



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Session: 2018-19 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: SMS1501

Time: 3 Hours

Course Name: Production Management

Max. Marks: 100

Instruction:

1. Attempt all questions.
2. Use of Calculators is Prohibited.
3. Section A contains 20 Questions. Each question carries 1 Marks.
4. Section B contains 06 Questions. Each question carries 5 Marks.
5. Section C contains 05 Questions. Each question carries 10 Marks.

Section – A

20X01 = 20 Marks

- 12.07.19
1. which of the following bearing has no wear?
 - a) magnetic bearing
 - b) roller bearing
 - c) plain bearing
 - d) none of above
 2. Pipe threads have a flank angle
 - a) 60°
 - b) 30°
 - c) 55°
 - d) 33°
 3. Distance between two consecutive thread in screw is called
 - a) Lead
 - b) Pitch
 - c) Thread depth
 - d) None of them
 4. Which screw thread has the designation S 24 x 5
 - a) Buttruss screw thread
 - b) Trapezoidal screw thread
 - c) Pipe thread
 - d) None
 5. What is a thread per inch in screw thread?
 - a) Pitch in inches
 - b) Axial distance moved by threaded part
 - c) Reciprocal of pitch in inches
 - d) Radial distance moved by threaded part



6. Sliding contact bearings, also called plain bearings have no problem of wear.
 - a) True
 - b) False
7. Nominal diameter of the screw thread is the same as core diameter.
 - a) True
 - b) False
8. In joining steel plate and asbestos, welding is preferred over riveting.
 - a) True
 - b) false
9. Tr 40 x 14(P 7), here 14 indicates
 - a) Pitch
 - b) Lead
 - c) Diameter
 - d) None of the mentioned
10. The spring is used in suspension system
 - a) True
 - b) False
11. Shafts are used to transmit rotary movement, torques and consequently energy.
 - a) True
 - b) False
12. Shafts are directly driven by.....
 - a) Engine
 - b) Bearing
 - c) Chain
 - d) None of the mentioned
13. Shafts are generally supported in two bearings.
 - a) True
 - b) False
14. Belt drive is used to transmit torques and speeds between two shafts, which may have a greater clearance than with gear wheel drives.
 - a) True
 - b) False
15. In positive coupling no external coupling force is required to maintain the force transmission when they are engaged.
 - a) True
 - b) False
16. What should be ensure for power transmission in belt drive.
 - a) Belt thickness
 - b) Belt Tension
 - c) Belt material
 - d) None of the mentioned



17. Belt drive with tooth is known as non-positive belt drive.
 - a) True
 - b) False
18. Which drive is used for longer distance power transmission.
 - a) Belt drive
 - b) Chain drive
 - c) Gear drive
 - d) None of the mentioned
19. Which power transmission is required lower maintenance.
 - a) Belt drive
 - b) Chain drive
 - c) Gear drive
 - d) None of the mentioned
20. Chain drives are generally used for drives with precise transmission ratio.
 - a) True
 - b) False

Section – B

06X5= 30 Marks

(Attempt any 06 questions out of 08 questions)

21. Explain the different types of screw thread according to their profile.
22. What are the uses of dowel pin?
23. What are the advantages of riveting compared to welding?
24. What material are used to produce rivets?
25. Write the advantages and disadvantages of the belt drives.
26. Give the name of different type of chains.
27. Write the advantages and disadvantages of chain drives.
28. What do you mean by the coupling? Give the name of different types of coupling.

Section -- C

05X10 = 50 Marks

29. Explain the following:
 - a) What do you understand by 10.9 written on a screw?
 - b) Explain the terminology of screw thread.
30. What is the purpose of the springs? What is the spring rate of a compression spring if a force of 400 N is required in order to compress the spring by 5.5 mm?
31. What do you mean by chain drives, explain with suitable example?
32. Write the functions of shaft and also explain its types?
33. Explain the different types of belts used for belt drive power transmission.



School of Manufacturing
Session: 2018-19 (Winter Semester)
B. Voc. Program, 5th Semester,
End-Sem. Examination

Course Code: SMS1501

Time: 60 Min.

Course Name: Production Management

Max. Marks: 100 Marks

Section – A

10X01 = 20 Marks

1. which of the following bearing has no wear?

- a) magnetic bearing
- b) roller bearing
- c) plain bearing
- d) none of above

Ans. a

2. pipe threads have a flank angle

- a) 60°
- b) 30°
- c) 55°
- d) 33°

Ans. c

3. A distance between two adjacent thread in screw

- a) Lead
- b) Pitch
- c) Thread depth
- d) None of them

Ans. b

4. Which screw thread has the designation S 24 x 5

- a) Buttress screw thread
- b) Trapezoidal screw thread
- c) Pipe thread
- d) None

Ans. a

5. What is a thread per inch in screw thread?

- a) Pitch in inches
- b) Axial distance moved by threaded part
- c) Reciprocal of pitch in inches
- d) Radial distance moved by threaded part

Ans. C



6. Sliding contact bearings, also called plain bearings have no problem of wear.

- a) True
- b) False

Ans. b

7. Nominal diameter of the screw thread is the same as core diameter.

- a) True
- b) False

Ans. b

8. In joining steel plate and asbestos, welding is preferred over riveting.

- a) True
- b) False

Ans. b

9. Tr 40 x 14(P 7), here 14 indicates

- a) Pitch
- b) Lead
- c) Diameter
- d) None of the mentioned

Ans. b

10. Which of the following function can the spring perform?

- a) Store energy
- b) Absorb shock
- c) Measure force
- d) All of the mentioned

Ans. D

11. Shafts are used to transmit rotary movement, torques and consequently energy.

- a) True
- b) False

Ans: a

12. Shafts are directly driven by.....

- a) Engine
- b) Bearing
- c) Chain
- d) None of the mentioned

Ans: a

13. Shafts are generally mounted in two bearings.

- a) True
- b) False

Ans: a



14. Belt drive is used to transmit torques and speeds between two shafts, which may have a greater clearance than with gear wheel drives.

- a) True
- b) False

Ans:a

15. In positive coupling no external coupling force is required to maintain the force transmission when they are engaged.

- a) True
- b) False

Ans: a

16. What should be ensure to power transmission in belt drive.

- a) Belt thickness
- b) Belt Tension
- c) Belt material
- d) None of the mentioned

Ans: a

17. Belt drive with toothed is known as non-positive belt drive.

- a) True
- b) False

Ans: b

18. Which drive is used to longer distance power transmission.

- a) Belt drive
- b) Chain drive
- c) Gear drive
- d) None of the mentioned

Ans: a

19. Which power transmission is required lower maintenance.

- a) Belt drive
- b) Chain drive
- c) Gear drive
- d) None of the mentioned

Ans: a

20. Chain drives are generally used for drives with precise transmission ration.

- a) True
- b) False

Ans: a



21. Explain the classification of screw thread according to their profile.

Ans.

1. Metric ISO screw thread

- Flank angle 60 degree
- The screw designation M16x1.5 where M indicates the metric thread and 16 is nominal diameter in mm and 1.5 is pitch.

2. Pipe thread

- Flank angle 55 degree

3. Trapezoidal screw thread

- Flank angle 30 degree
- The screw designation Tr16x1.5 where Tr indicates the trapezoidal thread and 16 is nominal diameter in mm and 1.5 is pitch.

4. Buttress screw thread

- Flank angle 33 degree
- The screw designation S 16 x 1.5 where S indicates the Buttress thread and 16 is nominal diameter in mm and 1.5 is pitch.
- High load capacity in one direction.

22. What are the uses of dowel pin?

Ans.

Dowel pins are used

1. for position fixing
2. to keep machine components in accurate alignment
3. as location guides for adjacent machine parts and to keep the two sections of a punch and die in alignment.

23. What are the advantages of riveting compared to welding?

Ans.

- No change in microstructure, so no reduction in strength and embrittlement in the joint sheet metal
- Different material and surface finishes, e.g. polished or coated, sheet metal can be joined.
- Joint can also be made where only one side is accessible.
- Lower energy consumption
- No health hazard due to gases or light radiation

24. What material are used to produce rivets?

Ans.

Rivets material include steel, copper, copper zinc and aluminum alloys as well as plastic and titanium in exceptional cases. To prevent electrochemical corrosion and the loosening of the joint, the rivets should be made from a similar material to the parts being joined.



25. Write the advantages and disadvantages of belt drives.

Ans.

Advantages and disadvantages of belt drives

Advantages:	Disadvantages:
<ul style="list-style-type: none">• Elastic power transmission• Quiet, shock-absorbing operation• Large shaft separations possible• No lubrication required• Low maintenance expense	<ul style="list-style-type: none">• Slippage due to expansion of the belts• As a result, no precise transmission ratio• Limited application temperature• Additional bearing load due to the necessary tensioning force for the belts

26. Give the name of different type of chains.

Ans.

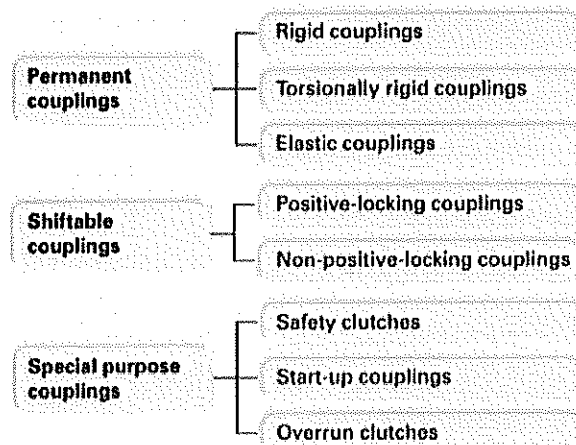
- Link chain
- Bolt chain
- Articulated chain
- Bush chain
- Roller chain
- Leaf chain
- Multi roller chain

27. Write the advantages and disadvantages of chain drives.

Advantages:	Disadvantages:
<ul style="list-style-type: none">• Slip resistant power transmission• Constant transmission ratio• Transmission of large forces possible• Low sensitivity to moisture, dirt and high temperatures	<ul style="list-style-type: none">• Limited chain velocity• Noisy• Lubrication required• Tendency to vibrate in the event of impact loads

28. What do you mean by the coupling? Give the name of different types of coupling.

Coupling is used to transmit the power between two shafts.



29.

a) What do you understand by 10.9 written on a screw?

Ans.

10.9 written on a screw shows the strength category.

The tensile strength R_m is calculated by multiplying the first number by 100. The yield strength R_e is the product of both number and the number 10.

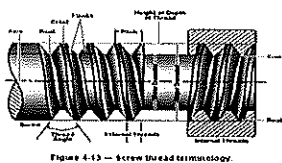
Example 10.9

Tensile strength $R_m = 1000 \text{ N/mm}^2$

Yield strength $R_e = 10 \times 9 \times 10 = 900 \text{ N/mm}^2$

b) Explain the terminology of screw thread with diagram.

Ans.



- Major Diameter- the largest diameter of a bolt at the crest, or the diameter of the roots of a nut
- Pitch Diameter- the diameter halfway between the major diameter and minor diameter
- Minor Diameter- the small diameter of a bolt at the root, or the diameter of the crest of a nut
- Pitch is the distance between the two adjacent thread.
- Lead is the linear distance traveled in one rotation.
- Crest- the top surface where the two sides of the threads meet
- Root- the bottom surface where the two sides of the threads meet

30. What is the purpose of the springs? What is the spring rate of a compression spring if a force of 400 N is required in order to compress the spring by 5.5 mm?

Ans.

1. To store energy for part of a functioning cycle.
2. To force a component to bear against, to maintain contact with, to engage, to disengage, or to remain clear of some other component.
3. TO counterbalance a weight or thrust (gravitational, hydraulic, etc.). Such springs are usually called equilibrator springs.
4. To maintain electrical continuity,
5. To return a component to its original position after displacement.
6. To reduce shock or impact by gradually checking the motion of a moving weight.
7. To permit some freedom of movement between aligned components without disengaging them.

These are sometimes called take-up springs.

→ We know that spring rate is



$$R = F/S$$

So here $f = 400 \text{ N}$

$$S = 5.5 \text{ mm}$$

Now put the values in above expression

$$R = 400/5.5$$

$$R = 72.73 \text{ N/mm}$$

31. What do you mean by chain drives with example?

Ans Chain drives are classed as traction drives, just like belt drives. They transmit rotating motion between two or more shafts. Chains are generally produced from quenched and tempered steel making them more durable. It is also heavier than belts.

Example Chains are generally used for drives with precise transmission ratios, for large center distances and large tensile forces. They are also reliable in adverse environmental conditions and are therefore used for forming machines. In conveying technology, for two wheeled vehicles, for hoists as well as for wood working and construction machinery.

32. Define the function of shaft and its types.

Ans. Shafts transmit rotary movement and torques and consequently energy. By constant, axles are used to mount rotating components. They do not transmit any energy. Shafts are directly driven by engines and couplings or by gear wheels, chains and belts.

Types Depending on their function, shafts can be classified into drive shafts and gear shafts, spindles, universal joint shafts as well as crankshafts and camshafts.

Drive shafts

Drive shafts transmit torque to other shafts, machines or tools. For ex: shaft driven by pulley transmits the torque to the saw blade.

Gear Shafts

In conjunction with gear wheels are used to change rotational speeds. The gear shaft is driven by the drive flange. The output either takes place via the left gear wheel Z1 or the right gear wheel Z2.

The two gear wheels are alternately engaged via the gear coupling.

33. Explain the different types of belts used belt drive power transmission.

Types

The belts are classified by the type of transfer by the belt pulleys into untoothed (non-positive locking) and toothed (positive –locking) belts.

Un-toothed belts:

Un-toothed belts transmit the tensile force by using friction between the running surfaces of the belts and belt pulley. A distinction is made between flat belts and v belts depending on the shape of the running surface.

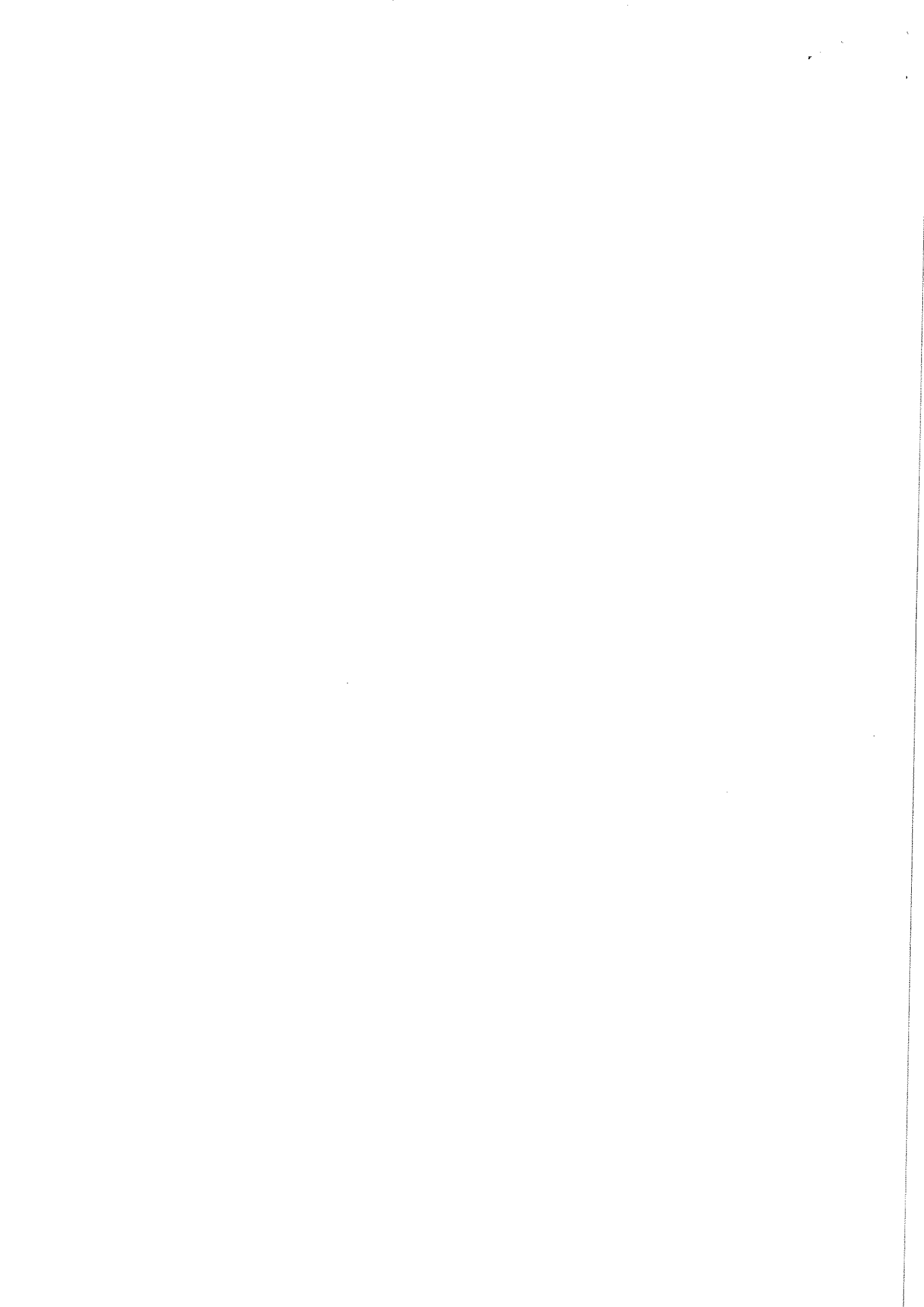
Flat Belts

The circumferential force on the belt pulley and the transmitted torque primarily depends on the tensioning force, the coefficient of friction between the belt and the pulley and the wrap angle

V-belts

V-belts are pulled into the pulley groove and press against the groove edges.

The large normal forces that arise enable large friction forces and transmission of high torques.





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Session: 2018-19 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: SMS1502

Time: 3 Hours

Course Name: Advanced Manufacturing

Max. Marks: 100

Instruction:

1. Attempt all questions.
2. Use of Calculators is Prohibited.
3. Section A contains 20 Questions. Each question carries 1 Marks.
4. Section B contains 06 Questions. Each question carries 5 Marks.
5. Section C contains 05 Questions. Each question carries 10 Marks.

Section – A

1. Mechanical clamping elements apply clamping force using.....
 - a) Toggle
 - b) Screws
 - c) Cams
 - d) All of the above
2. The closer the clamping screw to the work piece the is the clamping force.
 - a) Low
 - b) Greater
 - c) Moderate
 - d) Neutral
3. clamps are arranged so that the tool is unobstructed while machining.
 - a) Toggle
 - b) Flat
 - c) Step
 - d) Round
4. clamps are self-locking once the joints are aligned.
 - a) Toggle
 - b) Flat
 - c) Step
 - d) Round
5. also operate on the toggle principle
 - a) Quick release clamps
 - b) Flat clamps
 - c) Straight clamps
 - d) Step clamps
6. In an _____ clamp the clamping force is generated by a self-locking eccentric
 - a) Eccentric
 - b) Quick release
 - c) Toggle
 - d) Flat



7. Formulae for feed rate is
 - a) $F_r = f_z \times Z \times N$
 - b) $F_r = f_z \times N$
 - c) $F_r = f_z \times Z$
 - d) None of the above
8. When using clamps, the clamping bolt should be positioned as close as possible to the
 - a) Tool
 - b) Bed
 - c) Workpiece
 - d) Machine
9. Swivel clamps enables the workpiece to be inserted from the
 - a) Side
 - b) Bottom
 - c) Top
 - d) Bottom-Left
10. Hydraulic clamping systems consist of
 - a) A pressure generator
 - b) Control valves
 - c) Clamping cylinders
 - d) All of the above
11. are used in assembly if compressed air or mains power is not available.
 - a) Hand grinder
 - b) Hand pumps
 - c) Hydraulic pumps
 - d) Project suction
12. Air-hydraulic intensifiers convert the low pressure of a to high, hydraulic clamping pressure
 - a) Pneumatic system
 - b) Hydraulic system
 - c) Machine system
 - d) Vice system
13. Cylinders are suitable for quick closing and opening movements of clamping devices.
 - a) Hydraulic
 - b) CNG
 - c) LPG
 - d) Pneumatic
14. Pneumatic cylinders are combined with self-locking toggle clamps because of the
 - a) Ductility of material
 - b) Compressibility of material
 - c) Compressibility of air
 - d) Malleability of metal



15. Hydraulic clamping devices significantly reduces
- Productive time
 - Non-productive time
 - Dwell time
 - Peek time
16. Modular devices consist of
- Interlocking elements
 - Matching elements
 - A & B
 - None of the above
17. The hole system uses& screws to connect the individual modules.
- Dowels
 - Taper cross
 - Washers
 - None of the above
18. Modular fixture systems are suitable for & medium sized batch production on CNC.
- Large
 - Small
 - Oval
 - Shaper
19. Select parts of modular fixture systems from given parts
- Bracket element
 - Spacer elements
 - Clamping plate
 - Positioning plate
20. The modules are joined together with which are inserted into the T-Slots.
- Allen key
 - Dowels
 - Sliding keys
 - Screws

Section – B

06X05 = 30 Marks

21. What are the advantages of using of clamping fixtures in machining?
22. What are the advantages of magnetic clamping?
23. What advantage is gained by supporting the workpiece at three-points?
24. What are the requirements on clamping fixtures for machine tools?
25. Explain the principle of toggle lever clamp.
26. Under what circumstances swivel cylinders are used for clamping?
27. Whole clamping the work piece with flat clamps why is the work piece also gets clamped to the machine table?
28. What is the magnitude of the clamping force F_c with $F = 4.6$ kN, $l_1 = 60$ mm and $l_2 = 95$ mm?



29. Write short note on
- Three-point support
 - Flat clamp
 - Eccentric clamps
 - Machine vice
30. Why does clamping with electric permanent magnet chucks enable particularly high machining accuracy?
31. What are the advantages of hydraulic clamping systems?
32. What are the advantages of pendulum supports?
33. Describe modular systems with its types.



School of Manufacturing
Session: 2018-19 (Winter Semester)
B. Voc. Program, 5th Semester,
End-Sem. Examination

Course Code: SMS1502

Time: 60 Min.

Course Name: Advanced Manufacturing

Max. Marks: 100 Marks

Section – A

1. Mechanical clamping elements apply clamping force using.....
Ans. d) All of the above
2. The closer the clamping screw is to the work piece the the clamping force.
Ans. b) Greater
3. clamps are arranged so that the tool is unobstructed when machining.
Ans. b) Flat
4. clamps are self-locking once the joints are aligned.
Ans. a) Toggle
5. also operate on the toggle principle
Ans. a) Quick release clamps
6. In an _____ clamp the clamping force is generated by a self-locking eccentric
Ans. a) Eccentric
7. Formulae for feed rate is
Ans. a) $F_r = f_z \times Z \times N$
8. When using clamps, the clamping bolt should be positioned as close as possible to the
Ans. c) Work piece
9. Swivel clamps enables the work piece to be inserted from the
Ans. c) Top
10. Hydraulic clamping systems consist of
Ans. d) All of the above
11. are used in assembly if compressed air or mains power is not available.
Ans. b) Hand pumps
12. Air-hydraulic intensifiers convert the low pressure of a to high, hydraulic clamping pressure
Ans. a) Pneumatic system
13. Cylinders are suitable for quick closing and opening movements of clamping devices.
Ans. d) Pneumatic
14. Pneumatic cylinders are combined with self-locking toggle clamps because of the
Ans. c) Compressibility of air
15. Hydraulic clamping devices significantly reduces
Ans. b) Non-productive time
16. Modular devices consist of
Ans. c) A & B



17. The hole system uses& screws to connect the individual modules.

Ans. a) Dowels

18. Modular fixture systems are suitable for & medium sized batch production on CNC.

Ans. b) Small

19. Select parts of modular fixture systems from given parts

Ans.

- a) Bracket element
- b) Spacer elements
- c) Clamping plate
- d) Positioning plate

20. The modules are joined together with which are inserted into the T-Slots.

Ans. c) Sliding keys

Section – B

06X05 = 30 Marks

21. What are the advantages of the use of clamping fixtures in machining?

Ans. –elimination of non-value work such as marking and center punching.

- many work pieces cannot be machined without a clamping fixture.
- reduced manufacturing time
- improved repeatability
- reduced set-up time for aligning and clamping.

22. What are the advantages of magnetic clamping?

Ans. –this enables work pieces to be clamped quickly, securely and without deformation. It facilitates machining on five sides without the clamps being an obstruction.

- magnetic chucks with movable magnetic poles are used for low-deformation clamping of uneven or curved work pieces.

23. What advantage is gained by supporting the work piece at three-points?

Ans. for clamping rough work pieces are placed on three axially displaced points. The points of contact should be at greatest possible distance from each other. This three-point contact method forces that the work pieces to sit securely on each of the points.

24. What are the requirements on clamping fixtures for machine tools?

Ans.- secure clamping of work pieces

- minimum deformation of the work pieces when clamping
- high setting repeatability
- easy exchange of the clamping
- easy, fast and safe handling

25. Explain the principle of toggle lever clamp.

Ans. a clamping element using the toggle principle generates its greatest clamping force when the three joints A, B, C are aligned. From this position it is no longer possible for the toggle lever to be pushed back by a reaction force. Once the clamp moves past this extended position a safe clamping condition is guaranteed. The clamp is self-locking.



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26. Under what circumstances are swivel cylinders are used for clamping?

Ans. swivel clamps enable the work piece to be inserted from the top. Part of the total stroke is used to rotate the piston and with it the clamping claw when clamping and unclamping. The work piece is clamped in the final part of the stroke.

Swing clamps are used where the clamping points must be clear during insertion and removing of the work piece.

27. When clamping the work piece with flat clamps why is the work piece also clamped to the machine table?

Ans. flat clamps are arranged so that the tool is unobstructed when machining. Setting the clamping bolt at an angle ensures that the work piece is simultaneously pressed against the machine and down on the machine table during machine.

28. What is the magnitude of the clamping force F_c with $F = 4.6 \text{ kN}$, $l_1 = 60 \text{ mm}$ and $l_2 = 95 \text{ mm}$?

Ans.

$$\begin{aligned} F_c &= \frac{F \cdot l_1}{l_2} \\ &= \frac{4.6 \text{ kN} \cdot 60 \text{ mm}}{95 \text{ mm}} \\ &= 2.9 \text{ kN} \end{aligned}$$

Section – C

05X10 = 50 Marks

29. Write short note on

Ans.

a) Three-point support

Three-point contact method forces that the work piece to sit securely on each of the points

b) Flat clamp

Flat clamps are arranged so that the tool is unobstructed when machining.

c) Eccentric clamps

In eccentric clamps the center point of the clamping cam is out-of-center relative to the pivot point, in this the clamping is generated by a self-locking eccentric.

d) Machine vice

Machine vice are used to clamp suitably-shaped small and medium-sized work pieces for individual items and small series production.

30. Why does clamping with electric permanent magnet chucks enable particularly high machining accuracy?

Ans. electro-permanent magnet chucks use a short electrical pulse to switch between clamped and unclamped and vice versa. The clamping is generated by magnetizing permanent magnet cores using the magnetic field of an electric coil. The workpiece is held by the permanent magnets during machining. The plate is not supplied with power and does not warm up. The result is high machining accuracy.



31. What are the advantages of hydraulic clamping systems?

Ans. – high clamping force with low space requirements

- high rigidity of the clamping fixture
- versatile use
- fast generation of the force
- clamping force adjustment and changing via the machine control
- equal clamping forces at all clamping points reduce workpiece shape deviations.

32. What are the advantages of pendulum supports?

Ans. work pieces such as castings often have to be clamped on their non-machined surfaces. As these areas are not perfectly flat and are often slightly inclined the workpiece may deform when clamped. To prevent deformation during clamping the clamping elements must be able to adjust to the inclined surface.

Pendulum supports adjust to the shape of the workpiece. They enable the surface of the workpiece to be securely clamped without damage.

33. Describe modular systems with its types.

Ans. modular fixture systems consist of matching, interlocking elements. These individual components consisting of a base plate with bracket, structural, positioning, support, clamping and connecting elements, can be assembled into a fixture using separable joints. They are particularly suited to flexible manufacturing.

Modular fixture systems are divided into **T-slot and key systems** and **hole systems**.

With the **T-slot and key systems** the base plate the individual modules are provided with T-slots. The modules are joined together with sliding keys which are inserted into the T-slots.

This creates a positive connection both transversely and perpendicularly to the axis of the T-slot. When assembling the fixture, the sections can be moved to any position along the length of the T-slot. This enables a good match to the geometry of the work piece and unlimited adjustment.

The **hole system** uses dowel pins and screws to connect the individual models.

The mating holes in the base plate are located either above the threaded holes or adjacent to threaded holes.



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Session: 2018-19 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: SMS1503

Time: 3 Hours

Course Name: Quality Management

Max. Marks: 100

Instruction:

1. Attempt all questions.
2. Use of Calculators is Prohibited.
3. Section A contains 20 Questions. Each question carries 1 Marks.
4. Section B contains 06 Questions. Each question carries 5 Marks.
5. Section C contains 05 Questions. Each question carries 10 Marks.

Section – A

20X01 = 20 Marks

A project is defined as a

1) _____ with a 2) _____ and it must be used to create a 3) _____

1. a. endless endeavor
b. undefined endeavor
c. temporary endeavor
d. top secret endeavor
2. a. beginning and no end
b. break in between
c. beginning and an end
d. good team
3. a. disaster
b. mass product
c. two products
d. unique product, service or result

Please read the sentence below and mark the right answer in the question 4, 5 and 6 and 7.

4) _____, 5) _____, 6) and 7) _____ are typical tasks of Project management.

4. a. Launch or execution
b. Status and tracking
c. Conception and Initiation
d. Playing dice
5. a. Forecasts
b. Definition and Planning
c. Key Performance Indicator
d. Launch or execution



6.
 - a. Forecasts
 - b. Launch or execution
 - c. Key Performance Indicator
 - d. Performance and control
7.
 - a. Project close
 - b. Quality control
 - c. Playing dice
 - d. Launch or execution
8. Which generic approach's precursor is the Toyota Production System?
 - a. Kaizen
 - b. TQM
 - c. Lean manufacturing
 - d. Six sigma
9. Lean sigma was developed in which year...?
 - a. 1952
 - b. 1950
 - c. 1954
 - d. 1951
10. Lean is achieved by removing wastes
 - a. True
 - b. False
11. Any unnecessary movement of raw material is which type of wastes.
 - a. Transport
 - b. Overproduction
 - c. Defects
 - d. Inventory
12. Value stream mapping can be helpful to identifying instances of over process.
 - a. True
 - b. False
13. Lean six sigma improves the
 - a. Quality
 - b. Cost
 - c. Delivery
 - d. All of them
14. Which ISO Series is related to Quality Assurance in final inspection & test is used?
 - a. ISO 9000
 - b. ISO 9001
 - c. ISO 9002
 - d. ISO 9003



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15. Latest revision available for ISO 9001 was done in
 - a. 2015
 - b. 2016
 - c. 2008
 - d. 2018
16. Cost due to rework of the material will count in
 - a. Prevention cost
 - b. Appraisal cost
 - c. External failure cost
 - d. Internal Failure cost
17. Which tool is used for root cause analysis
 - a. Process flow chart
 - b. Scatter diagram
 - c. Fishbone diagram
 - d. Controls chart
18. Cost of good Quality will include
 - a. Prevention & external failure cost
 - b. Internal & external Failure cost
 - c. Appraisal & Prevention cost
 - d. Appraisal & Internal Failure cost
19. Machine & instruments based activity is considered in
 - a. Quality Assurance
 - b. Quality control
 - c. Quality assurance & Quality control
 - d. Quality objectives
20. OHSAS is related to
 - a. Environment & finance
 - b. Health & safety
 - c. Management & Training
 - d. None of these

Section -- B

(Attempt any 06 questions out of 08 questions)

06X5= 30 Marks

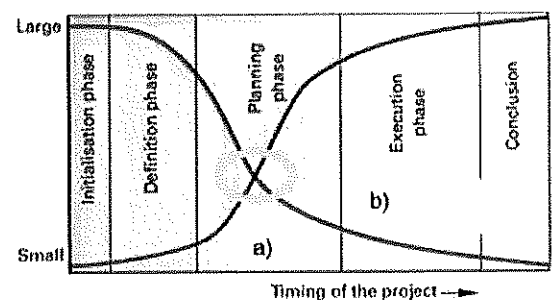
21. In the lesson we discussed the interplay of knowledge and influence of decisions in the progress of projects.

Please name the red line correctly

a).....

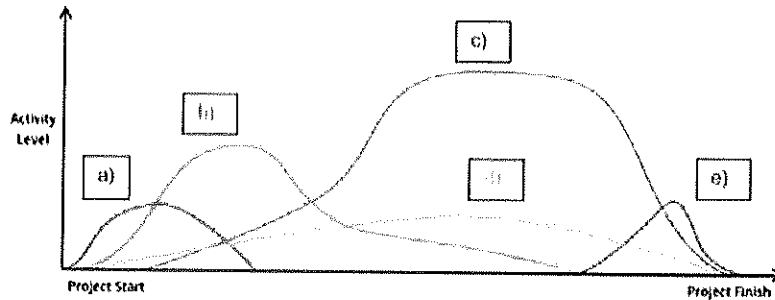
Please name the blue line correctly

b).....





- c) Explain the importance of the intersection point in the yellow circle in own words. What document should be signed ideally at this point?
- 22. The diagram below was discussed in the lesson. Please name the five a)-e) curves correctly. Please make an appropriate statement regarding the meaning of the graph.



- a)
- b)
- c)
- d)
- e)

Statement:

.....

.....

- 23. Define the six sigma.
- 24. Define the Lean.
- 25. What are the reasons for over production?
- 26. Differentiate between Quality control & Quality assurance using practical example. (3+2)
- 27. Write down the points should be taken care while preparing check sheet with an example.
- 28. Write down the importance of CAPA (Corrective action & Preventive action) and prepare CAPA for machining parts.

Section – C

05X10 = 50 Marks

- 29. In the respective boxes visualize the structure of line production and project work. Explain your

Organization structure line production

drawing!

.....

.....



Organization structure Project

.....
.....

30. What are the different type of wastes in Lean manufacturing & define them?
31. What are the reasons for defects and waiting in manufacturing process?
32. What are the benefits of using lean six sigma?
33. Explain the followings
 - (a) Pareto Diagram
 - (b) Appraisal & Prevention cost





School of Manufacturing

Session: 2018-19 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: SMS1503

Time: 60 Min.

Course Name: Quality Management

Max. Marks: 100 Marks

Please read the sentence below and mark the right answer in the question 1, 2 and 3.

A project is defined as a 1)..... with a 2)..... and it must be used to create a 3).....

1. a. endless endeavor
b. undefined endeavor
c. temporary endeavor
d. top secret endeavor
2. a. beginning and no end
b. break in between
c. beginning and an end
d. good team
3. a. disaster
b. mass product
c. two products
d. unique product, service or result

Please read the sentence below and mark the right answer in the question 4, 5 and 6 and 7.

4), 5), 6)..... and 7)..... are typical tasks of Project management.

4. a. Launch or execution
b. Status and tracking
c. Conception and initiation
d. Playing dice
5. a. Forecasts
b. Definition and Planning
c. Key Performance Indicator
d. Launch or execution



6.
 - a. Forecasts
 - b. Launch or execution
 - c. Key Performance Indicator
 - d. Performance and control
7.
 - a. Project close
 - b. Quality control
 - c. Playing dice
 - d. Launch or execution
8. Which generic approach's precursor is the Toyota Production System?
 - a. Kaizen
 - b. TQM
 - c. Lean manufacturing
 - d. Six sigma

Ans.C

9. Lean sigma was developed in which year...?
 - a. 1952
 - b. 1950
 - c. 1954
 - d. 1951

Ans. B

10. Lean is achieved by removing wastes
 - a. True
 - b. False

Ans. A

11. Any unnecessary movement of raw material is which type of wastes.
 - a. Transport
 - b. Overproduction
 - c. Defects
 - d. Inventory

Ans.A

12. Value stream mapping can be helpful to identifying instances of over process.
 - a. True
 - b. False

Ans. A

13. Lean six sigma improves the
 - a. Quality
 - b. Cost
 - c. Delivery
 - d. All of them

Ans. D



14. In which ISO Series Quality Assurance in final inspection & test is used?
 - a. ISO 9000
 - b. ISO 9001
 - c. ISO 9002
 - d. ISO 9003
15. Latest revision available in ISO
 - a. 2015
 - b. 2016
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 - a. Environment & finance
 - b. Health & safety
 - c. Management & Training
 - d. None of these

Section- B

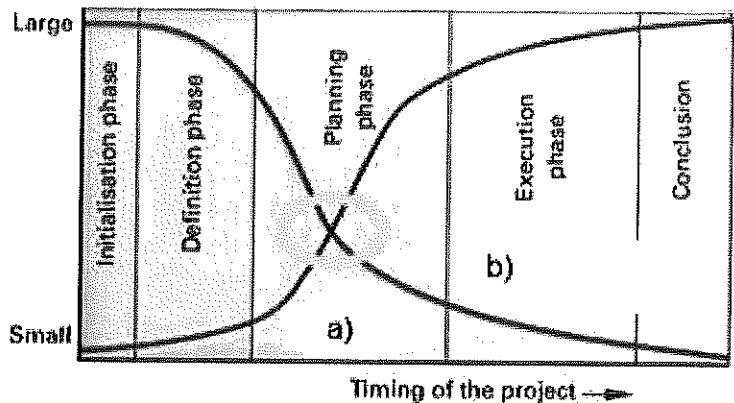
21. In the lesson we discussed the interplay of knowledge and influence of decisions in the progress of projects.

Please name the red line correctly

a) Knowledge

Please name the blue line correctly

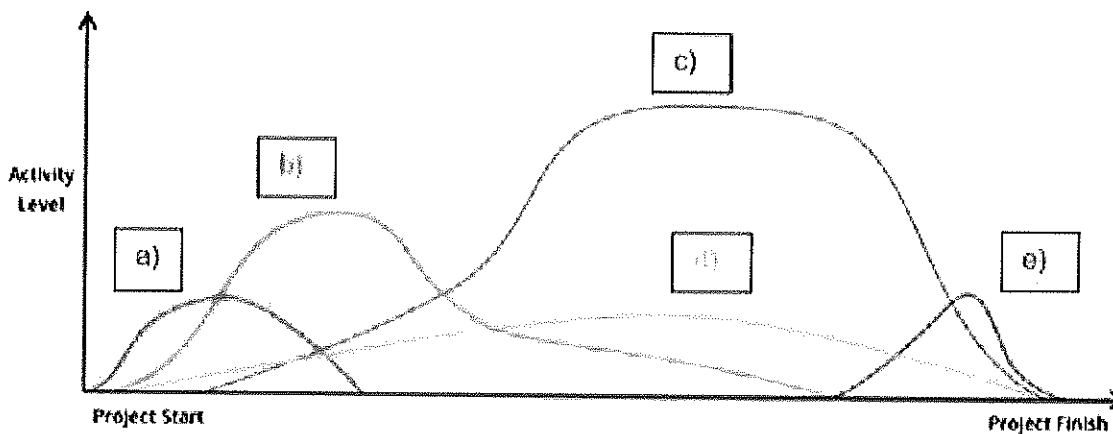
b) Influence of decision



c) Explain the importance of the intersection point in the yellow circle in own words. What document should be signed ideally at this point?

At this moment the knowledge has increased to such a value that the project contract can be signed. The influence of the decision has decreased, but is still high enough to make the decision for the coming project phases.

22. The diagram below was discussed in the lesson. Please name the five a)-e) curves correctly. Please make an appropriate statement regarding the meaning of the graph.



- a) Conception and initiation
- b) Definition and planning
- c) Launch or execution
- d) Performance and control
- e) Project close



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Statement: Planning is the most important at the start of a project. Then, executing takes over and has the highest activity level. Controlling is important throughout the entire project.

23. Define the six sigma.

Define the six sigma.

Ans. its statistical concept where a process only produces 3.4 defects per million opportunities (DPMO).

Six Sigma is developed at Motorola in the 1980's. Six Sigma reduces the amount of defective products manufactured or services provided, resulting in increased revenue and greater customer satisfaction.

24. Define the Lean.

Toyota developed Lean in the 1950s. Lean is achieved by removing "Waste", which is activity not required to complete a process. After removing Waste, only the steps required to produce a product or service that is satisfactory to a Customer will remain.

Lean is simply a method, resulting in increased revenue, reduced costs and improved customer satisfaction.

25. What are the reasons for over production?

- Large batch size
- Unreliable process
- Unstable schedules
- Unbalance cells or departments
- Working to forecast/ inaccurate information not actual demand

26. Differentiate between Quality control & Quality assurance and explain with practical example. (3+2)

Quality Assurance	Quality Control
Process Audit	Product Audit
Plan how to fix a process	Measurement & Inspection related Activity
Document Based Activity	Machine & Instruments based activity
Mainly Software and computes based approach	Mainly Shop Floor activity

Example: -

Suppose any company wants to make Clutch wire so company need drawing from customer.

So they need drawing

After receiving drawing they will make plan for execution.

So they all documentation regarding it.

Material Test Certification, Planning for production

PPAP Documentation etc.

Above all these things will count in Quality Assurance.

After start production in plant they need to be control the production with the help of measuring instruments like micrometre, Vernier calliper, cmm etc. that will count in Quality control



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27. Write down the points should be taken care while preparing check sheet with an example.

- Constructing a check sheet involves the following steps
 - Agree on the event being observed. Everyone has to be looking for the same thing.
 - Decide on a time period to collect data. This could range from hours to weeks.
 - Design a form that is clear and easy to use, with columns clearly labeled and adequate space for entering data.
 - Collect the data consistently and honestly. Make sure there is time allowed for this data-gathering task.

○ Lathe Machine check sheet.(Preventive maintenance)					
○					
○ Check all Oil point					
○ Check grease point					
○ Machine cleaning					
○ Rust checking					
○ Check oil level					
○ Run out of spindle					
○ Greasing in Chuck					

28. Write down the importance of CAPA (Corrective action & Preventive action) and prepare CAPA for machining parts.

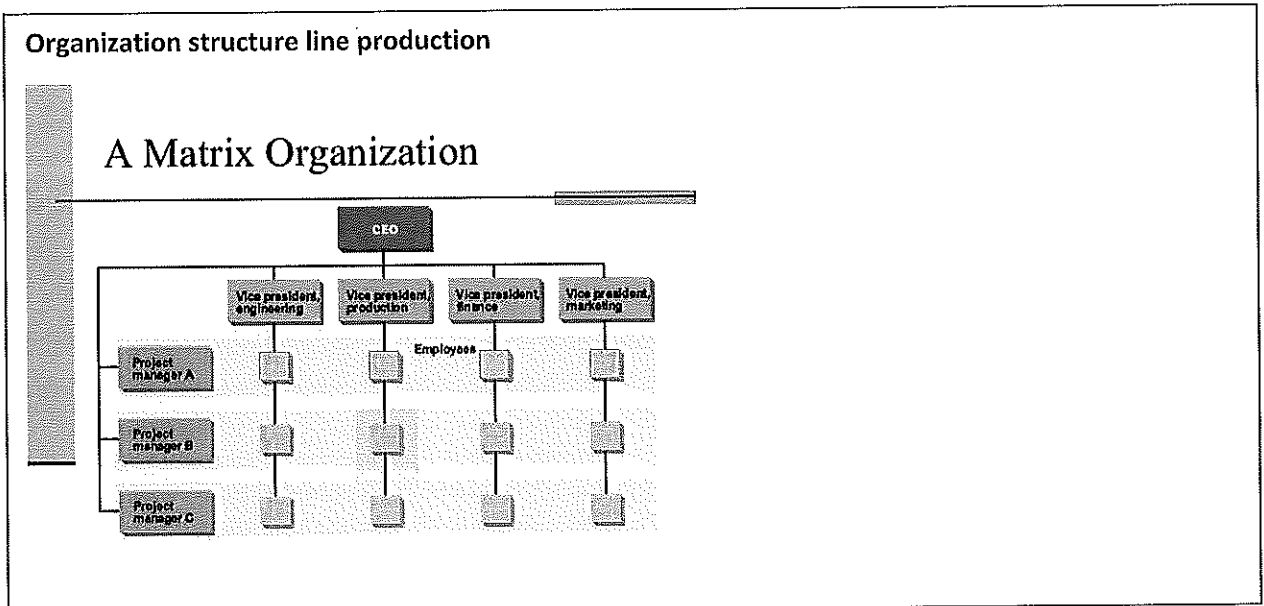
- Corrective Action & preventive Action
- CAPA are improvements imposed on an organization process to eliminate undesirable situation and nonconformity.
- CAPA is the determination of the effectiveness of a given action plan.



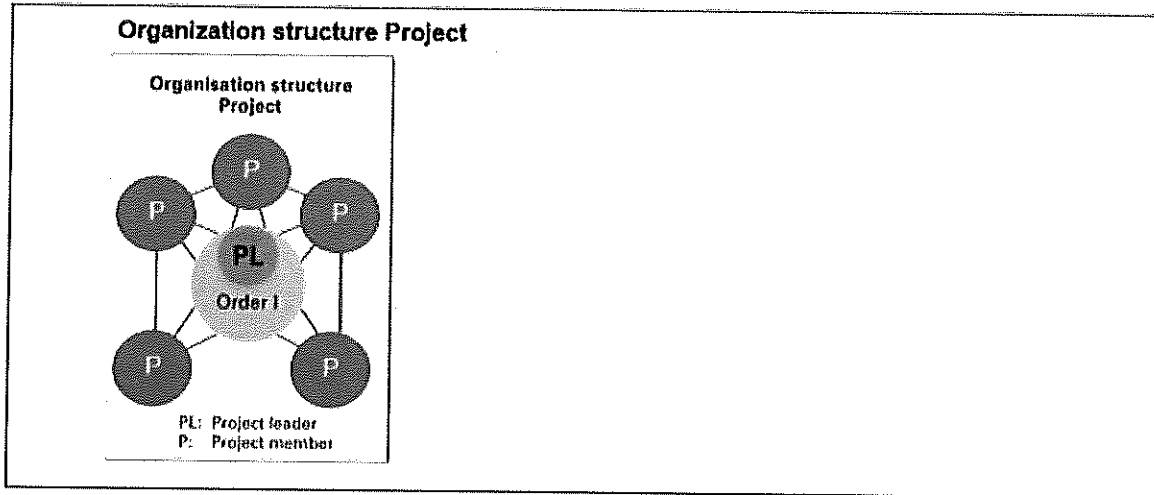
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SN	Failure Example	Correction	Corrective Action	Preventive action (it will be a preventive action only if it had been pro-actively thought of initially and implemented)
1	Food served in restaurant turned cold by the time it was delivered	The food is taken back, reheated and again served	Introduced a practice that food will be brought in a thermally insulated container and served	Food items that need to be served hot should have been placed on food warmers that are located close to the customer's tables.
2	Passenger slips on wet floor of the railway station and has a fall	The passenger is given first aid and the floor is mopped dry	Immediately placed a container for collecting the water dripping from the ceiling and the leak was sealed by end of the day	Sealant should have been provided on all ceiling joints and subjected to leak testing initially and should have been part of the ongoing maintenance check
3	New refrigerator does not cool due to gas leaked upon damage during transportation	Leak was fixed and gas refilled	100% pre-delivery inspection introduced on all products to check & correct for any gas leakage. Subsequently the packaging was improved to prevent transit damages	The packaging and transportation should have been designed and tested to ensure adequate protection to the product in the first place
4	Vehicle skids while braking on a snow clad road leading to an accident	The vehicle and the passengers were attended and instructed to drive with caution	Caution sign boards fixed on the roads and more frequent snow clearing instituted.	Caution sign boards and clearance should have been in place right from beginning.... Yet further, vehicle should have been fitted with ABS (Anti Skid Braking System)
5	Wrong sorting of insurance claims leads to delays in payments	All delayed claims attended on priority	Sorting guidelines reviewed, enhanced and the sorters re-educated	Different claim types should have been designed with different sizes / color for easy sorting - Auto sorting based on bar codes should have been introduced.

Section- C



29. In the respective boxes visualize the structure of line production and project work. Explain your drawing!
 A line structure is organized according to its designation. The information and orders always follow the line.
 Hierarchies in line production are needed to ensure the quality of the production.



Project structure has to ensure direct communication between the members. It has always the Project Manager (Leader) in the center. Orders and communication can go from one member to the other. The Manager or Leader has to be held in the loop. The advantage of this structure is the short reaction time in the project and also that the message is less falsified.

30. What are the different type of wastes in Lean manufacturing & define them?

a. Overproduction:

Overproduction occurs when something is created before it is needed. overproduction the worst type of waste because it is very expensive, lowers quality and contributes to other types of waste, such as inventory and transport.

b. Transport

Any unnecessary movement of raw materials, works-in-progress or finished products contributes to the waste of transport. Not all transport is waste, of course, but moving items only when strictly necessary is a key goal of Lean organizations.

c. Inventory

One of the biggest advantages of modern point of sale and manufacturing technology is the ability for producers to create products only when doing so is dictated by demand.

d. Motion

The waste of transport is about unnecessary movement of items. The waste of motion, on the other hand, is about unnecessary movements of people. Poorly organized workspaces are frequent contributors to the waste of motion.

e. Waiting

The waste of waiting is idle time that happens when two interdependent processes are out of sync. A process may be stalled waiting for parts, instructions, workers, or repairs.



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f. Over process

Over processing occurs when complex processes are used when a simple one would do. Over processing can also involve adding features to products that customers don't need. Another example of over processing is using expensive equipment that is not really necessary.

g. Defects

Defects are a very obvious form of waste. When a product or part can't be used for its intended purpose the cost of the resources and labor that went into its creation are lost.

h. Human potential

The waste of human potential is a recent addition to the list of Lean wastes. It is an important one. It involves the underutilization of talent.

31. What are the reasons for defects and waiting in manufacturing process?

Defects Caused by:

Unclear operating procedure/specifications

Skills shortage

Incapable process

Operator error

Transportation

Excessive stock

Waiting Caused by:

Poor man/machine coordination

Long changeovers

Unreliable processes/quality

Batch completion, not single piece transfer between operations

Time required to perform rework

32. What are the benefits of using lean six sigma?

- **Decreases cost**

Removing "Waste" from a process. Waste is any activity within a process that isn't required to manufacture a product or provide a service that is up to specification.

Solving problems caused by a process. Problems are defects in a product or service that cost your organization money.

- **Improves efficiency**

Lean Maximizing organization's efforts toward delivering a satisfactory product or service to your customers Allowing your organization to allocate resources/revenue produced from newly improved processes towards growing your business.

- **Increases revenue**

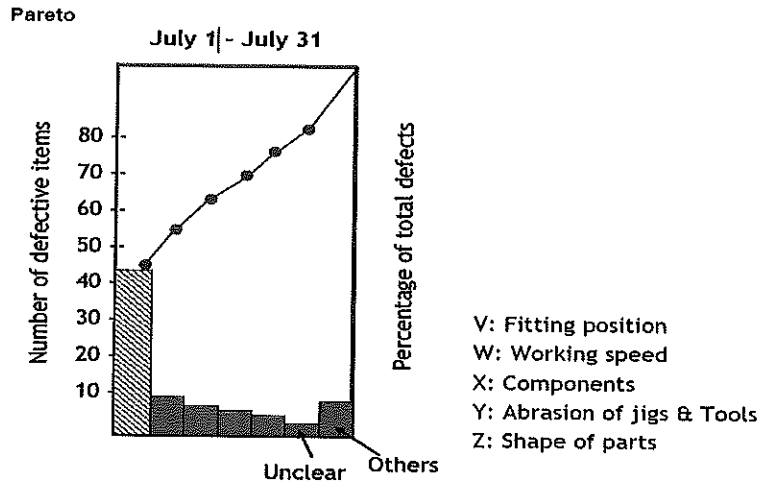
- **Develops effective people/employees**



33. Explain the followings

(a) Pareto Diagram

- The Pareto principle (also known as the 80/20 rule)
- 80/20 rules mean 80% problems occurred due to 20% reason.
- Pareto diagram is used for identify main defects.
- This is based on cumulative percentages.



(b) Appraisal & Prevention cost

<u>Prevention Cost: -</u>	<u>Appraisal Cost:-</u>
APQP	Incoming Inspection
FMEA	In process
FTA	Final Inspection
Process Variability	Calibration
Variation reduction	Auditing
Lesson learned	Registration Cost
Education training	



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Session: 2018-19 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: SMS1504

Course Name: 3D Measurement

Time: 3 Hours

Max. Marks: 100

Instruction:

1. Attempt all questions.
2. Use of Calculators is Prohibited.
3. Section A contains 20 Questions. Each question carries 1 Marks.
4. Section B contains 06 Questions. Each question carries 5 Marks.
5. Section C contains 05 Questions. Each question carries 10 Marks.

Section – A

20X01 = 20 Marks

1. What is the lower critical temperature of steel?
(a) 720°C (b) 721°C (c) 722°C (d) 723°C
2. Which of the following microstructure type is of quenched steel?
(a) Martensite (b) Ferrite (c) Cementite (d) Pearlite
3. What is the range of heating temperature in spheroidizing annealing?
(a) 680°C to 750°C (b) 720°C to 870°C (c) 500°C to 1070°C (d) 723°C to 900°C
4. Which microstructure does technically pure iron form?
(a) Ledeburite (b) Martensite (c) Ferrite (d) None of these
5. Iron with 2.5 % to 3.7 % carbon is:
(a) Wroth iron (b) Steel (c) Martensite (d) Cast iron
6. If carbon percentage is more than 0.8% in steel, then:
(a) Carbon come out of steel (b) Carbon evaporate in environment
(c) Steel become cast iron (d) It deposit at grain boundaries.
7. Heating iron that contain carbon (steel) to over 723-degree C changes its microstructure. This change in microstructure is due to:
(a) change in crystal lattice. (b) Change in carbon percentage
(c) Thermal distortion (d) High temperature
8. What is the crystal structure of austenite?
(a) BCT (b) BCC (c) FCC (d) BCC & BCT
9. Tempering is done to:
(a) Reduce toughness (b) Reduce carbon
(c) To improve hardness (d) To reduce brittleness.
10. What is carbon percentage range in steel?
(a) 4.5% to 6% (b) 0.1% to 2% (c) 3% to 8.7% (d) None of these.



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11. Which agent have gentle quenching effect?
(a) Water (b) Oil (c) Water and oil (d) Solid quenching agents
12. Temperature for hot quenching bath is:
(a) 200°C to 500°C (b) 1000°C (c) 500°C to 800°C (d) 100°C to 400°C
13. Spheroidizing annealing converts the lamellar cementite into:
(a) Granular cementite (b) Into ferrite (c) Into ledeburite (d) Into perlite
14. In the case of Nitriding, the increase in hardness is based on the formation of:
(a) Carbides (b) Ferrite (c) Nitride (d) Austenite
15. What percentage of carbon is suitable for hardening?
(a) More than 0.2% carbon (b) 1% carbon (c) 2% carbon (d) 1 to 2%
16. Martensite shape is:
(a) Round shape (b) Needle shape (c) Square shape (d) Flat
17. Influence of alloying elements while quenching:
(a) Reduce critical cooling speed (b) Increase critical cooling speed
(b) Doesn't affect (d) None of these
18. In skin hardening, the deeper areas of the workpiece are:
(a) Heated to the hardening temperature (b) heated up to 500°C
(c) a & b (d) Not heated to the hardening temperature
19. Carburizing is done for the steel which is having:
(a) 0.1% to 0.2% carbon (b) 5% carbon (c) 2% carbon (d) 8% carbon
20. α -iron is having microstructure type of:
(a) Martensite (b) Ferrite (c) Austenite (d) All

Section – B

06X05 = 30 Marks

21. Why recrystallization annealing is done for steels?
22. Explain microstructure of iron with 3.5% carbon.
23. Write three properties of γ -austenite.
24. Write the significance of iron carbon equilibrium diagram.
25. Write any two annealing defects.
26. What is stress relief annealing?
27. Plot a hardening graph between time and temperature.
28. Explain internal process in quenching.

Section – C

05X10 = 50 Marks

29. Explain the microstructure of steel for following-
 - a) With less than 0.8% carbon.
 - b) With more than 0.8% carbon.



30. Explain skin hardening process with diagram.
31. Write any four types of heat treatment process and explain any two.
32. What are hardening distortion and hardening cracks? Explain.
33. Explain carburizing and Nitriding with appropriate diagram.



School of Manufacturing

Session: 2018-19 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: SMS1504

Time: 60 Min.

Course Name: 3D Measurement

Max. Marks: 100 Marks

Section-A

(20 x 01 = 05)

1. What is the range of heating temperature in spheroidizing annealing?

Ans. (a) 680°C to 750°C

1. What is the lower critical temperature of steel?

Ans. (d) 723°C

2. Name the microstructure type of quenched steel.

Ans. (a) Martensite

3. What is the range of heating temperature in spheroidizing annealing?

Ans. (a) 680°C to 750°C

4. Which microstructure does technically pure iron form?

Ans. (c) Ferrite

5. Iron with 2.5 % to 3.7 % carbon is:

Ans. (d) Cast iron

6. If carbon percentage is more than 0.8% in steel, then:

Ans. (d) It deposit at grain boundaries.

7. Heating iron that contain carbon (steel) to over 723-degree C changes its microstructure. This change in microstructure is due to:

Ans. (a) change in crystal lattice.

8. What is the crystal structure of austenite?

Ans. (c) FCC

9. Tempering is done to:

Ans. (d) To reduce brittleness.

10. Write the carbon percentage range in steel.

Ans. (b) 0.1% to 2%

11. Which agent have gentle quenching effect

Ans. (b) Oil

12. Temperature for hot quenching bath is:

Ans. (a) 200°C to 500°C

13. Spheroidizing annealing converts the lamellar cementite into

Ans. (a) Granular cementite

14. In the case of Nitriding, the increase in hardness is based on the formation of:

Ans. (c) Nitride



15. What percentage of carbon is suitable for hardening?

Ans. (a) More than 0.2% carbon

16. Martensite shape is

Ans. (b) Needle shape

17. Influence of alloying elements while quenching:

Ans. (a) Reduce critical cooling speed

18. In skin hardening, the deeper areas of the workpieces are:

Ans. (d) Not heated to the hardening temperature

19. Carburizing is done for the steel which is having:

Ans. (a) 0.1% to 0.2% carbon

20. α -iron is having microstructure type of:

Ans. (b) Ferrite

Section- B

(06 x 05 = 30)

21. Why recrystallization annealing is done for steels?

Ans.

Recrystallization annealing (Process annealing) is used if a microstructure is deformed by cold forming has to be returned to its undistorted microstructure state. A completely new microstructure is formed over several hours of annealing at 550°C to 650°C.

22. Explain microstructure of iron with 3.5% carbon.

Ans.

Proportion of carbon above 0.8 % precipitates as flake graphite at the grain boundaries, while the remaining proportion of carbon crystallises as lamellar cementite. Accordingly, the microstructure of iron casting alloys consists of a pearlite or ferrite- pearlite matrix and Flake graphite deposited between the grains.

23. Write three properties of γ -austenite.

Ans.

Austenite is tough,
malleable and
not magnetisable, in contrast to ferrite.

24. Write the significance of iron carbon equilibrium diagram.

Ans.

The iron-carbon phase diagram provides an overview of which type of microstructure a ferrous material with a certain carbon content has, at specific temperature.

25. Write any two annealing defects.

Ans.

Annealing defects

- Non-compliance with annealing temperature and annealing times leads to unforeseen microstructure transformation.
- If the annealing temperature is exceeded by a significant amount for an extend period of time, it can damage or destroy the material.

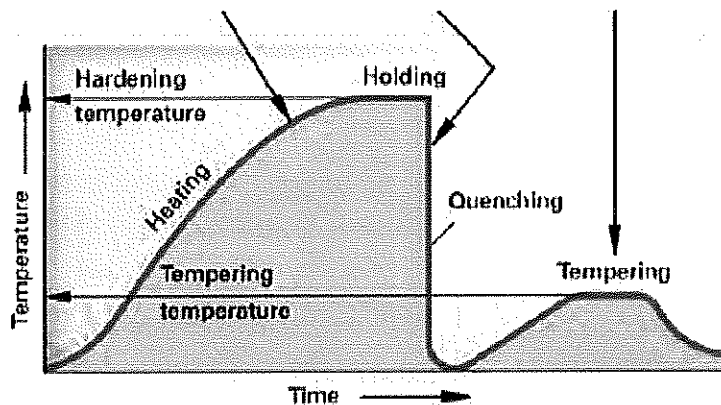
26. What is stress relief annealing?

Ans.

Stress relief annealing reduce internal stresses in the work piece through the plastic flow of the material. The internal stress may have arisen during casting, rolling, forging or welding. The work piece is annealed at 550-degree C to 650-degree C for 1 to 2 hours.

27. Plot a hardening graph between time and temperature.

Ans.



28. Explain internal process in quenching.

Ans.

However, if the austenitised steel is cooled very quickly, the face-centered cubic austenite lattice rapidly transforms into the body centered cubic ferrite lattice when it falls below the GSK line. The carbon atom in the center of the crystal does not have time to migrate out of the lattice.

A carbon atom as well as the iron atom are now located in the centre of the lattice. This significantly deforms the crystal lattice. The result is a needle-shaped microstructure referred to as **martensite**. It is very hard, but brittle.



29. Explain the microstructure of steel for following-

- a) With less than 0.8% carbon.
- b) With more than 0.8% carbon.

Ans.

- Steel with less than 0.8 % carbon have a microstructure that contain ferrite and pearlite grains. This is referred to as ferrite- pearlite microstructure.
- Steel with more than 0.8 % carbon contain so much carbon that, besides the lamellar cementite in the pearlite grains, cementite is also deposited at the grain boundaries.

The greater the amount of cementite in the microstructure, the harder, but also more brittle, the steel.

30. Explain skin hardening process with diagram.

Ans.

Skin hardening involves the rapid heating of a thin external layer of a workpiece manufactured from harden-able steel and its immediate quenching to improve its hardness.

The deeper areas of the workpiece are not heated to the hardening temperature during the short heating period and remain unhardened.

For induction hardening, the heat is generated by eddy currents in the skin of the workpiece. The eddy currents are generated by a high frequency alternating current that flows through an induction coil.

The workpiece is fed into the induction coil at a constant speed so that only the skin is heated to the hardening temperature and it is then quenched in a shower. The hardness penetration depth can be adjusted by the through-put speed and the current frequency.

31. Write any four types of heat treatment process and explain any two

Ans.

- I. **Annealing** is a heat treatment that consists of slow heating, holding at an annealing temperature and slow cooling.

Annealing processes differ according to the annealing temperature and the duration of the annealing.

- II. **Hardening** consists of several working steps. The workpiece is first heated to the hardening temperature and then held at this temperature. It is then quenched, i.e. immersed in water or oil. This makes the steel very hard, but also brittle and fragile. As a result, the workpiece is then

tempered, i.e. heated to the tempering temperature. The workpiece is then air cooled. This gives steel its customary hardness.



III. Skin hardening

IV. Case hardening

32. What are hardening distortion and hardening cracks? Explain.

Ans.

Hardened workpieces displays changes in dimension and form, so-called hardening distortion. Particularly abrupt quenching may even lead to hardening cracks. Hardening distortion and hardening cracks form in two phases:

During immersion in the quenching agent, the skin zone cools very quickly and decreases in size as a result.

The core is still hot and retain its original size, which prevents the skin zone from shrinking.

This leads to stresses, distortion or cracks at the boundaries.

33. Explain carburizing and Nitriding with appropriate diagram.

Ans.

Carburising in a liquid case hardening agent involves immersing and holding the workpiece in carbon emitting molten salt. Cyanide salt melts are extremely toxic. The work can only be performed in accordance with the guidelines on handling toxic substances issued by the Employers Liability Insurance Association. Correct disposal of cyanide salt residues and cyanide-containing washing water must be ensured.

For gas carburising, the workpieces are inserted in a gas-tight furnace through which a carbon-emitting gas is conducted. Various gas mixtures are used as a carburising gas, the key components of which include carbon monoxide CO and hydrogen. Strict safety precautions must be observed, as the gases are toxic and explosive.

Nitriding involve the enrichment of a thin layer of case of a workpiece made from Nitriding steel with nitrogen, which forms a very hard and wear resistance case.

In the case of Nitriding, the increase in hardness is not based on the formation of martensite, but on the formation of the extremely hard nitrogen compounds (nitrides) in the workpiece's case.





BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Session: 2018-19 (Winter Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: SMS1505

Time: 3 Hours

Course Name: Basics of Programming

Max. Marks: 100

Instruction:

1. Attempt all questions.
2. Use of Calculators is Prohibited.
3. Section A contains 20 Questions. Each question carries 1 Marks.
4. Section B contains 06 Questions. Each question carries 5 Marks.
5. Section C contains 05 Questions. Each question carries 10 Marks.

Section – A

20X01 = 20 Marks

1. For smooth- running, low- maintenance and free from play which guide ways are used.
 - a) Slide guide ways
 - b) Roller guide ways
2. Which of the following step is not involved in processes of coating of paint?
 - a) Cleaning of the components
 - b) Creation of a primer
 - c) Dry in the oven
 - d) Coating the parts
3. What is the die clearance range for 2mm sheet thickness if the shear strength is 250-400?
 - a) 0.04 – 0.05mm
 - b) 0.015mm
 - c) 0.08 – 0.09mm
 - d) 0.11 – 0.13mm
4. Which coating is preferred for aluminum and aluminum alloys?
 - a) Phosphating
 - b) Chromating
 - c) Both a & b
 - d) None of the above
5. During cutting the necessary cutting force F is dependent on.....
 - a) Die clearance
 - b) Cut area
 - c) Cutting punch
 - d) Maximum shear strength
6. The paint coating material essentially consists of....
 - a) Liquid binder
 - b) Powder pigments
 - c) Solvent thinner
 - d) All of above



7. Which one of the following cutting process is not suitable for non-ferrous metals?
 - a) Oxy-fuel cutting
 - b) Plasma cutting
 - c) Laser cutting
 - d) Water jet cutting

8. Spray painting method not used for.....
 - a) 2D surface
 - b) Structured parts
 - c) Small flat pieces
 - d) All of above

9. What is the cutting speed in plasma cutting for quality cut?
 - a) Up to 6m / min
 - b) Up to 4m / min
 - c) Up to 10m / min
 - d) Up to 2m / min

10. Which coating method is used as short-term corrosion protection as well as an anti-friction layer on sheet metal for metal forming?
 - a) Phosphating
 - b) Chromating
 - c) Electroplating
 - d) None of above

11. Which one of the following is not a type of thermal cutting?
 - a) Oxy-fuel cutting
 - b) Plasma cutting
 - c) Laser cutting
 - d) Water jet cutting

12. Which powder coating method is used for Solvent free coating with thermosetting resins?
 - a) Plastic spaying
 - b) Electro coating
 - c) Electrostatic powder coating
 - d) All of the above

13. How much pressure is used for Spray painting (compressed air spraying) method?
 - a) 1 - 2 bar
 - b) 2 - 6 bar
 - c) Up to 250 bar
 - d) All of the above



14. What is the material thickness for waterjet cutting?
- 1 to 100 mm
 - 1 to 1000 mm
 - 20 to 5000 mm
 - 10 to 50 mm
15. Which metal coating method is used for coating of any metals, alloys and components that provide a mechanical adhesion?
- Electroplating
 - Hot dipping of metals
 - Thermal spraying
 - None of above
16. Which electroplating materials are used to provide wear resistance on polishing rolls?
- Nickel and chrome plating
 - Nickel coating
 - Hard nickel and hard chrome
 - None of the above
17. Which of the following material is used for chromating?
- Iron
 - Manganese
 - zinc
 - magnesium
18. What is the cutting speed in oxy-fuel cutting for 5mm thickness?
- 400mm / min
 - 800mm / min
 - 1200mm / min
 - 200mm / min
19. What is the percentage of sheet metal thickness for Die clearance?
- Above 25%
 - Above 10%
 - Up to 5%
 - Up to 30%
20. Which coating method is generally used for coating of indexable insert?
- Phosphating
 - Enameling
 - CVD coating
 - Thermal spraying

Section – B

06X05 = 30 Marks

21. Define coating and write their function.
22. Explain the nibbling process in shearing machine.



23. What is Electro coating (electrophoretic dip painting)? Write their advantages and applications.
24. Explain sheet metal consumption.
25. Which materials are used for metal coating and provide the names for metal coating methods.?
26. Explain the Die clearance.
27. What are the advantages and disadvantages of water jet and plasma cutting?
28. What are the advantages of electrostatic powder coating?

Section – C

05X10 = 50 Marks

29. Explain phosphating and chromating method of coating.
30. Explain electroplating with the help of diagram and also write its application.
31. Describe Chemical Vapor Deposition (CVD) method of metal coating.
32. What is the difference between plasma cutting and laser cutting?
33. Explain the following.
 - a) Oxy-fuel cutting
 - b) Water jet cutting



School of Manufacturing
Session: 2018-19 (Winter Semester)
B. Voc. Program, 5th Semester,
End-Sem. Examination

Course Code: SMS1505

Time: 60 Min.

Course Name: Basics of Programming

Max. Marks: 100 Marks

Section – A

20X01 = 20 Marks

1. For smooth- running, low- maintenance and free from play which guide ways are used.
b) Roller guide ways
2. Which of the following step is not involved in processes of coating of paint?
c) dry in the oven
3. What is the die clearance range for 2mm sheet thickness if the shear strength is 250-400?
a) 0.04 – 0.05mm
4. Which coating is preferring for aluminum and aluminum alloys?
b) chromating
5. During cutting the necessary cutting force F is dependent on.....
b) Cut area
d) Maximum shear strength
6. The paint coating material essentially consists of....
d) All of above
7. Which one of the following cutting process is not suitable for non- ferrous metals?
a) Oxy- fuel cutting
8. Spraying paint method is not used for.....
b) Structured parts
9. What is the cutting speed in plasma cutting for quality cut?
b) Up to 4m / min
10. Which coating method used as short-term corrosion protection as well as an anti-friction layer on sheet metal for use in metal forming
a) phosphating
11. Which one of the following is not a type of thermal cutting?
d) Water jet cutting
12. Which powder coating method is use Solvent free coating with thermosetting resins?
c) Electrostatic powder coating
13. How much pressure is used in Spraying (compressed air spraying) method?
b)2-6 bar
14. What is the material thickness for waterjet cutting?
a) 1 to 100 mm



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15. Which metal coating method is used for coating of any metals, alloying and components that provide a mechanical adhesion?
c) Thermal spraying
16. Which electroplating materials are used to provide wear resistance on polishing roll?
c) Hard nickel and hard chrome
17. Which of the following material is used in chromating?
d) magnesium
18. What is the cutting speed in oxy-fuel cutting for 5mm thickness?
b) 800mm / min
19. What is the percentage of sheet metal thickness for Die clearance?
c) Up to 5%
20. Which coating method is generally used for coating of indexible insert?
c) CVD coating

Section – B

06X05 = 30 Marks

21. Define coating and write their function.

Ans. Coating is a covering that can be applied to the surface of an object, normally called as substrate. The purpose of application of coating is the value enhancement of the substrate by improving its appearance, corrosion resistant property, wear resistance, etc.

- Low friction
- Abrasion resistance
- Chemical resistance
- Electrical insulation
- Rust and corrosion prevention
- Function and aesthetic

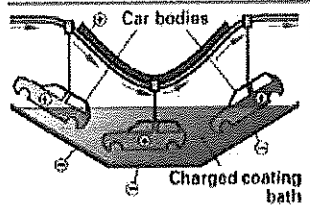
22. Explain the nibbling process in shearing machine.

Ans. Nibblers are used to cut out arbitrary shapes in sheet metals. the material is cut using a punch with short, rapidly –sequenced stroke. Nibblers are also used on NC -controlled machines to make shapes which can not be punched using standard tools from the tool magazine. During the process, the metal penal is traversed under the tool so that erequired shape is created.

23. What is Electrocoating (electrophoretic dip painting). writes their advantages and applications?

Ans.

Electrocoating (electrophoretic dip painting)
The grounded component is immersed in a paint bath to which a voltage is applied. The paint particles become charged and are drawn by the electrical forces to the part to which they adhere.

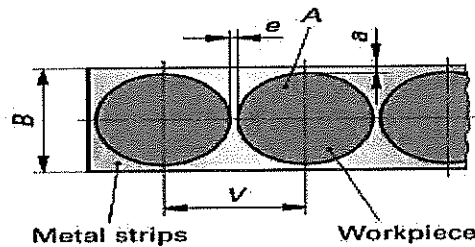


The coating is uniform and penetrates deep into uneven surfaces including areas that are difficult to access and cavities.

Anti-corrosive coating for automotive bodies and other highly structured parts (corrosion primer)

24. Explain sheet metal consumption.

Ans. Between the workplace webs of thickness e and borders of thickness a_n at the strip are required. when determining the metal consumption A_0 for each work piece cut from a sheet metal strip of width B with strip feed V , waste at the strip ends is not taken into account.



Metal consumption according to feed rate

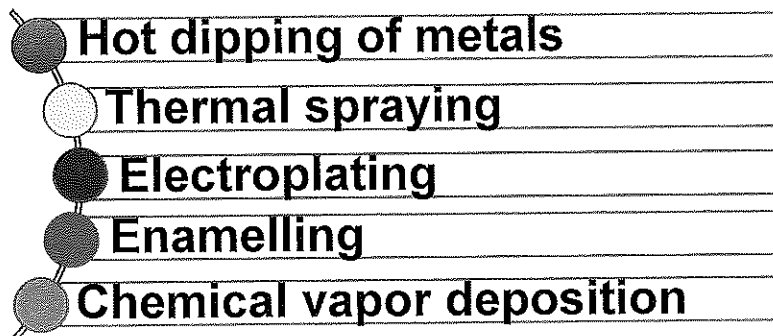
$$A_0 = V \cdot B$$

25. Which materials are used for metal coating and write the name of metal coating methods.?

Ans.

Materials for metal coating:

- I. For corrosion protection - zinc, nickel, chromium, molybdenum, chromium-nickel-iron alloys.
- II. For protection against wear -- hard nickel, hard chrome and nickel layers with embedded lubricant and particles of hard materials.





26. Explain the Die clearance.

Ans. A die clearance must be present between punch and blanking die. The size of the die clearance depends on the sheet metal thickness, the shear strength of the sheet metal, the required tool life and the quality of the cut surface. Normally, the die clearance is 0.5% for fine cutting, and otherwise up to 5% of the sheet metal thickness. Whether the correct die clearance has been adhered to can be checked by observing the cut surface. If it is raw and brittle, and shows strong burring, the die clearance is too big.

27. What is the advantages and disadvantages of water jet and plasma cutting?

Ans. water jet cutting

Advantages: - cutting of all material possible, no heat effects and therefore no distortion

Disadvantages: -only used when thermal cutting processes are unsuitable

Plasma cutting

Advantages: -cutting of all metals at high cutting speed and good cutting quality is possible

Disadvantages: -protective equipment required to counter to generated noise, dust and smoke, expensive machines.

28. What are the advantages of electrostatic powder coating?

Ans. Advantages

- Solvent free coating with thermosetting resins.
- Recovery of the over-spray coating powder.
- Environmentally friendly.
- All-over coating and good adhesion to the part.

Section – C

05X10 = 50 Marks

29. Explain phosphating and chromating method of coating.

phosphating

- During phosphating, the steel structure, such as an automotive body shell, either sprayed with **zinc phosphate** solution in an enclosure or immersed in a zinc phosphate bath.
- This process forms an **iron phosphate layer** on the steel surface approximately 20 microns deep that is bonded.
- This layer serves as a primer for the paint and prevents rust forming under the paint layer.
- The phosphate layer can be used as short-term **corrosion protection** as well as an **anti-friction layer** on sheet metal for use in metal forming.
- The main types of phosphate coatings are manganese, iron and zinc.

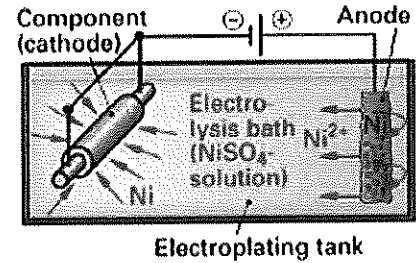
Chromating

- Chromate conversion coatings are the most widely used coating for corrosion protection of Aluminum and Aluminum alloys minimizing surface oxidation. It is commonly used for an undercoat for paint or adhesive applications due to the excellent bonding properties it provides.
- It is used aluminum and magnesium for coating.
- Chromating coating is performed by dipping and spraying.
- It has greenish-yellow colour.

30. Explain electroplating with the help of diagram and also write its application.

Ans. Electroplating is the process of applying a metal coating on another piece of metal (or another conductive surface) through an **electro-deposition process**. In electroplating, the deposited metal becomes part of the existing product with the plating/coating.

- The part to be coated is immersed in an electrolytic bath (metal salt solution) and connected as the cathode. The electrochemical processes forms a metal layer on the part.
- When the electricity flows through the circuit they make, the electrolyte splits up and some of the metal atoms it contains are deposited in a thin layer on top of one of the electrodes—it becomes electroplated.



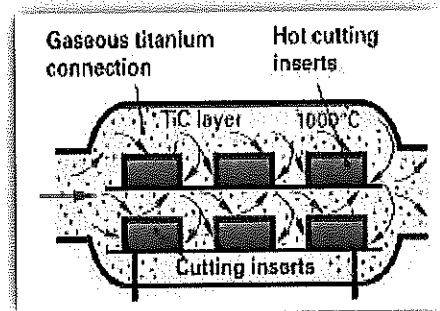
Applications

- Nickel and chrome plating such as for automotive parts and many small parts.
- Hard nickel and hard chrome are used to provide wear resistance on polishing rolls.
- Medical device that created with nickel is coated with palladium or gold.
- Nickel coating used for inkjet nozzle plate.
- The silver plating coating is popular in radio frequency conductivity applications such as antennas, radio chassis, and cellular phone gear

31. Describe Chemical Vapor Deposition (CVD) method of metal coating.

Ans. Chemical Vapor Deposition (CVD) is an atmosphere controlled process conducted at elevated temperatures (1000 °C) in a CVD reactor.

During this process, **thin-film coatings** are formed as the result of reactions between various gaseous phases and the heated surface of substrates within the CVD reactor. As different gases are transported through the reactor, distinct hard coating layers are formed on the tool.



Advantage

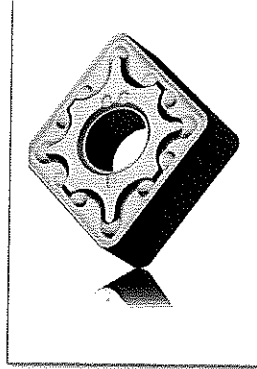
- Possibility of coating with oxides, metal carbides and metal nitrides.
- Thin multilayer coating are also possible.

Applications



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- Coating of tools and indexible cutter inserts, guide rollers, thread guides and similar objects with hard materials coatings of Al_2O_3 , TiC , TiN , $TiAlN$ and $AlCrN$.



32. What is the difference between plasma cutting and laser cutting?

Ans.

plasma cutting

in plasma cutting, the material is cut by a plasma beam which impacts the cutting location at an extremely high temperature and high speed. Plasma means an electrically- charged, highly heated gas.

First, a pilot arc is ignited between the tungsten electrode and the cutting nozzle. The supplied cutting gas flows through the arc and is immediately converted to a plasma state due to the high temperature. A voltage applied between the electrode and workpiece accelerates the plasma towards the workpiece.

as soon as the plasma beam contacts the workpiece, the arc jumps across to the workpiece and the pilot arc is switched off. The high- energy plasma beam, which has a temperature of up to 30,000 °C, melts the material at the contact location and blows it out of the kerf.

When plasma cutting non- conductive materials (non – metals) no arc is possible between the electrode and the workpiece. For this reason, a further electrode must be used to close the electric circuit.

Application	Alloy steels, non-ferrous metals and non-metals
Material thick-nesses	1 mm to 100 mm
Cutting speed	Up to 6 m/min for separating cuts and up to 4 m/min for quality cuts
Cutting gases	Argon, nitrogen, mixture of the two, helium, compressed air
Advantages	Cutting of all metals at high cutting speeds and good cutting quality is possible
Disadvantages	Protective equipment required to counter the generated noise, dust and smoke, expensive machines

Laser cutting

In laser cutting, a laser beam is used for cutting. Laser beams are coherent, high- energy light beams. They are created with the aid of gases (gas lasers) or crystals (solid state lasers) and then focused on a very small area of the material surface (beams of the coherent light) through a lens system similar to that of a burning lens. This results in a high energy density. The material melts or evaporates, and is then blown out of the kerf by a gas jet. The process is sub- divided into laser fusion cutting and laser flame cutting depending on the mode of action.



Application	All steels, aluminium alloys, plastics, ceramics
Material thicknesses (examples)	10 mm with steel 0.1 mm with films
Cutting speed	0.6 mm with steel 90 mm/min with plastic films
Cutting gases	Nitrogen, argon, oxygen
Advantages	Cutting of many materials possible, extremely good cut quality; high cutting speed
Disadvantages	Protective equipment necessary; expensive machines

33. Explain the following.

Ans.

a) Oxy-fuel cutting

Plain carbon and low-alloy steels burn in pure oxygen if their ignition temperature is exceeded. This is around 1200°C and is below the melting temperature.

Flame cutting exploits this behavior. The cutting point on the workpiece is heated up to the ignition temperature using a fuel gas- oxygen is connected. After this, the steel burns at the incandescently hot cutting point. The resultant iron oxide together with the molten steel by the pressure of the oxygen jet. Forward movement of the cutting torch results in a kerf.

Application	Plain carbon and low-alloy steels
Material thicknesses	5 mm to 1,000 mm
Cutting speed	800 mm/min at 5 mm thickness 400 mm/min at 80 mm thickness
Advantages	Use of manually-guided burners and NC-controlled machines possible
Disadvantages	Not suitable for thin sheets, alloy steels and non-ferrous metals

b) Water jet cutting

Waterjet cutting works with a very thin waterjet which often has a blasting abrasive such as quartz sand mixed in with it in order to increase the eroding action.

Cutting process

The cutting water is brought up to a pressure of around 4,000 bar using a pump and fed into the cutting head. The blasting abrasive is added here. the jet, which is between 0.1 and 0.5 mm in width, then starts to cut the material from a starting hole in the workpiece. The cutting speed depends on the hardness and toughness of the material in addition to the required cut quality. A very smooth and burr-free cut edge is achieved using fine cutting in which the process runs at around 25% of the possible cutting speed.

Considerable noise is produced during waterjet cutting. This can be reduced by cutting underwater.



Application	Metals, non-ferrous metals, plastics, textiles, composite materials, laminated materials
Material thicknesses	1 mm to 100 mm
Cutting speed	0.4 m/min for steel 0.8 m/min for aluminium
Cutting material	Water with abrasive additives
Advantages	Cutting of all materials possible; no heat effects and therefore no distortion
Disadvantages	Only used when thermal cutting processes are unsuitable



School of Manufacturing
Session: 2018-19 (Winter Semester)
B. Voc. Program, 5th Semester,
End-Sem. Examination

Course Code: SMS1506

Time: 60 Min.

Course Name: Project Preparation

Max. Marks: 100 Marks

Section-A

(20 x 01 = 05)

1. What is the range of heating temperature in spheroidizing annealing?
Ans. (a) 680°C to 750°C
1. What is the lower critical temperature of steel?
Ans. (d) 723°C
2. Name the microstructure type of quenched steel.
Ans. (a) Martensite
3. What is the range of heating temperature in spheroidizing annealing?
Ans. (a) 680°C to 750°C
4. Which microstructure does technically pure iron form?
Ans. (c) Ferrite
5. Iron with 2.5 % to 3.7 % carbon is:
Ans. (d) Cast iron
6. If carbon percentage is more than 0.8% in steel, then:
Ans. (d) It deposit at grain boundaries.
7. Heating iron that contain carbon (steel) to over 723-degree C changes its microstructure. This change in microstructure is due to:
Ans. (a) change in crystal lattice.
8. What is the crystal structure of austenite?
Ans. (c) FCC
9. Tempering is done to:
Ans. (d) To reduce brittleness.
10. Write the carbon percentage range in steel.
Ans. (b) 0.1% to 2%
11. Which agent have gentle quenching effect
Ans. (b) Oil
12. Temperature for hot quenching bath is:
Ans. (a) 200°C to 500°C
13. Spheroidizing annealing converts the lamellar cementite into
Ans. (a) Granular cementite
14. In the case of Nitriding, the increase in hardness is based on the formation of:
Ans. (c) Nitride



15. What percentage of carbon is suitable for hardening?

Ans. (a) More than 0.2% carbon

16. Martensite shape is

Ans. (b) Needle shape

17. Influence of alloying elements while quenching:

Ans. (a) Reduce critical cooling speed

18. In skin hardening, the deeper areas of the workpieces are:

Ans. (d) Not heated to the hardening temperature

19. Carburizing is done for the steel which is having:

Ans. (a) 0.1% to 0.2% carbon

20. α -iron is having microstructure type of:

Ans. (b) Ferrite

Section- B

(06 x 05 = 30)

21. Why recrystallization annealing is done for steels?

Ans.

Recrystallization annealing (Process annealing) is used if a microstructure is deformed by cold forming has to be returned to its undistorted microstructure state. A completely new microstructure is formed over several hours of annealing at 550°C to 650°C.

22. Explain microstructure of iron with 3.5% carbon.

Ans.

Proportion of carbon above 0.8 % precipitates as flake graphite at the grain boundaries, while the remaining proportion of carbon crystallises as lamellar cementite. Accordingly, the microstructure of iron casting alloys consists of a pearlite or ferrite- pearlite matrix and Flake graphite deposited between the grains.

23. Write three properties of γ -austenite.

Ans.

Austenite is tough,
malleable and
not magnetisable, in contrast to ferrite.

24. Write the significance of iron carbon equilibrium diagram.

Ans.

The iron-carbon phase diagram provides an overview of which type of microstructure a ferrous material with a certain carbon content has, at specific temperature.

25. Write any two annealing defects.

Ans.

Annealing defects

- Non-compliance with annealing temperature and annealing times leads to unforeseen microstructure transformation.
- If the annealing temperature is exceeded by a significant amount for an extend period of time, it can damage or destroy the material.

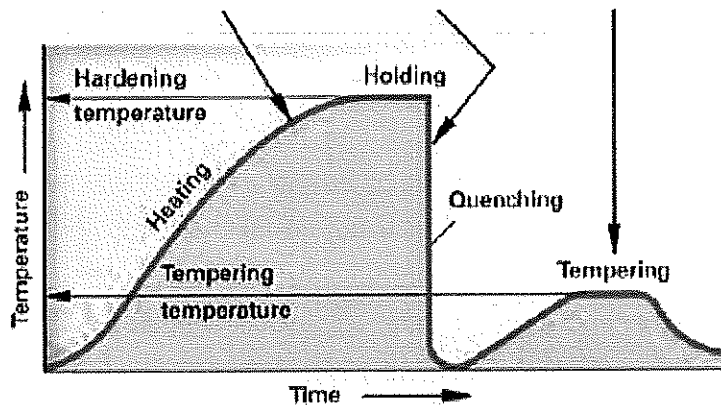
26. What is stress relief annealing?

Ans.

Stress relief annealing reduce internal stresses in the work piece through the plastic flow of the material. The internal stress may have arisen during casting, rolling, forging or welding. The work piece is annealed at 550-degree C to 650-degree C for 1 to 2 hours.

27. Plot a hardening graph between time and temperature.

Ans.



28. Explain internal process in quenching.

Ans.

However, if the austenitised steel is cooled very quickly, the face-centered cubic austenite lattice rapidly transforms into the body centered cubic ferrite lattice when it falls below the GSK line. The carbon atom in the center of the crystal does not have time to migrate out of the lattice.

A carbon atom as well as the iron atom are now located in the centre of the lattice. This significantly deforms the crystal lattice. The result is a needle-shaped microstructure referred to as **martensite**. It is very hard, but brittle.



29. Explain the microstructure of steel for following-

- a) With less than 0.8% carbon.
- b) With more than 0.8% carbon.

Ans.

- Steel with less than 0.8 % carbon have a microstructure that contain ferrite and pearlite grains. This is referred to as ferrite- pearlite microstructure.
- Steel with more than 0.8 % carbon contain so much carbon that, besides the lamellar cementite in the pearlite grains, cementite is also deposited at the grain boundaries.

The greater the amount of cementite in the microstructure, the harder, but also more brittle, the steel.

30. Explain skin hardening process with diagram.

Ans.

Skin hardening involves the rapid heating of a thin external layer of a workpiece manufactured from harden-able steel and its immediate quenching to improve its hardness.

The deeper areas of the workpiece are not heated to the hardening temperature during the short heating period and remain unhardened.

For induction hardening, the heat is generated by eddy currents in the skin of the workpiece. The eddy currents are generated by a high frequency alternating current that flows through an induction coil.

The workpiece is fed into the induction coil at a constant speed so that only the skin is heated to the hardening temperature and it is then quenched in a shower. The hardness penetration depth can be adjusted by the through-put speed and the current frequency.

31. Write any four types of heat treatment process and explain any two

Ans.

- I. **Annealing** is a heat treatment that consists of slow heating, holding at an annealing temperature and slow cooling.

Annealing processes differ according to the annealing temperature and the duration of the annealing.

- II. **Hardening** consists of several working steps. The workpiece is first heated to the hardening temperature and then held at this temperature. It is then quenched, i.e. immersed in water or oil. This makes the steel very hard, but also brittle and fragile. As a result, the workpiece is then

tempered, i.e. heated to the tempering temperature. The workpiece is then air cooled. This gives steel its customary hardness.



III. Skin hardening

IV. Case hardening

32. What are hardening distortion and hardening cracks? Explain.

Ans.

Hardened workpieces displays changes in dimension and form, so-called hardening distortion. Particularly abrupt quenching may even lead to hardening cracks. Hardening distortion and hardening cracks form in two phases:

During immersion in the quenching agent, the skin zone cools very quickly and decreases in size as a result.

The core is still hot and retain its original size, which prevents the skin zone from shrinking.

This leads to stresses, distortion or cracks at the boundaries.

33. Explain carburizing and Nitriding with appropriate diagram.

Ans.

Carburising in a liquid case hardening agent involves immersing and holding the workpiece in carbon emitting molten salt. Cyanide salt melts are extremely toxic. The work can only be performed in accordance with the guidelines on handling toxic substances issued by the Employers Liability Insurance Association. Correct disposal of cyanide salt residues and cyanide-containing washing water must be ensured.

For gas carburising, the workpieces are inserted in a gas-tight furnace through which a carbon-emitting gas is conducted. Various gas mixtures are used as a carburising gas, the key components of which include carbon monoxide CO and hydrogen. Strict safety precautions must be observed, as the gases are toxic and explosive.

Nitriding involve the enrichment of a thin layer of case of a workpiece made from Nitriding steel with nitrogen, which forms a very hard and wear resistance case.

In the case of Nitriding, the increase in hardness is not based on the formation of martensite, but on the formation of the extremely hard nitrogen compounds (nitrides) in the workpiece's case.

