composition and therefore that particular composition will solidify at that particular temperature. Therefore, each temperature corresponds to a particular alloy composition.



Q14. Write briefly about the properties of stainless steel grades 304 and 316.

Ans. Stainless steel grades 304 and 316 are austenitic stainless steel.

- The Chromium percentage in these steels vary between (16-30) % and Ni percentage vary between (2-20) percent.
- They are non-hardenable and non-magnetic
- Used in cookware, beverages and food equipment, heat exchanger, piping, chemical equipment.

Chromium increases the resistance to corrosion. But at the same time chromium tends to increase ferromagnetism in these steels. Ni compensates that.

Section – C

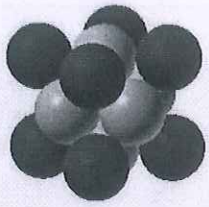
04X06 = 24 Marks

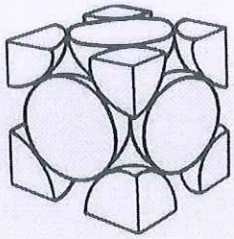
Q15. Calculate the atomic packing factor of FCC material with a neat sketch.

Ans.

Face Centered Cubic Structure (FCC)

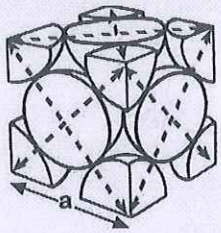
- **Close packed directions are face diagonals.**
  --Note: All atoms are identical; the face-centered atoms are shaded differently only for ease of viewing.
- **Coordination # = 12**





APF of FCC

- **APF for a body-centered cubic structure = 0.74**



Close-packed directions:
length = 4R
$=\sqrt{2}\,a$

Unit cell contains:
6 x 1/2 + 8 x 1/8
= 4 atoms/unit cell

$$APF = \frac{\text{atoms}}{\text{unit cell}} \rightarrow 4\,\frac{4}{3}\pi\left(\frac{\sqrt{2}a}{4}\right)^3 \leftarrow \frac{\text{volume}}{\text{atom}} \Big/ a^3 \leftarrow \frac{\text{volume}}{\text{unit cell}}$$

Q16. What is hardening processes in steel and why tempering needs to be done after hardening?

Ans. Hardening in steels is carried out for high carbon steels. Steel is quenched from a high temperature state (Austenite). This leads to the formation of martensite. Martensite is very hard and has high strength. The high hardness and strength of martensite is due its crystal structure which is BCT. The BCT crystal structure entraps carbon atoms. With more increase in the carbon atoms, the c/a ratio of martensite BCT structure increases.

Tempering is a process of heat treating, which is used to increase the toughness of high carbon steel. Tempering is usually performed after hardening, to reduce some of the excess hardness, and is done by heating the metal to some temperature below the critical point for a certain period of time, then allowing it to cool in still air. Tempering causes some of the carbon atoms entrapped in BCT martensite cells to diffuse out and precipitate as cementite. This increases the toughness in the material.

Q17. Explain the different case hardening processes in steels.

Ans. Case-hardening or surface hardening is the process of hardening the surface of a metal object while allowing the metal deeper underneath to remain soft, thus forming a thin layer of harder metal (called the "case") at the surface. For iron or steel with low carbon content, which has poor to no hardenability of its own, the case-hardening process involves infusing additional carbon or nitrogen into the surface layer. Case-hardening is usually done after the part has been formed into its final shape

Carburizing

Carburizing is a process used to case-harden steel with a carbon content between 0.1 and 0.3 wt% C. In this process steel is introduced to a carbon rich environment at elevated temperatures for a certain amount of time, and then quenched so that the carbon is locked in the structure; one of the simpler procedures is repeatedly to heat a part with an acetylene torch set with a fuel-rich flame and quench it in a carbon-rich fluid such as oil.

Carburization is a diffusion-controlled process, so the longer the steel is held in the carbon-rich environment the greater the carbon penetration will be and the higher the carbon content. The carburized section will have a carbon content high enough that it can be hardened again through flame or induction hardening.

It is possible to carburize only a portion of a part, either by protecting the rest by a process such as copper plating, or by applying a carburizing medium to only a section of the part.

The carbon can come from a solid, liquid or gaseous source; if it comes from a solid source the process is called **pack carburizing**. Packing low carbon steel parts with a carbonaceous material and heating for some time diffuses carbon into the outer layers. A heating period of a few hours might form a high-carbon layer about one millimeter thick.

Liquid carburizing involves placing parts in a bath of a molten carbon-containing material, often a metal cyanide; gas carburizing involves placing the parts in a furnace maintained with a methane-rich interior.

Nitriding

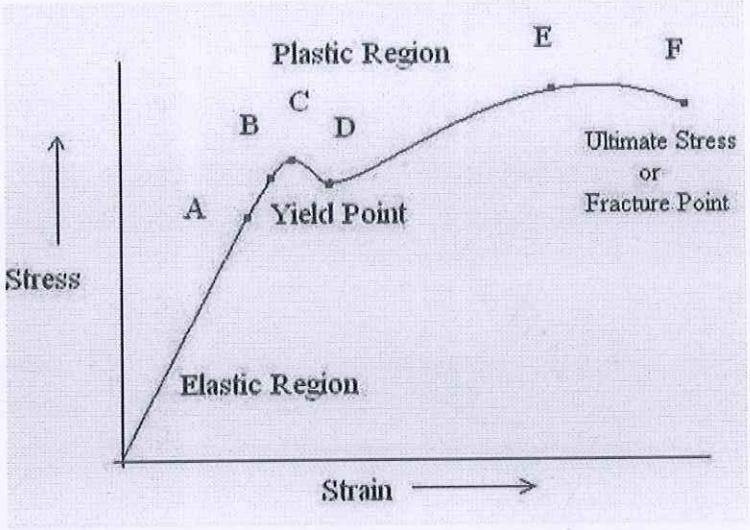
Nitriding heats the steel part to 482–621 °C (900–1,150 °F) in an atmosphere of ammonia gas and dissociated ammonia. The time the part spends in this environment dictates the depth of the case. The hardness is achieved by the formation of nitrides. Nitride forming elements must be present for this method to work; these elements include chromium, molybdenum, and aluminum. The advantage of this process is that it causes little distortion, so the part can be case-hardened after being quenched, tempered and machined. No quenching is done after nitriding.

Carbonitriding

Carbonitriding uses a gaseous atmosphere of ammonia and hydrocarbons is used instead of sodium cyanide. If the part is to be quenched, it is heated to 775–885 °C (1,427–1,625 °F); if not, then the part is heated to 649–788 °C (1,200–1,450 °F).

Q18. With neat diagram show the stress-strain characteristics of brittle and ductile material and indicate important points on the curve and explain briefly about these characteristic points.

Ans. Stress-Strain Curves for Ductile Materials If a ductile bar of uniform cross-sectional area is subjected to gradually increasing axial tensile force (generally is done in Universal Testing Machine) till failure of the bar occurs, when the stress-strain curve plots the curve may be divided into following parts:



Stress-Strain curve in ductile materials

Portion OA: This portion is absolutely straight, where the stress is proportional to strain and the material obeys Hooke's law ($\sigma = E \epsilon$). The value of stress at point A is called proportional limit.

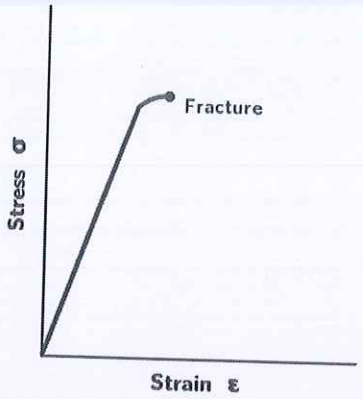
Portion AB: In this portion, Hook's law is not obeyed, although the material may still be elastic. The point B indicates the elastic limit.

Portion BC: In this portion, the metal shows a strain even without increase in stress and the strain is not fully return when load is removed.

Portion CD: Yielding start in this portion and there is a drop of stress at the point D directly after yielding begins at C. The point D is termed as lower yield point and C is called upper yield point.

Portion DE: After yielding has taken place at D, further straining takes place at this portion by increasing the stress and the stress–strain curve continues to rise up to the point E. Strain in this portion is about 100 times that of portion O-A. At the point E, the bar begins to form a local neck. The point E is termed as ultimate tensile stress point.

Portion EF: In this portion, the load is falling off from the maximum and fracture at F takes place. The point F is termed as fracture or breaking point and the identical stress is called breaking stress.



Stress Strain Curves for Brittle Materials: Materials which show very small elongation before they fracture are called brittle materials. The shape of curve for high carbon steel, concrete and high strength light alloys or any brittle materials is shown in fig. 3. For most brittle materials the permanent elongation (i.e. increase in length) is less than 10%.