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UNIT I – THEORY OF METAL CUTTING

1. Define Metal Cutting.

Metal cutting or machining is the process of removing unwanted material from a block of metal in the form of chips. To perform the metal cutting operation, relative motion is required between the tool and the work. This relative motion is achieved in most machining operation by means of a primary motion, called "cutting speed" and a secondary motion called "feed". The shape of the tool and its penetration into the work surface, combined with these motions, produce the desired shape of the resulting work surface.

2. Classify the types of metal cutting process. (Dec, 2014)

Metal cutting process is classified into two types.

They are, i) Orthogonal cutting ii) Oblique Cutting

Orthogonal cutting: The cutting edge of tool is perpendicular to the work piece axis. It is also known as two dimensional cutting

Oblique cutting: The cutting edge is inclined at an acute angle with normal to the cutting velocity vector is called oblique cutting process. It is also known as Three dimensional cutting

3. State any two differences between orthogonal cutting and oblique cutting. (May,11& Dec, 2013)

S.No	Orthogonal cutting	Oblique cutting
1	Cutting edge of the tool is perpendicular to the direction of tool travel	Cutting edge of the tool is inclined to the direction of tool travel
2	The direction of chip flow is perpendicular to the cutting edge	The direction of chip flow is angled to the cutting edge
3	The chip coils in a tight flat spiral	The chip flows sideways in a long curl.
4	Grooving, Slotting, Broaching operations	All Machining operations

4. What is meant by Shear plane and Shear angle in metal cutting?

When cutting tool is introduced into the work piece, plastic deformation takes place in a narrow region in the surrounding of the cutting edge, the material ahead of it is sheared continuously along a plane called the **Shear plane**. The shear plane is inclined at an acute angle to the axis, the angle is known as **Shear angle**.

5. What is chip and mention its different types?

The sheared material begins to flow along the cutting tool face in the form of small pieces is called chip. The chips are mainly classified into three types.

- a. Continuous chip.
- b. Discontinuous chip.
- c. Continuous chip with built up edge(BUE)

6. What are the factors that favour the formation of continuous chips?

The following factor favours the formation of continuous chip.

- (i) Ductile material (ii) Smaller depth of cut (iii) High cutting speed (iv) Large rake angle
- (v) Sharp cutting edge.(vi)Proper cutting fluid,(vii) Low friction between tool face and chips

7. What are the favourable factors for discontinuous chip formation?

- a. Machining of brittle material, b. Small rake angle, c. Higher depth of cut,
- d. Low cutting speeds, e. Cutting ductile material with low speed and small rake angle of the tool.

8. What is meant by built up edge (BUE) (June, Dec 2012)

While machining ductile materials, due to high temperature and pressure in the cutting zone and also high friction in the tool-chip interface may cause the work material to adhere or weld to the cutting edge of the tool forming the built up edge. This causes the finished surface to be rough.

9. What are the important properties or characteristics required for a tool material?

- 1.High hot hardness 2.High Temperature strength 3.Low co-efficient of friction
- 4.High thermal conductivity 5.Low ductility.

10.State few cutting tool materials.

- 1. Plain Carbon steels, 2. High Speed Steel (HSS) 3. Cemented Carbides 4.CBN 5. Ceramics
- 6. Stellite 7. Diamonds

11. What are the advantages of diamond tools?

- i). High cutting speeds about 50 times greater than HSS tool
- ii).Cutting very hard materials such as glass, plastics, ceramics etc.
- iii).They have low coefficient of friction and cut up to 1650 °C

12. Classify the various angles in cutting tool?

- 1) Back rake angle 2) Side rake angle 3) End relief angle 4) Side relief angle
- 5) Side cutting angle 6) End cutting angle.

13. What is the effect of back rake angle and mention the types?(Dec,2010)

Back rake angle of tool increases the strength of cutting tool and cutting action. It can be classified in to two types. 1. Positive rake angle. & 2. Negative Rake angle.

14. What are all conditions for using positive rake angle? (Dec,2011)

- 1.To machine the work hardened materials.
- 2.To machine low strength ferrous and non-ferrous metals.
- 3.To machine long shaft of small diameters.
- 4.To machine the metal below recommended cutting speeds.
- 5.Using small machine tools with low horse power.

15. When will be the negative rake angles be used?(May 2013)

- a. To machine high strength alloys.
- b. The machine tools are more rigid.
- c. The feed rates are high.
- d. To give heavy and interrupted cuts.

They are generally used for cutting grey, malleable cast iron, cast steels, die steels and tool steels.

16. What is tool signature? and mention two systems used in tool designation.

The various angles of tools are mentioned in a numerical number in particular order. That order is known as tool signature or tool designation.

They are i. American Standard Association (ASA) ii) Orthogonal Rake System (ORS)

17. What is orthogonal rake system? (June 2014)

Orthogonal rake system is one of the system of tool signature or tool designation. In this system, the planes for designating tools are the plane having principal or side cutting edge and the plane normal to it. This normal plane is known as orthogonal plane.

18. Define ASA system.

ASA system is one of the system of tool signature or tool designation. In the ASA system, the angles of tool face, that is, its slope, are defined in two orthogonal planes, one parallel to and the other perpendicular to, the axis of the cutting tool, both planes being perpendicular to the base of the tool.

19. What are the important characteristics of a cutting tool material?

- i. Hot hardness ii. Wear resistance iii. Toughness iv. Low friction v. Cost of tool
- vi. High thermal conductivity vii. Resistance to thermal shock
- viii. Easy to grind and sharpen.

20. How do you define tool life? (May 2010, 11, Dec, 2012, 14))

The time period between two consecutive re sharpening of a cutting tool, with which the tool cuts the material effectively is called as tool life.

Taylor's tool life equation is $VT^n = C$

where, V= Cutting speed in m/min, T = tool life in min, n= exponent & C= Constant.

21. Write the factors affecting the tool life.

Factors affecting cutting tool life are

- i. Cutting speed ii. Feed and Depth of cut. iii. Tool Geometry iv. Tool material v. Type of Cutting Fluid vi. Work material

22. What is chip breaker? and classify the different types of chip breakers (May, 2012)

The chip coils in a helix and curl around the work and the tool and may injure the operator in case of continuous chip. A chip breaker is a metal piece attached to the tool, breaks the chip and reduces the difficulties. The chip breakers are classified into .

- a. Step type. b. Groove type. c. Clamp type.

23. Define tool wear and classify it? (June & Dec, 2013)

Tool wear can be defined as the loss of weight or mass of tool that lost due to the contact of sliding surfaces. Tool wear can be classified into i) Abrasion wear, ii) Adhesion wear iii) Diffusion wear iv) Flank wear v) Crater wear.

24. Name two reasons for flank wear in cutting tools (Dec, 2011)

- The reasons for flank wear are i) Friction ii) Large contact area iii) Temperature iv) Length of wear land

25. Write the factors which influence the cutting temperature.

The factors influence the cutting temperatures are

- a) Work piece b). Tool material, c). Tool geometry d). Cutting speed e). Depth of cut f). Cutting fluid.

26. Why is lubrication not required while machining cast iron? (June, 2014)

While machining cast iron, the lubrication is not required because

- i). Cast iron is a brittle metal ii). Discontinuous chip formation. iii). Machining at Low temperature iv). Low hardness.

27. What are the functions of cutting fluid? (Dec, 2010)

- 1. Cool the tool and the work piece 2. Reduce the friction
- 3. Protect the work against rusting 4. Improves the surface finish
- 5. Prevent the formation of built up edge.

28. What are the properties of cutting fluid?

- i. It should have good lubricant properties, ii. High heat absorbing capacity,
- iii. It should have a high specific heat, high heat conductivity and high film co-efficient,
- iv. High flash point. v. It should be odorless, vi. It should be non-corrosive to work and tool,
- vii. It should have low viscosity to permit free flow of the liquid.

29. Classify the cutting fluids.

The classification of cutting fluids are

- a). Straight or Neat oils – Derived from petroleum, animal, vegetable substances.
- b). Water mixed cutting fluids- Water blend usually one part of oil to 15 parts of water.
- c). Synthetics or semi chemical cutting fluids- Chemical additives added with mineral oils.

30. Define machinability of metal? and write the factors affecting machinability.

Machinability is defined as the ease with which a material can be satisfactorily machined life of the tool before tool failure or resharpening. The factors affecting the machinability are

- a. Chemical composition of work piece material, b. Microstructure of work piece material
- c. Mechanical properties like ductility, toughness etc.
- d. Physical properties of work materials.
- e. Method of production of the work materials.

31. What is machinability index?

It is a comparison of machinability of different material to standard material.

$$\text{Machinability index, (\%)MI} = \frac{\text{Cutting speed of material for 20 minutes tool life}}{\text{Cutting speed of standard steel for 20 minutes tool life.}} \times 100$$

Materials with high machinability index indicates that the material can be easily machined.

Part B

1. How is metal removed in metal cutting? Explain the process with simple sketch
2. Describe the mechanism of metal cutting
3. Discuss the various types of chips produced during metal machining.
4. Explain 'Merchant force circle' along with assumptions
5. State and discuss the parameters that influence the life of tool.
6. List the important characteristics of a cutting tool material
7. Write briefly about cutting tool materials used in metal cutting .
8. Enumerate the essential requirements of a tool material
9. What are the functions of Cutting fluids and its types
10. Write a short note on tool wear mechanism in metal cutting

UNIT II – TURNING MACHINES

1. State various types of lathes?

Lathes are classified by their specifications and applications and the drive mechanisms like belt drive or gear drive . The following are the classification of lathes.

- 1) Engine lathe. 2) Bench lathe. 3) Tool room lathe
- 4) Semi-automatic lathe. 5) Automatic lathe

2. What are the principle parts of a lathe?

Lathe has constructed by the following parts. The parts are produced by various manufacturing process various materials used.

- 1) Bed 2) Headstock 3) Tailstock 4) Carriage 5) Cross-slide 6) Tool post
- 7) Compound rest 8) Apron 9) Saddle 10) Lead screw.

3. What are the various operations can be performed on a lathe?

Lathe machine has performed the following various operations . Most of the operations done in cylindrical parts.

- 1) Turning 2) Facing. 3) Forming. 4) Knurling 5) Chamfering 6) Thread cutting.
- 7) Drilling 8) Boring 9) Under cutting 10) Tapping 11) Grooving 12) Parting off etc.

4. Name the specifications of a centre lathe (Dec,2013)

The specification of the centre lathe is the geometrical structure of the centre lathe.

- i) Height of centres, ii) Swing or Maximum diameter over bed ways iii). Swing or diameter over carriage iv) Maximum job length v).Bed length vi) Diameter of hole through Lathe spindle.

5. Mention any two limitations of centre lathe (Dec,2011, June,2012))

The limitations of the lathe is as follows.

- i).Only Maximum of Four tools can be used ii). Large setting time of the job
- iii).Too much idle time involved between movement of tools.
- iv) Lower rate of production.

6. State various parts mounted on the carriage (June,2013)

- i) Saddle- H shaped casting fitted over the bed
- ii). Cross-slide – Wedge shaped slide which carries compound rest and tool post
- iii).Compound rest- Marked in degrees, use during taper turning.
- iv).Tool post- Holding the tool
- v). Apron- Hangs in front of the bed. It has gears, levers for moving carriage with the lead screw.

7. State the various feed mechanisms used for obtaining automatic feed.(Dec,2014)

The feed mechanism is the most important in lathe it is used to change the speed of the spindle and directions of the spindle.

- 1) Tumbler gear mechanism
- 2) Quick change gearbox.
- 3) Tumbler gear-Quick change gearbox.
- 4) Apron mechanism with lead screw and feed rod.

8. What is the purpose of tumbler gear mechanism of lathe (June,2012)

The purpose of tumbler gear mechanism is to perform the various operations in lathe machines. The spindle speed and directions changed for using the gears engaged in the mechanism.

- i).For reversing the feed mechanism .
- ii) For auto feed
- iii). For reversing thread cutting mechanism.

9. List any four methods by which taper turning is done in a centre lathe (May,10,11& Dec,2011)

Taper turning can be carried out on lathes by following methods:

- i). By swiveling compound rest
- ii). By Tailstock set over method.
- iii) By using broad nose form tool
- iv) By using a taper turning attachment.

8. List out work holding devices.

- 1) **Chucks**- Three jaw self centering chuck, Independent Four jaw chuck, Magnetic chucks.
- 2) **Face plate**- a circular cast iron disc with slots
- 3) **Angle plate** - Holding the work conjunction with face plate
- 4) **Rests**- Steady rest and Follower rest used for avoid bending moment in long jobs.
- 5) **Mandrels**- Shafts or spindles used for holding bored jobs for machining outside surfaces
- 6) **Centres**- Live and dead centres which are used for holding the long jobs at ends.
- 7) **Carriers or dogs**- Straight tail and Bend tail used to hold the work conjunction with centres.

9. What is the use of mandrels? (Dec,2014)

Mandrels are usually solid steel shafts or spindles, which are used for holding small bored parts for machining their outside surfaces on lathe. The mandrels are availed in many types based on the components which is to be machines. Types of Mandrels are

- a) Solid
- b) Stepped
- c) Collar
- e) Expanding
- d) Cone

10. What is a centre gauge that is used in threading?(June 2014)

A center gauge, also sometimes known as a fishtail gauge, is a tool used in machining to check the angle of tool bits used to cut screw threads. It is a small, flat handheld object made of metal, about 57 by 19 millimeters in size.

Triangular notches are cut into the metal at precise dimensions and angles, and these notches are used as templates for shaping the machine tool bit. The center gauge helps ensure that the tool bit is the correct dimensions to cut these threads.

11. Define the term "Conicity".

The ratio of the difference in diameters of the taper to its length.

$$\text{Conicity, } K = \frac{D-d}{l}$$

Where, D - Bigger diameter, d - Smaller diameter

l - Length of the work piece.

12. What are the uses of headstock?

Headstock carries a hollow spindle with nose to hold the work piece. To Mount the driving and speed changing mechanisms. The work holding device of chuck is mounted in the headstock spindle and the gears used in mechanism all inside the headstock assembly.

13. What is an apron? (Dec,2012)

The integral part of several gears, levers and clutches mounted with the saddle for moving the carriage along with lead screw while thread cutting and auto feeding. The total carriage assembly is called apron it is most important in the tool setting and movement in lathe machines.

14. What are the special attachments which can be mounted on a centre lathe?

Lathe has used to various operations by specific various attachments to perform the process not done with common lathe machines. The attachments are as follows:

- i) Milling attachment ii). Grinding attachment iii). Copying attachment
- iv). Radius turning attachment v) Taper turning attachment

15. Distinguish between Capstan Lathe from Turret Lathe (May 2010)

S.No	Aspects	Capstan Lathe	Turret Lathe
1	Turret position	Turret is mounted on auxiliary slide which moves on guide ways	Turret is mounted directly on saddle
2	Feeding of tools	Saddle is fixed, tools are fed by slide	Entire saddle is moved
3	Tool travel	Limited tool travel	Almost full length of bed
4	Carriage movement	Movable	Fixed

16. What is a semi-automatic lathe?

Lathe has majorly classified with three types of operations by performance wise they are automatic, semiautomatic, conventional. A lathe in which all the machining operations are performed automatically and loading and unloading of work piece, coolant on or off is performed manually.

17. What are the advantages semi-automatic lathes?

For using the semi-automatic lathes we get the the following benefits they are

- 1) Production time is minimized.
- 2) Accuracy will be high.
- 3) Production rate is increased.

18. State use of providing lead cam in single spindle automatic screw cutting machine? (Dec,12)

The turret slide travel is controlled by a lead cam. The lead cam gives a slow forward and fast return movement to the turret slide. The cam is engaged with ratchet wheel provide inside the turret indexing mechanism. The cam is rotate the ratchet wheel this is the indexing of turret mechanism.

19. What are the advantages of sliding head automatic lathes?

The advantages of a sliding head automatic lathe is that long slender work pieces can be machined with very good surface finish, accuracy and concentricity in sliding head automatic lathes. Basically the long bars are getting vibration and run out while in operation. But this type of sliding head automatic lathes suitable for long bars.

20. State the advantages of swiss type screw cutting machine.

The swiss type screw automatic lathe has the following advantages.

- 1.It has five tool Slides
- 2.Wide range of speeds
- 3.Rigid construction.
- 4.Micrometer tool setting
- 5.Inter Changeability of cams.
- 6.Simple design of cams.
- 7.Numerous working stations.

21. Define automatic lathes.

Automatic lathes or simply automats are machines tools in which all the operations required to finish off the work piece are done automatically without the attention of an operator. This type of lathes manufacturing the parts are high accuracy and high production rate and low cost of operations.

22. State any four advantages of automatic lathes.(Dec,2013)

The automatic lathes are mostly used for automation industries and high production rate required industries only. The following are the advantages of the automatic lathes.

1. Mass production of identical parts.
2. High accuracy is maintained.
3. Time of production is minimized.
4. The bar stock is fed automatically.

23. What are the types of single spindle automatic lathe? (June, 2013)

The single spindle automatic lathes are used for same operation repeated by small interval of timings between the two consecutive operations.

1. Automatic cutting off machine.
2. Automatic screw cutting machine.
3. Swiss type automatic screw machine.

25. What is Swiss type Automates.

These are designed for machining long accurate parts of small diameter, such as 4 to 25 mm. An exclusive feature of these machines is the longitudinal travel of the headstock, or of a quill carrying the rotating work spindle. This is one of the special machine used in industries.

26. How automats are classified?

Classification According to the type of work used a)

Bar stock machine. b) Chucking machine.

Classification According to the number of spindles

a) Single spindle machine. b) Multi spindle machine.

Classification According to the position of the spindle

a) Horizontal Spindle machine. b) Vertical Spindle machine.

27. State the principle of multi spindle automats.

The principle of the multi spindle automate is that it has a tool slide working on the jobs on all spindles simultaneously. The multi spindles lathes perform the various operations in same time in same setting or the same operations performed in the all spindles at a time it is used for mass production.

28. How multi spindle automats are classified?

According to the type of work used

a) Bar stock machine. b) Chucking machine.

According to the Arrangement of spindle

a) Horizontal Spindle machine. b) Vertical Spindle machine.

According to the principle of operation

a) Parallel Action type, b) Progressive action type.

29. Mention the typical operations carried on automatic lathes.

The automatic lathes performed the variety of operations in the same setting. The operations are performed by automatically by the sequence of the job feeding by the feed mechanism. Centering, Boring, Knurling, Cutting off, Reaming, Thread cutting, Drilling and spot facing.

PART B

1. Name the various lathe accessories. How does a four jaw chuck differ from a three jaw Chuck (Dec 2011)
2. Draw the neat sketches of Steady and follower rests and brief their applications (May 2011)
3. Name various types of taper turning methods and explain any one of them (Dec,2014)
4. Explain with neat sketches the working principle of taper turning operation using form tool and by swiveling the compound rest.(Dec,2013)
5. Discuss any two special attachments on lathes.(June,2014)
6. Explain any four work holding devices that can be used on lathe.(June,2014)
7. Explain the method of thread cutting using compound slide in a lathe
8. List the type of work holding devices and tool holding devices that are generally used on lathe.
9. Discuss the main parts of turret lathe(Dec,2011)
10. Explain the working principle of capstan and turret lathe (Dec,2014)
11. State the differences between capstan and turret lathes (Dec,2013)
12. Describe the single spindle automatic lathe (June,2014)
13. Describe the working principle of Swiss type automatic lathes(Dec,2014)
14. Write a short note on automatic screw type machines.(Dec,2013)
15. What is meant by 'tool layout' of a turret lathe?(Dec,2011)
16. Explain parallel action and progressive action of multi spindle automatics (June,2014)
17. Write the procedure of tool layout of automatic screw machine.(June,2014)

UNIT III – SHAPER, MILLING AND GEAR CUTTING MACHINES

1. Define reciprocating machines and list out few examples.

Reciprocating machines are the machines in which rotary motion is converted into linear motion.

These motion conversion is made by the different types of mechanism used in the machines.

Examples: 1. Shaper, 2. Planer 3. Slotter 4. Broacher etc.

2. What are the different types of mechanism used in shaper?

The mechanism used in the shaping machines for converting the reciprocation motion into rotary motion by the ram is connected with the rotary motion mechanism. The following are the mechanism used in shaping machine.

- a. Crank and slotted Mechanism
- b. Whitworth mechanism
- c. Hydraulic system mechanism

3. How are shaping machines specified? (June, 2012, 2013)

The shaping machine is specified by the size and shape of the machine and the size of the job to be machined. The shaper is specified as follows.

- i). Maximum length of stroke
- ii) Type of Driving mechanism
- iii). Size of Table.
- iv). Power of motor
- v). Speed and Feed available.

4. List the different types of parts involved in the shaper

The shaping machine has minimum number of parts but all the parts are very strong and rigid condition because of the rigid work pieces are machined by this shaping machine. The following are the parts of shaping machine.

- a. Base, b. Column, c. Cross rail, d. Saddle, e. Table, f. Ram, h. Tool head.

5. What are the different operations performed by using shaper?

The shaping machine has mostly used for surface machining using single point cutting tool. The following operations are performed in shaping machines.

- 1. Horizontal surface
- 2. Vertical surface
- 3. Angular surface
- 4. Cutting slot and key ways
- 5. Irregular surface.

6. What is the need of quick return mechanism in shaper?

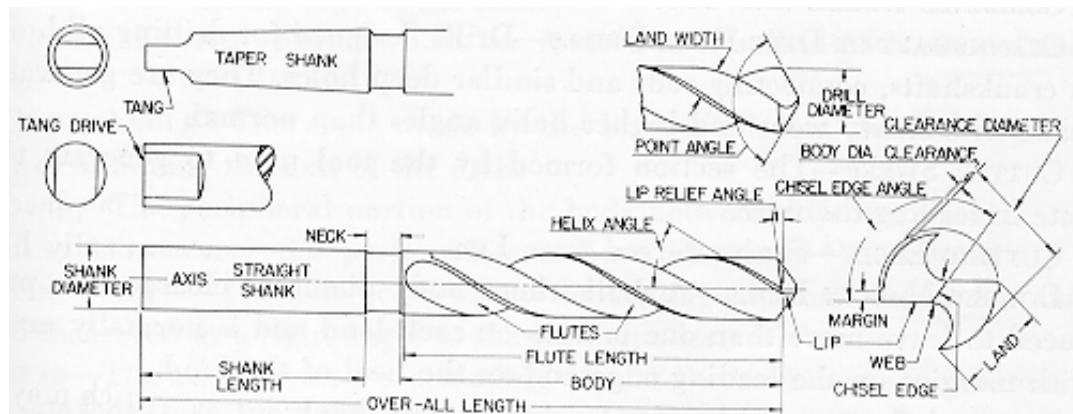
In shaping machine, the metal is cut during the forward stroke and in the return stroke no metal is removed. It is known as idle stroke. To reduce the total machining time the idle stroke time should be reduced. So the return stroke is made faster than the cutting stroke. This is done by a mechanism called quick return mechanism.

7. **What are the advantages of hydraulic shaper mechanism?**

The following are the advantages of hydraulic system used in shaper mechanism.

- a. The cutting and return speed are partially constant throughout the stroke.
- b. Infinite number of cutting may be obtained from zero to maximum value and control easier.
- c. No jerk, vibrations are occurred.

8. **Draw the nomenclature of standard drill (Dec,2013)**



9. **Give the functions of flute on taps.(June,2014)**

The flute is the helical groove. It is used to remove the chip through the helical groove and the cutting fluid will enter through the flute surface. Also, Flutes are used

- i) To reduce the cutting forces.
- ii) To avoid friction between work piece and tap interface.

10. **Mention any four drilling machine specifications**

The drilling machines used for to make holes in a work piece. The following are the specifications of the drilling machines.

1. Maximum size of the drill in mm that the machine can operate
2. Table size of maximum dimensions of a job can mount on a table
3. Maximum spindle travel in mm
4. Number of spindle speed & range of spindle speeds in rpm.

11. **List any four machining operations that can be performed on a drilling machine?**

The drilling machine has used for the following operations to produce the workpiece. But this operations are most important in each and every part of the product. The following are the operations performed in drilling machines.

1. Drilling
2. Reaming
3. Boring
4. Counter boring
5. Counter sinking
6. Tapping
7. Trepanning
8. Spot facing.

12. Write the differences between drilling and boring?

The size of the bore is only difference between the drilling and boring operations. In drilling drill bits are used for make holes but in boring the boring tools are used for making bores.

Drilling: A process of initiating a hole or enlarging a hole with a tool called Drill.

Boring: The process of enlarging a hole that has already drilled using a boring tool is called as boring.

13. What is meant by counter boring?

Counter boring is a operation of enlarging the end of the hole through a certain distance to form a seat for the bolts and nuts have been seated. This operation is made by the using end mill cutters or boring tools as which one is suitable for that work piece.

14. What is reaming?

It is the secondary operation after the drilling operation has been performed to produce the accurate hole or finish the hole. After drilling operation the hole surface is not in correct size because of the spindle vibration so the reaming tool make the correct size and good surface finish.

15. List the types of drilling machines.

The drilling machines are classified their size and degree of freedom used in the machines.

The following are the classification of drilling machines.

1. Portable drilling machine
2. Upright drilling machine
3. Radial drilling machine
4. Gang drilling machine
6. Multiple spindle drilling machine
7. Automatic drilling machine
8. Deep hole drilling machine

16. What is gang drilling machine?

More number of single spindle with essential speed and feed are mounted side by side on one base and have common work table, is known as the gang- drilling machine. The same time more number of work pieces performed in the same table of the machine in different size of holes.

17. What is a deep hole drilling? State its applications (Dec,2011)

It is a drilling process of producing very deep holes of L/D ratio 6 to even 30. The depth of the holes so long so it is called deep hole drilling process. It is used to produce deep holes in rifle barrels, cranks shafts, long spindles, oil holes in shafts, bearings, connecting rods etc.

18. What is climb milling? Mention its advantages (Dec,2011)

In climb milling, the work moves parallel to the cutter rotation. Its advantages are

1. Cutter with higher rake angle can be used. This reduces power requirements.
2. Cutter wear is less because chip thickness is maximum at the start of cut.

19. What is the difference between up milling and down milling?(May,2011, Dec,2013,2014)

Up milling	Down milling
1.Work is feed against the rotating cutter	1.Work moves parallel to the cutter rotation
2.Thickness of the chip is minimum in the initial stages and increases maximum at the end of the cut	2.Thickness of the chip is maximum in the initial stages and minimum at the end of the cut
3.Cutter lifts the work, so requires more clamping force	3.Cutter holds the work, so requires less clamping force
4.Surface finish is not good	4.Good surface finish

20. How the milling machines classified?

- i) Column and knee type
 - a) Plain milling machine, b) Vertical milling machine, c) Universal milling machine
- ii) Plano miller
 - a) Manufacturing , b) Fixed bed type
- iii) Special types
 - a) Rotary Table milling machine, b) Drum type milling machine,
c) planetary milling machine d) Pantograph milling machine.

21. What is the difference between a plain and an universal milling machine?(Dec,2012)

1. In plain milling machine the table is provided with three movements, longitudinal, cross and vertical. In universal milling machine in addition to these three movements, there is a fourth movement to the table. The table can be swiveled horizontally and can be fed at angles to the milling machine spindle.

2. The universal milling machine is provided with auxiliaries such as dividing head, vertical milling attachment, rotary table etc. Hence it is possible to make spiral, bevel gears, twist drills, reamers etc on universal milling machine.

21. What are the specifications of the milling machine?

The milling machines specifications are based on the size of the machine and the capacity of the work piece has performed by this machine. The following are the specifications of the milling machine.

- 1.The table length & width 2.Number of spindle speeds &feeds.
3.Power of driving motor 4. Job working length and width.

23. List out the various milling operations?

The milling machine is commonly used for flat surface work piece operations . The following are the mostly used operations in milling machines.

- 1.Plain or slab milling 2.Face milling. 3.Angular milling. 4.Gang milling. 5.End milling.
6.T- slot milling 7.Gear cutting.

24. What are the cutter holding devices of a milling machine?

The milling cutters are to fixed in the spindle for milling operations when the spindle rotates the cutters also rotates. The cutters diameter not matched with spindle diameter so it needs holding devices in milling machines. The following are the cutter holding devices

1. Arbors
2. Adaptors
3. Collets

25. How do you classify milling cutters? (May,2010)

Milling cutters are classified by their performance of operations and volume of work piece.

- i). Plain milling cutters,
- ii) Side milling cutters
- iii) End milling cutters
- iv) Face milling cutters
- v) T-slot milling cutters,
- vi) Angle milling cutters
- vii). Form milling cutters
- viii) Slitting milling cutters.

26. What is meant by plain or slab milling?

Plain or slab milling is the operation of producing flat horizontal surface parallel to the axis of the cutter using a plain or slab milling cutter. The flat surfaces are produced by this operations. Mostly the facing operations are performed by the plain milling cutters and slab milling cutters.

27. What is meant by the term indexing?

Indexing is the process of dividing the periphery of a job in to equal number of divisions. The indexing is used in both areas of the milling machine. One is tool indexing it is to move the next tool for operations . another one is work piece indexing it is used to next operation area of the work piece.

28. What are the three types dividing heads?

The indexing mechanism is used in dividing heads. This dividing heads are attached with the milling machine table and to perform the indexing operations. These are classified as follows.

1. Plain or simple dividing head.
2. Universal dividing head
3. Optical dividing head.

29. What are the other forming methods for manufacturing gears?

The gears are manufactured by the forming process. The following are the gear forming process used in various machines.

1. Gear cutting by single point form tool.
2. Gear cutting by shear speed shaping process.
3. Gear broaching.
4. Template method.
5. Gear milling using a formed end mill.

30. What are the various types of gear generating process? (Dec,2014)

The gear generating is the one of the gear manufacturing process the specialized machines used for this gear production. These machines used only for gear production. The following are these gear generating process:

1. Gear shaping process.
2. Gear planning process.
3. Gear hobbing process.

31. Mention two advantages of gear hobbing (Dec, 2011)

The following are the advantages of using gear hobbing machines to produce the gear manufacturing process.

1. Only one cutter is used for all number of gears of same module.
2. Accurate and quick process.
3. Suitable for batch production.
4. No requirement of independent tooth indexing.

32. What are the limitations of gear hobbing?

The gear hobbing machine is used to produce external gear manufacturing and the work piece must be in the form of flat surfaces. The following are the limitations of the gear hobbing machines.

1. Internal gears cannot be generated.
2. Hobbing process cannot be applied very near to shoulders

33. Distinguish between Gear forming and generating process.

Gear forming	Gear generating
1. The tool used is a form cutter with standard involutes.	1. One cutter is used for all number of gears
2. Gear blank is rotated every tooth is over-indexed	2. Gear blank is not indexed.
3. Each module this process requires a set of standard cutter.	3. One cutter is enough for more number of modules
4. Time consuming and inaccurate method	4. Accurate and quick process.

34. What is the main disadvantage of gear shaping?

The main disadvantage of gear shaping is that Worm and worm wheels cannot be generated on a gear shaper. The cost of the gear shaping machine is too high compared to other gear manufacturing machines. The skilled labours also needed to operate the gear shaping machines.

35. List the various gear finishing processes?

The gear finishing is the most important process in gear manufacturing. The unwanted material in between two gear teeth and surfaces are removed by this gear finishing process. The following are the gear finishing process:

1. Gear shaving.
2. Gear burnishing.
2. Gear grinding.
4. Gear lapping.

PART B

1. Sketch the drive mechanism of a shaping machine having crank and slotted type of quick return. Explain briefly how the ram is made to reciprocate and how the stroke length is altered.
2. Sketch and explain the hydraulic drive of horizontal shaper.
3. Write the applications of shapers.
4. Explain different types of drilling machines with their specific features.
5. Sketch the Quill mechanism. Write its main parts and their functions.
6. What is radial drilling machine?.Sketch and describe it
7. Sketch the following operations performed in the drilling machine
 - a)Drilling, b) Reaming c) Boring d) Counter boring e) Counter sinking f) Spot facing g) Tapping
8. Sketch a twist drill and indicate on it the point angle, chisel edge angle and other parameters
9. Sketch and explain the following operations performed on a milling machine
 - a) Dove tail b).Slots and splines c) Plain milling d) Face milling e) End milling
10. Describe the construction of a) Plain milling cutters b) End milling cutters
11. Describe the column and knee type milling machine with a neat sketch. (June
12. Explain the indexing mechanism of a dividing head on a milling machine
13. Explain the principle of gear hobbing with neat sketch
14. Explain the gear shaping process with neat sketches
15. Why is gear finishing required?.Discuss the various types of gear finishing operations

UNIT IV – ABRASIVE PROCESS AND BROACHING

1. What is meant by Grinding? Why is grinding called finishing process?

Grinding is a metal removal process or operation performed by means of rotating abrasive wheel that acts as a cutting tool against the work piece. Grinding is called finishing process, because the grinding process removes metal usually in the order of 0.25 to 0.50 mm. which produces very high quality surface finish.

2. State purpose of grinding process.

To remove small amount of metal from work piece and finish then to close tolerance. To obtain a better surface finish. To machine hard surfaces which cannot be machined by high speed steels.

3. Name two artificial abrasive materials.

Artificial abrasive materials are

- i) Silicon carbide
- ii) Aluminium oxide
- iii) Cubic Boron Nitride (CBN)
- iv) Boron Carbide

4. What is meant by “grade” and “structure” of a grinding wheel?

“Grade” or hardness indicates the strength with which the bonding material holds the abrasive grain together in the grinding wheel. A to I are soft, J to P are medium, Q to Z are hard.

“Structure” of a grinding wheel refers to the relationship between the volume of abrasive material and volume of bond. 1 to 6 are Dense and 7 to 15 are open

5. How is grinding wheel designated?

Grinding wheel is designated with 1) Abrasive, 2) Grain size 3) Grade 4) Structure 5) Bond 6) Manufacturer’s mark (Optional).

Example: **A-50 Q 8 V-30** represents A-Alumina, 50- grit size, Q- medium hardness 8-medium structure, V- vitrified bond and 30- manufacturer’s identification number

6. List out the types of grinding operations.

Various types of grinding operations are

- 1. Surface grinding
- 2. Cylindrical grinding - a) External b) Internal
- 3. Centerless grinding

7. Enumerate few principal bonds of grinding wheels.

- 1) Vitrified Bond (V)
- 2) Silicate bond(S)
- 3) Resinoid bond (B)
- 4) Shellac Bond (E)
- 5) Rubber Bond (R)

8. What are the specifications of grinding machines? (AU May14/Dec 10)

A grinding machine is specified according to

- i) Table width
- ii) Maximum Length of table traverse
- iii) Grinding wheel diameter
- iv) Height of grinding head
- v) Power required.

9. State the difference between ‘Truing’ and ‘Dressing’ of a grinding wheel.(Dec,2013)

“**Truing**” is a process of trimming the cutting surface of the grinding wheel to run true with the axis. The process of loading and breaking away the glazed surface so that new sharp abrasive particles are again present to work for efficient cutting is called ‘**Dressing**’

10. What are the types of surface grinders? (Dec,2011)

The different types of surface grinders are:

1. Reciprocating table surface grinders - a. Horizontal type b. Vertical type.
2. Rotating table. - a. Horizontal spindle b. Vertical spindle.

11. What is a tool post grinder? (June,2014)

Tool post grinder is a grinding machine in which the cutting tools are re sharpened. It has a rotary table and universal grinding head. The tool is stationary and the grinding wheel rotates and resharpens the cutting edge.

12. How the centre less grinder operates?

The centre less grinder operates with two wheels as the cutting wheel, to remove the excess stock and a regulating wheel which is used to control the speed of rotation of the work and the rate of feed rate.

13. What are the operations done in centre less grinders?

The various operations are:

- a) Through feed grinding
- b) In feed grinding
- c) End feed grinding

14. What are the main disadvantages in centre less grinding?

The main disadvantages are:

- a) The hollow work cannot be ground
- b) The work having multiple diameters is not easily handled.
- c) Work with flat and keyways cannot be ground.

15. What are the advantages of centre less grinding?

The advantages of centre less grinding are:

- a) The work piece is supported through the operations.
- b) No tendency for chatter or deflection of work
- c) Easy control of the size of the work
- d) No need of chucking or mounting

16. Define surface integrity

Surface integrity describes not only the topological (geometric) features of surfaces and their Physical and chemical properties, but also their mechanical and metallurgical properties and Characteristics. Surface integrity is an important consideration in manufacturing operations, because it influences such properties as fatigue strength, resistance to corrosion, and service lives

17. What are the defects responsible for inadequate surface integrity?

Several surface defects are responsible for inadequate surface integrity. They are

- a) Micro cracks
- b) Craters
- c) Heat affected zone
- d) Inclusions
- e) Laps, Folds, seams
- f) Splatter
- g) Surface plastic deformation.

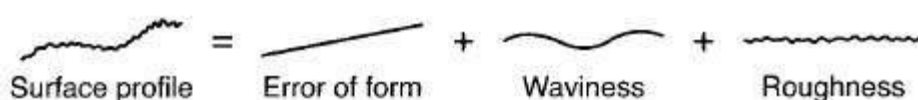
18. What is the need of honing?(Dec,2014)

Honing is also a surface finishing process like grinding, which uses a “hone” tool that consists of stones to abrade the metals.

19. Differentiate Surface roughness with Waviness

Roughness is defined as closely spaced, irregular deviations on a small scale; it is expressed in terms of its height, width, and distance along the surface.

Waviness is a recurrent deviation from a flat surface; it is measured and described in terms of the space between adjacent crests of the waves.



20. What is the need of honing and buffing process?

Honing is also a surface finishing process like grinding, which uses a “hone” tool that consists of stones to abrade the metals.

Buffing is used give much high lustrous, reflective finish that cannot be obtained by polishing. The buffing process consists of applying a very fine abrasive with rotating wheel

21. What is Lapping?

Lapping is a high degree of surface finishing process used for producing geometrically accurate flat, cylindrical and spherical surfaces. In the lapping process, a layer of fine abrasive particles usually suspended in a liquid, is held in between the work piece and the lap.

22. What is meant by polishing?

Polishing is the surface finishing operation performed by a polishing wheel, for the purpose of removing appreciable metal to take out scratches, hole marks, Pits and other defects from rough surfaces.

23. Define broaching and specifications of a broaching machine. (May,2010 & Dec,2012)

Broaching is a processes of machining a surface with a special multipoint cutting tool called 'broach' which has successively higher cutting edges in a fixed path. Specifications are

1. Maximum length of stroke in mm
2. Maximum force developed by the slide in tones

24. What are the advantages and limitations of broaching? (June.2012)

Advantages:

1. Roughing, semi finishing & finishing cuts are completed in one pass of the broach
2. Broaching can be used for either external or internal surface finish

Limitation:

1. High initial cost of the broach tool compare to other tools
2. Job work or batch work is not advisable due to the high tool cost.

25. How broaches are classified?

According to the type of surface broached

- a) Internal broaches b) External broaches

According to the method of operation

- a) Push broaches b) Pull broaches

According to the operations performed on the work

- a) Surface broaches b) Keyway broaches
c) Round hole broaches d) Spline broaches

26. List any four broaching operations or application of broaching machine (May 2011)

- i) Surface broaching
- ii) Keyway broaching
- iii) Round hole broaching
- iv) Spline broaching
- v) Gear broaching.

27. What is meant by push broach?

A push broach is pushed through the work during cutting. During broaching the broach comes under compressive load. To avoid bending, the push broach is made short. Because of this, only less amount of material is removed by the broach.

28. What is meant by pull broach?

A pull broach cuts the material while it is pulled through the work piece. During pulling the broach comes under tensile load. So it is not bend during machining. So the broach can be made longer. So more amount of material can be easily removed by the broach.

29. What do you mean by continuous broaching?

Continuous broaching is used for fast production of large number of pieces by surface broaching. The work pieces are continuously fed onto the broach by means of a conveyor or a rotary table.

30. List some of the materials of broaching tools. (June, 2014)

Most broach tools are made up of

- i) 18-4-1 High speed steel (HSS)
- ii) Cemented Carbides

31. Give a summary of the abrasive of their application for different operation?

<i>ABRASSIVE</i>	<i>APPLICATION</i>
Aluminium	Cleaning, Cutting and Deburig
Silicon Carbide.	Faster cleaning, Cutting.
Glass Heads	Matt polishing, cleaning
rushed glass	Peening and cleaning.

PART B

1. Give the specification of a grinding wheel and discuss the various bonding materials used for making grinding wheels
2. Sketch and explain the three methods of external cylindrical centreless grinding
3. Explain the factors to be considered to select a grinding wheel and recommended Parameters
4. Sketch a block diagram of a plain cylindrical grinding machine and briefly explain its working. Distinguish between “Traverse grinding” and “plunge grinding” done in this machine.
5. Sketch the setup of a grinding wheel and work piece for the following
 - 1).Chucking type internal grinding
 - 2).Centreless internal grinding
6. Write briefly about Tool and Cutter grinder
7. How the grinding wheels are designated? And explain with a suitable example.
8. With neat sketch, discuss the working of a surface broaching machine
9. Explain various operations performed by a broaching machine
10. Write briefly about broaching machines and its operations with neat sketches

UNIT V – CNC MACHINING

1. What is meant by numerical control? State their advantages. (Dec,2013)

Numerical control machine can be defined as a form of programmable machine in which the process are controlled by a program of numbers, letters, and symbols.

Their advantages are 1) Rapid production 2) Repeatability 3) No need of setting time

2. What is NC part programming?

NC part programming is the step by procedure of by which the sequence of processing steps to be performed on the NC machine is controlled by a program of numbers, letters, and symbols.

3. What is APT language? Mention any 4 post processor statement in APT.

APT [automated programming language] is a computer program, it automatically calculates the tool path, generates program and controls the machine by receiving general high level languages.

COOLNT, END, FEDRAT/ MACHIN/ RAPID

4. What is CNC & part program?

CNC is system consists of a computer, controller and a NC machine tool. Computer is used to store and edit the program. Controller controls the tool path based on the program. Part program is a high level language containing the instructions for machining a part to various standard words, codes and symbols.

5. Compare a closed loop NC system with open loop NC system. (May,2011)

In open loop NC system, the loop is open, there is no feedback and action of controller has no reference to the result it produces. In closed loop NC system, the actual position and velocity of axis is measured and compare with the desired reference by a feed back. The difference between actual and desired values is the “error”

6. What is an interpolation? And list out the types of interpolation.

The method by which contouring systems move from one programmed point to another is called Interpolation. There are four types i) Linear Interpolation ii).Circular interpolation, iii).Parabolic interpolation iv) Helical interpolation.

7. What is post processing?

Post processing is a computer program that takes a generalized part program output and adopts it to a particular machine control unit and machine tool combination. It is the basic intelligence required to change the program into computer language

8. What is preparatory function? How is it important in CNC Programming? (May,2011) It is word address format represented by the letter G, Followed by a numerical code for the operation of the control unit to instruct the machine tool.

Function Meaning

G00 Point to point, Rapid positioning

G01 Linear interpolation

G02 Circular interpolation Clockwise

G03 Circular interpolation Anti-Clockwise

G04 Dwell

9. What is a canned cycle? (May 2010,June2014)

A canned cycle is a combination of machine moves that performs any one particular machining function such as drilling, milling, boring, tapping, dwell etc.

10.Name the various elements of CNC machines.

1. Tape reader
2. Mini computer
3. Servo and interface logic
4. Motion feedback

11.Distinguish between point to point and continuous path system(Dec,2011)

Point to point (PTP) is a NC system, which controls only the position of the components. In this system, the path of the component motion relative to the work piece is not controlled.

The continuous or Contouring NC systems are capable of controlling not only the positions but also the component motion, i.e., the travelling velocity and the programmed path between the desired positions

12.What do you mean by machining center with respect to NC machines? (Dec,2011)

A machining center is a NC machine tool which is capable of carrying out a range of machining operations normally performed by a different types of conventional machine tools. On this machining center, operations such as milling, drilling, boring, tapping and reaming are performed automatically in accordance with instructions expressed by a NC system

13. Define subroutines. (June,2012,2013,Dec,2014)

Program sections required more than one can be defined as subroutines and stored in the control. They can be called several times in part programs. Geometric values, feed rates, spindle speeds are defined in subroutines as parameters.

The user sub-routine is a NC program, which describes a sequence of operations, which is often repeated when machining particular part. The sub-routine is called from the main NC program with a M 98 command. A typical application for subroutines is the machining of similar parts with different dimensions.

14. What is Linear interpolation (Dec,2012)

In linear interpolation, the programmed points are connected by straight lines. It is used for straight line moves, whether the length between the points are short or long.

15. What is meant by tool magazines in a CNC machine? (June,2012)

The concept of the ATC is that the range of tools for a specified job shall be made available for automatic selection and positioning. ATC can be:

- i. Drum type – for holding small number of tools store in periphery of drum
- ii. Chain type – for more number of tools (30 – 40 or more tools can be used)

16. Mention advantages of stepper motor(June,2013)

The advantages of stepper motors are 1).No need of a feedback system 2).High accuracy positioning 3).No need of digital to analog conversion equipment.4) They can easily accelerate a load

17. State the differences between CNC andDNC(Dec,2013)

CNC refers to a system that has a local computer to store all required numerical data. The advantages of CNC systems include the possibility to store and execute a number of large programs, to allow editing of programs, to execute cycles of machining commands, etc. Distributed numerical control (DNC) is similar to CNC, except a remote computer is used to control a number of machines. The Data and commands are sent from the central computer to the individual machines and other hard ware components, and on execution and performances are transmitted from the components back to the central computer.

18. List the main elements of NC machine tool (June,2014)

The main elements of NC machine tool are: 1) The control unit 2).The drive units 3).The position feedback units 4).Magnetic box 5).Manual control

19. State any four advantages of N.C.machines. (Dec,2014)

The advantages of NC machines are 1).High accuracy 2).Less scrap 3) Excellent reliability 4).Less cycle time 5) Less operator skill required 6).Reduced inspection 7) High production rate.

20. What is manual part programming?

Manual part programming is a process of writing programs which consists of a set of instructions [contains codes, symbols and numbers] to carry out the machining of the work.

21. Explain Slide and Sideways

In general machine tools are provided with tables, slides, carriages etc., to carry the work pieces or cutting tools etc., these parts are sliding in nature and mounted on the ways that are fixed on the other parts (column, housing, bed or knee) of the machines known as sliding ways.

22. Why are the balls re-circulating screws used in CNC machines?

Ball screws are primarily employed in feed mechanism in machine tools. The advantages are as follows:

- i. In the ball screw the lead between the threads of the screw and the nut is not transmitted by direct contact, but through spherical balls. Balls rotate between the helical grooves of the screw and nut in a manner that function in a ball bearing. An essential feature is the provision of recirculation of balls.
- ii. Low coefficient of friction in the order of 0.004
- iii. Higher transmission efficiency allows larger thrust loads to be carried with less torque
- iv. By preloading the assembly, clearances and consequent backlash can be eliminated. The accuracy of ball screw is high.

23. Describe G functions or Preparatory functions:

These are the commands which prepare the machine for the different modes of movement like positioning, contouring, thread cutting etc., the preparatory functions always precede the dimension word.

G00 – point to point positioning

G01 – linear interpolation

24. Describe M functions or miscellaneous functions:

M – Codes are miscellaneous function codes which denote the auxiliary or switching information coolant ON/OFF, spindle speed etc.

M00 – programme stop

M01 – optional stop

25. Describe the general form of a program line and explain each term

The tool path of the CNC machine is described in machine tools. The general form is as follows: (some of the terms are optional)

N... G... X... Y... Z... A... B... C... F... S... T... M... Where,

N - Sequence number of the instruction

G - Preparatory function referring to a particular machine variety

X, Y, Z - Coordinates

A, B, C - Angular data

S- Spindle speed

T- Tool code to select the tool

M - Miscellaneous function or non-machining operations

N 001 G 01 X 120, 5 Z-43 F 100.0 M08

26. What is meant by Machine datum? or Machine zero point

It is the origin of the co-ordinate system with the lathe. It is on the mounting flange of the main spindle and the turning axis. It cannot be changed by the user of the machine. It is fixed by the manufacturer and programmed into the computer. The point generally has the coordinates $X=0$, $Z=0$

27. Explain the machine reference point and tool reference point.

Machine reference point:

The position of the reference point R is determined by the manufacturer. The value of the machine reference coordinates X and Z are fixed and cannot be changed by the user.

Tool reference point (T):

Point T is exactly the point of rotation of the tool post

28. Why is the tool nose compensation important?

The carbide insert used in turning operation has a certain corner radius and the carbide tip tool will break or melt when working. These radii are standardized according to ISO.

29. What are the different types of dimensioning systems used?

Absolute dimensioning or Baseline dimensioning system

All measurements are taken from a fixed origin. In these all the dimensions should be positive

Incremental dimensioning or Delta dimensioning system

All the measurements for the next position are calculated from the point at where the slide was resting previously. Both positive and negative dimensions may come

30. Write down the types of statements in APT language.(AU Dec15)

1. Geometric statements
2. Motion statements
3. Postprocessor statements
4. Special control or Auxiliary statements

31. What is micro machining and mention its types.

Micromachining is the removing (as in drilling, planning, or shaping) of small amounts of material (such as metal) by action other than that of a sharp-edged tool. Micromachining is done with an electron beam.

Two types are i) Bulk micromachining 2) Surface micromachining.

32. Distinguish surface micro machining and bulk micro machining

Surface micromachining defines a succession of thin film deposition by CVD process and selective etching, Bulk micromachining defines structures by selectively etching inside a substrate. Whereas surface micromachining creates structures on top of a substrate, bulk micromachining produces structures inside a substrate.

35. Define wafer and wafer machining.

Wafer is a silicon substrate and is etched to produce structures. Wafer machining is a surface micro machining process done by 1) Wafer grinding 2) UV exposure

PART B

1. Explain the working principle of NC machine tool with the help of a diagram. State advantages and limitations of NC machines .
2. Explain the main difference between point to point and continuous path type NC machine tools
3. Write briefly about, open loop, closed loop and adaptive control system in CNC machine tool.
4. List advantages of CNC systems over conventional NC systems
5. Classify Linear interpolation
6. State different types of CNC machines.
7. Write briefly about machining centers .
8. What are the special requirements of feed drives of CNC machines? What types of motors are used for feed drives
9. With neat sketch, explain the working of ATC
10. Explain part programming procedure with suitable example