Ch-01 >>> Nonconvectional M/C Process <<<

→ Two types of Maching process.
① Convectional
② Non convectional

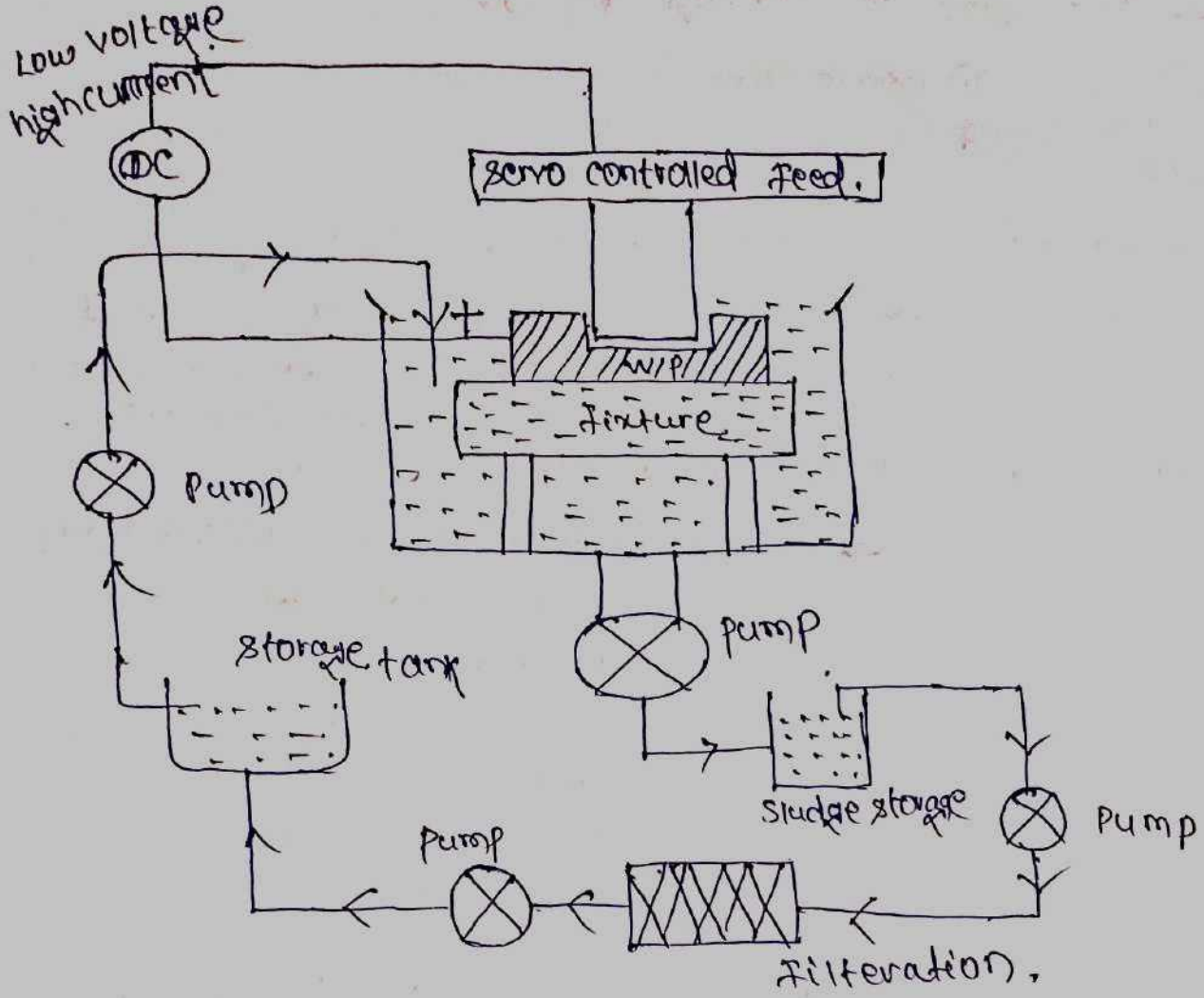
→ convectional → Workpiece touches the tool.
→ Drilling, Maching, Grinding, lathe etc.
→ Low surface finish, larger man power moretime consumption, lowe tool life.

→ Nonconvectional → W/P is not touch the tool
→ forex: electro chemical M/C Process
Electro discharge
Plasma arc
Leaser beam
abrasive Jet
electron beam.
→ Low surface finish.
Lesser power required.
Aparantely using time requires.
Long tool life.

Non convectional :-

→ Those energy source which are renewable & ecological safe that is called non convectional machining process.
→ It is a special type of Machining process in which there is no direct contact bet^n the tool & the workpiece.
→ In non-convectional m/c process It is a form of energy is used to remove unwanted material from a given w/p.

→ Electro chemical Machining Process :-



*) Working Process :-

→ First the workpiece is assembled in the fixture tool & tool is brought close to the workpiece. The tool & w/p is immersed in a suitable electrolyte.

→ After that, potential difference is applied across the workpiece (anode) & tool (cathod). The removal of material is starts. The material is removed as in the same manner as we have discussed above in the working principle.

→ Tool feed system advances to the tool towards

the workpiece & always keeps a required gap in bet^ them. The material from the workpiece is comes out as possible ions & combine with the lines present in the electrolyte & precipitates as as sludge.
→ Hydroxen gas is libarated at cathode during the machining process.
→ Since the dissocitation of the material from the workpiece takes place at atomic level, so it gives excellent surface finish.
→ The sludge from the tank is takenout & separated from the electrolyte. The electrolyte after filtration again trasported to the tank of the ECM process.

→ Application :-

→ The ECM process is used for die sinking operation, profiling & contouring, drilling, grinding, treparning & Micro machining.
→ It is used for machining steam turbine blades within closed limits.

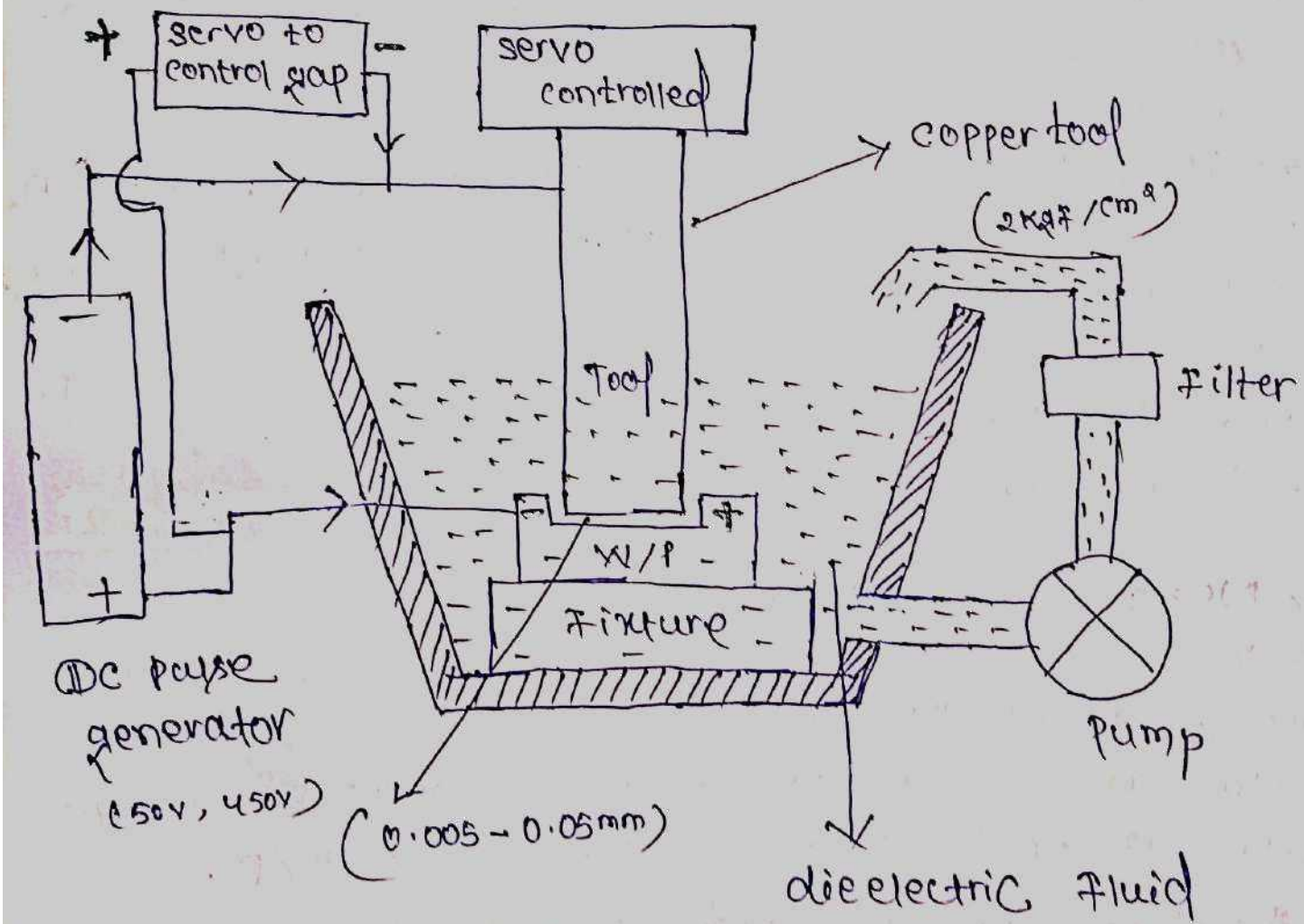
→ Advantages :-

→ Negligible tool wear.
→ Complex & concave curvature parts can be produced easily by the use of conver & concave tools.
→ No forces & residual stress are produced, because there is no direct contact bet^ tool & w/p.
→ Excellent surface finish is produced.
→ Less heat is generated.

Disadvantages :-

→ The risk of corroxion for tool, workpiece & equipment increases in the case of saline & acidic electrolyte.
→ Electrochemical machining is capable of machining electrically conductive materials only.
→ High power consumption.
→ High initial investment cost.

② Electro discharge Machining process : (EDM) :-



1 kgf = 9.8 N
2 kgf = 19.6 N/cm².

→ **Equipment** :- The various equipment used in electro discharge machining are

① Dielectric reservoir, pump & circulating system :-
→ Pump is used to circulate the dielectric medium bet^ the two electrodes. Kerosene or deionized water is used as dielectric medium.

② Power generator & control unit :-
→ Generator is used to apply potential difference. The voltage used in this machining process is not constant but it is applied in pulse form.

③ Working tank with work holding device :-
→ It has working tank with a work holding device. The workpiece is hold in the work holding devices. The tank contains dielectric medium.

④ Tool holder :- It is used to hold the tool.

⑤ servosystem :- A servosystem is used to control the tool. it maintains the necessary gap bet^ the electrodes.

Working of EDM :-

1→ First the tool & w/p is clamped to the m/c. After that with the help of servo mechanism a small gap is maintain in bet^ the tool & workpiece.

2→ The tool & w/p is immersed in dielectric medium.

3→ A potential difference is applied across the electrode. An electric spark is generated in bet^ the tool & w/p. The spark generates a heat about 10000 degree celsius & due to this heat the material from the w/p starts to vaporize & melts.

4→ The spark generates in electrical discharge machining

is not contineous. As the voltage breaks, the dielectric fluid flushes away the molten materials leaving behind a crater.
→ This process keep continue & machined the w/p.

*) Advantages :-

→ Less time required as compared to convectional machining.
→ Metals having high melting point temp. can be easily machined.
→ Excellent surface finish can be obtained.
→ Complex shapes & corners can be machined.
→ Burface machining surface.

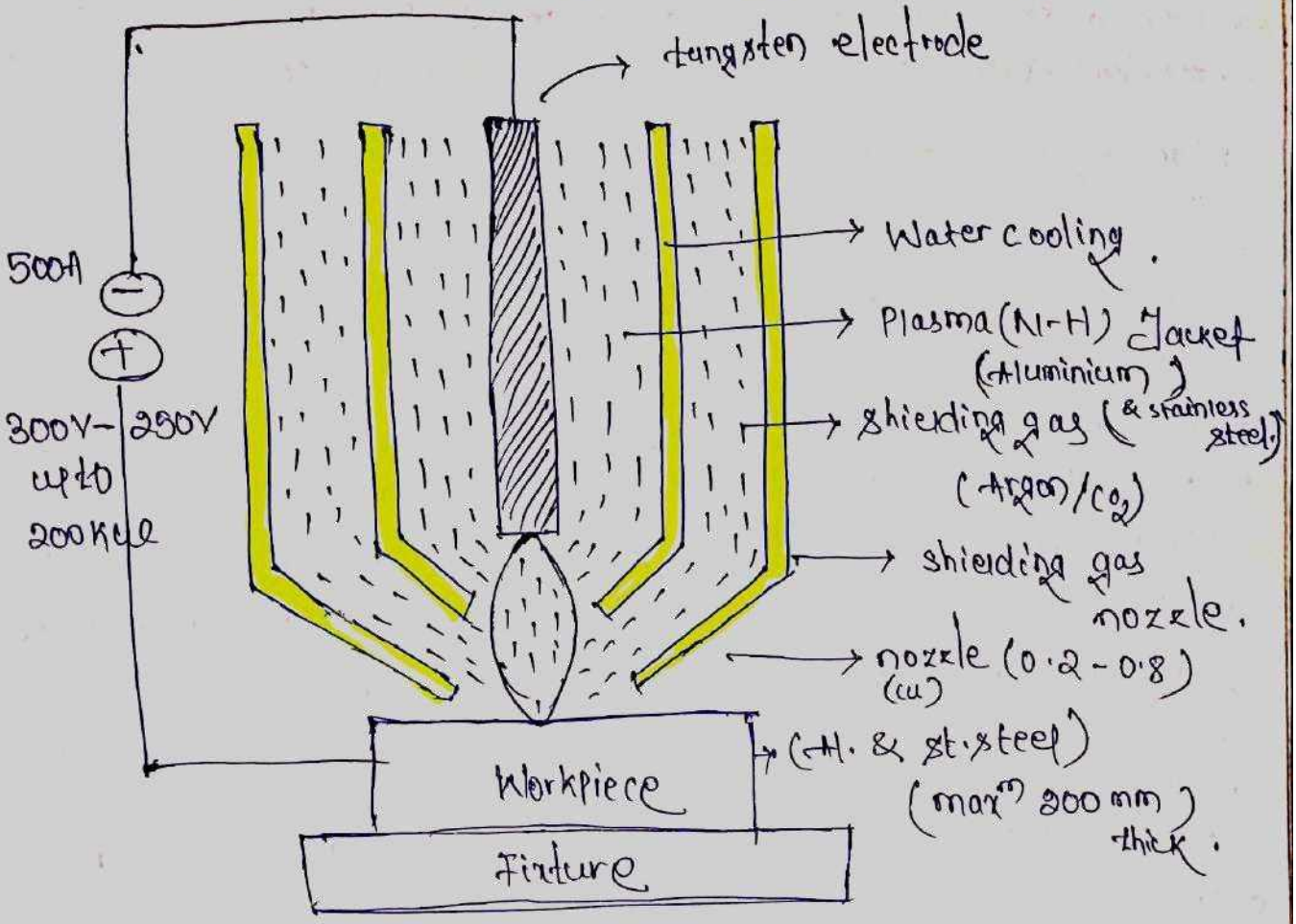
*) Disadvantages :-

→ Only electrical conductive materials can be machined.
→ High voltage required.
→ High initial cost.
→ High maintanance.
→ More time required for machining.
→ Thin materials can't be machine.

*) Applⁿ / uses :-

→ It is mostly used by mold making & dies industries.
→ It is used for coinage die making.
→ It also used in aerospace Industries.
→ It use to creat small holes in variety of application.

* PLASMA ARC Machining Process :- (PAM)



→ Equipments required :-

1. DC electric Supply.
2. Tungsten electrodes.
3. Nozzle.
4. Plasma & Shielding gas.
5. W/P & Fixture.

→ What is plasma :-

→ When a gas or air heated at high temps, the number of collisions bet^n atoms increases.

→ When you heat the gas above 5500°C, it partially ionises into +ve ions, negetive ions & neutral ions.

→ When you further heat the gas above 11000°C then, it completely ionises.
→ Such a completely ionised gas is called plasma.
→ Plasma states lies in bet' temp 11000°C to 28000°C.

Working of PAM :-

→ It consist of a plasma gun.
→ Plasma gun has an electrode made up of tungsten situated in the chamber.
→ Here this tungsten electrode is connected to the -ve terminal of DC power supply thus the tungsten acts as cathod.
→ While the +ve terminal of DC power supply is connected to the nozzle thus the nozzle of the plasma gun acts as anode.
→ As we give the power supply to the system, an electric arc develops bet' the cathodic tungsten electrode & an anodic nozzle.
→ As the gas comes in contact with the plasma, there is a collision bet' the atoms of gas & electrons of an electric arc & as a result, we get an ionised gas, that means we get the plasma state that we wanted for PAM.
→ Now this plasma is targeted towards the workpiece with a high velocity & the machining process starts.
→ In the whole process, high temp cond's are required, as a hot gasses come out of nozzle there are chances of over heating.
→ In order to prevent this overheating, a water jacket is used.

Advantages :-

→ In PAM hard as well as brittle metals can be easily machined.
→ It can be applied to almost all types of Metals.

→ We get a better dimensional accuracy.
→ It is a simple process to carry out & a very efficient process.
→ It takes a big part in automobile repair of jet engine blades.

Disadvantages :-

→ Its initial cost is very high.
→ It is uneconomical for bigger cavities to be machined.
→ Inert gas consumption is high.
→ This process can affect human eyes so a proper goggles or helmet must be coorn by an operator.
→ Take proper precaution for whole process.

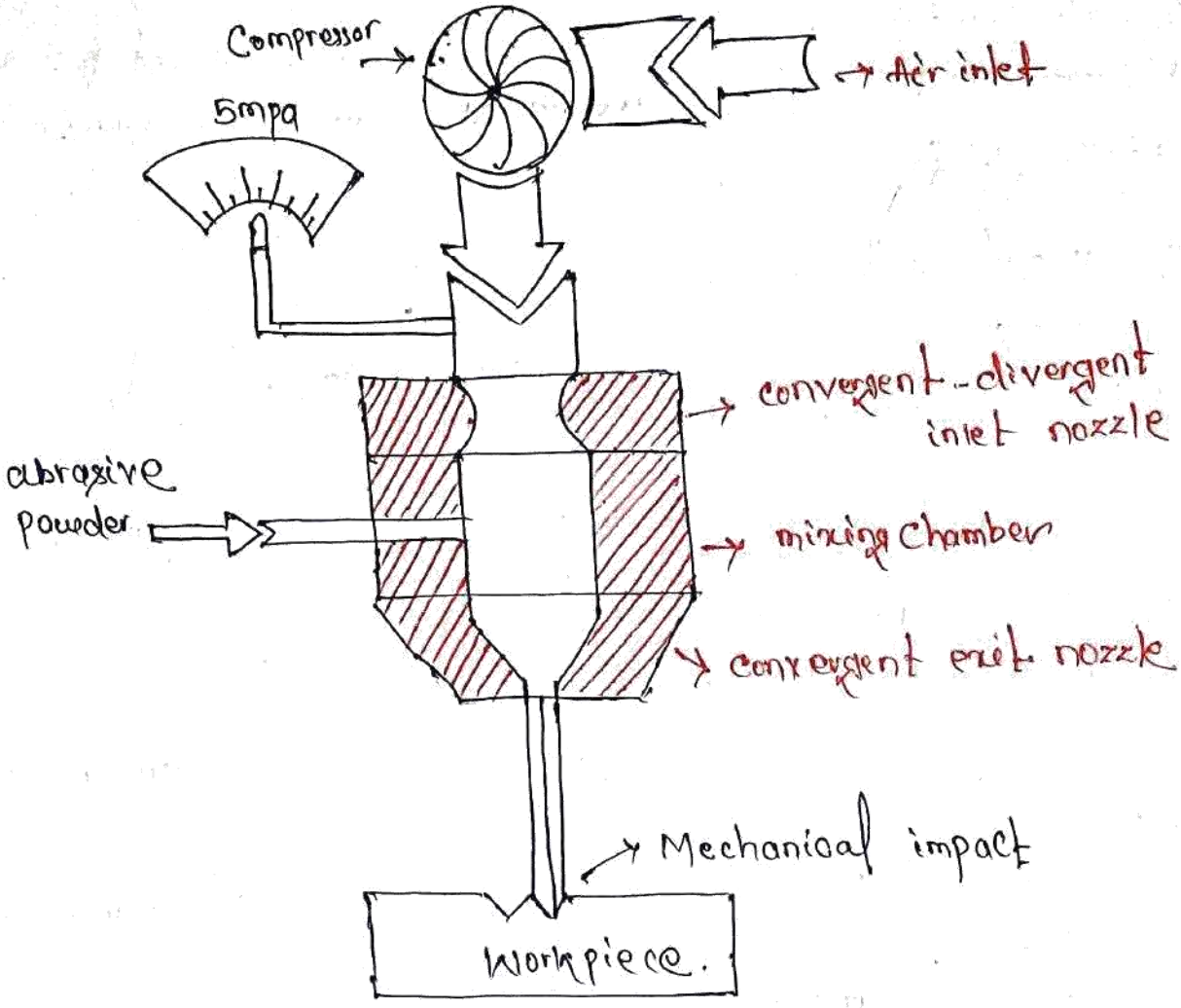
Application :-

→ It is mostly used for cryogenic, high temp corrosion resistance alloys.
→ It is also used in case of titanium plate upto 8 mm thickness.
→ It is used in nuclear submarine pipe system & for welding steel rocket motor case.

*) Abrasive Jet Machining Process :- (AJM)

→ Equipments are used in AJM are as follows.

① Gas propulsion system
② Abrasive feeder.
③ Abrasive
④ Cutting nozzle.
⑤ Machining chamber
⑥ Compressor
⑦ Air inlet.



*) Working principle :-

→ The basic concept of AJM is abrasive erosion or metal cutting by high velocity abrasive particle. Its working process can be easily summarized into following point.

① 1st gas or air compressed into gas compressor. There the density & pressure of gas increases.

② Now this compressed gas send to filtration unit, where dust & othere suspended particle removed from it.

③ This clean gas sends to drier, which absorb moisture from it. It is used to avoid water or oil contamination of abrasive power.

④ Now this clean & dry gas sends to mixing chamber where abrasive feeder feed abrasive particle in it. The

abrasive particle is about 50 micro meter grit size.

(5) The high pressuring abrasive carried gas send to nozzle where its pressure energy converted into kinetic energy. The velocity of abrasive particle leaving the nozzle is about 200m/s.

(6) The standoff distance bet^ workpiece & nozzle is about 2mm.

(7) Now these high velocity abrasive particles impinge on the w/p. These high velocity abrasive particles remove the material by micro cutting action as well as brittle fracture of the work material.

Advantages :-

→ High surface finish.
→ It can machine heat sensitive material.
→ It is free from vibration.
→ Initialization cost is low.
→ Thin section can be machined easily.

Dis advantages :-

→ Low metal remove rate.
→ Abrasive particle can embedded into w/p mostly in soft metals.
→ Nozzle life is limited so it needs frequently replacement.
→ Abrasive particle can't be reuse in this process.
→ It can't use for m/c soft & ductile material.

Application / uses :-

→ It is used in drilling & cutting of hardened metals.
→ It is used for machining brittle & heat sensitive material like glasses, quartz, sapphire, mica, ceramic etc.
→ It is used for manufacturing electronics devices.

*) Leaser Beam Machining process :-

*) Main parts :- The various main parts used in the LBM are

1) A pump medium :- A pump medium is needed that contains a large number of atoms. The atoms of the media are used to produce leasers.

2) Flash lamp :- It is used to provide the necessary energy to the atoms to excite their electrons.

3) Power supply :- A high voltage power source is used to produce light in the flash tube.

4) Capacitor :- It is used to operate the leaser beam machine at pulse mode.

5) Reflecting Miror :- There are two types of miror is used first one is 100% reflecting & other is partially reflecting.

→ 100% reflecting miror is kept at one end & partially reflecting Miror is at another end.

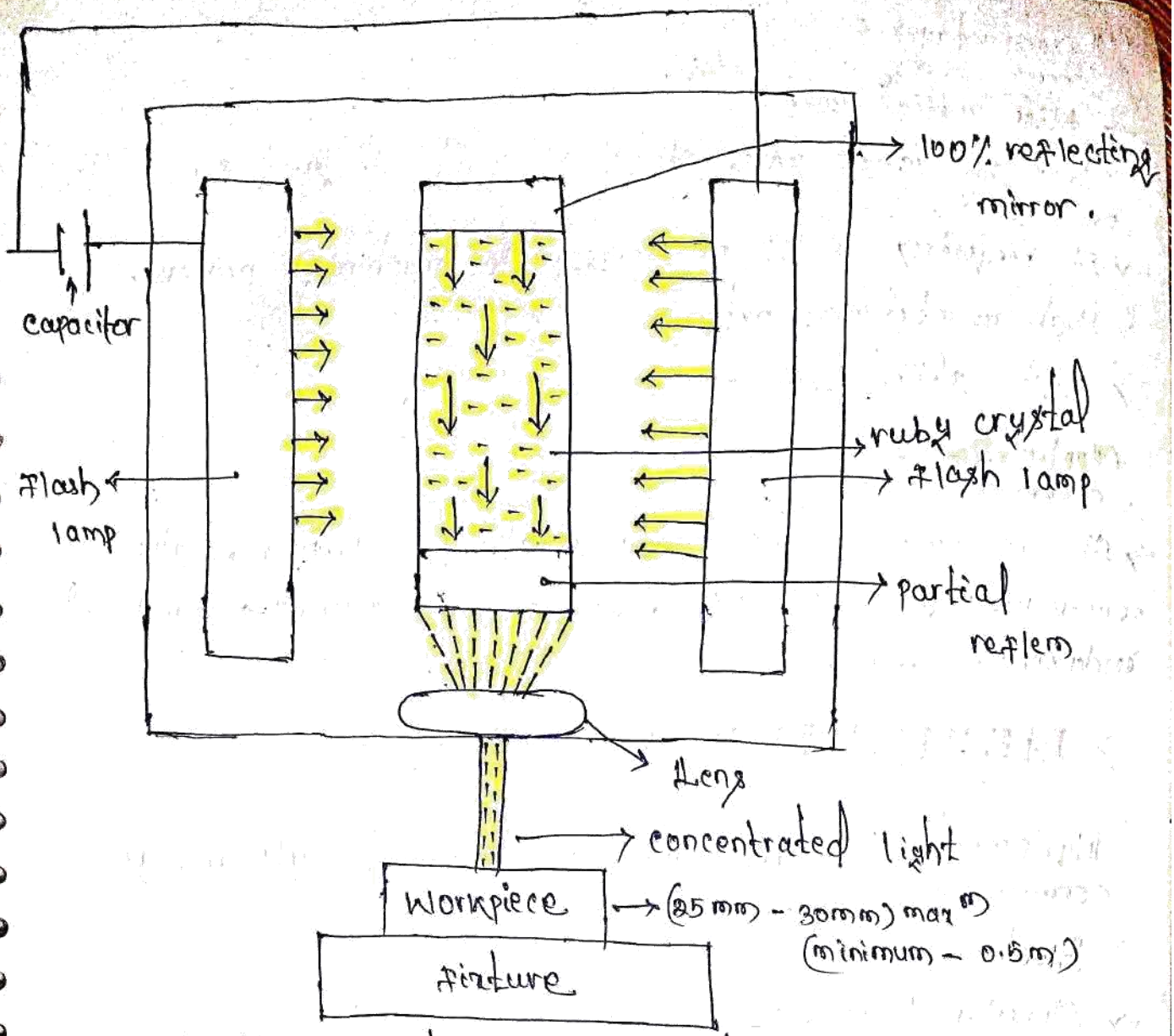
→ The leaser beam comes out wher partially reflecting miror is kept.

→ Working of Leaser Beam Machining :-

→ A very high energy leaser beam is produced by the laser m/c. This leaser beam produced is focused on the workpiece to be machined.

When the leaser beam strikes the surface of the workpiece, the thermal energy of the leaser beam is transferred to the surface of the workpiece. This heats, melts, vaporizes & finally removes the material from the workpiece.

→ In this way leaser be machining works.



Laser (Light amplification by stimulated emission of radiation)

Advantages :-

→ It can be focussed to a very small diameter.

→ low maintenance cost.

→ It produces a very high amount of energy, about 100 mJ per square mm of area.

→ It is capable of producing very accurately placed holes.

→ There is no physical contact bet^n the tool & w/p.

→ Very high precision work.

Disadvantages :-

→ High initial cost.
→ Low production rate since it is not designed for mass production.
→ It requires a lot of energy for machining process.
→ High maintenance cost.
→ High skilled trainer.

Application :-

→ It is used in heavy manufacturing industries, light manufacturing industries, electronic industries, medical industries etc.

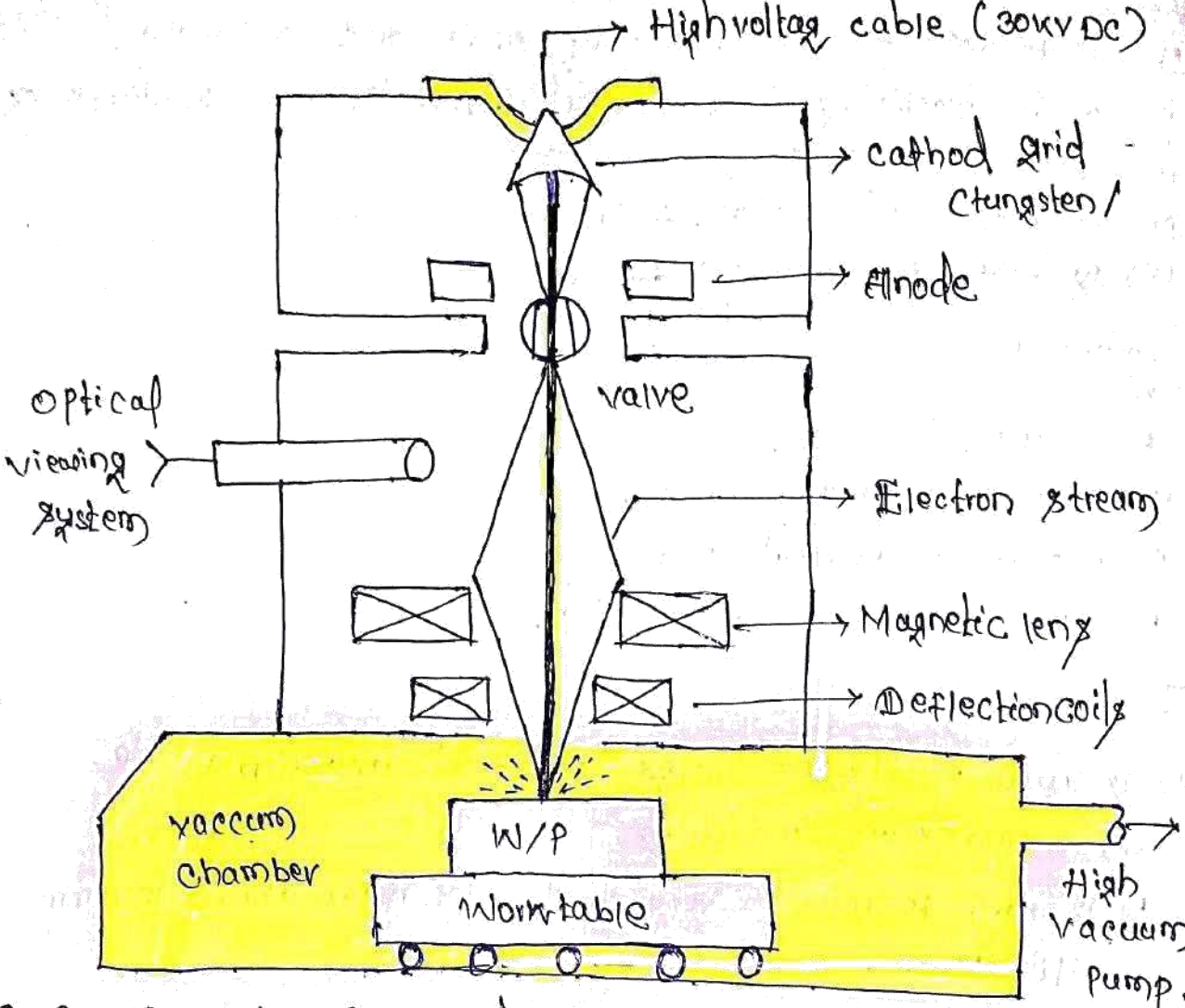
⇒ ELECTRON BEAM Machining process :-

Equipments :- There are some important parts are as follows

→ Electron Gun.
→ Annular Bias Grid.
→ Magnetic Lenses.
→ Electromagnetic lens & deflection coil.
→ W/P & work holding device.

⇒ WORKING :- The EBM works same as leaser beam machining. Its working can be summarize into following points,

① 1st electron gun produces high velocity electron particles. These electron particles move towards anode which is placed after cathod table.
② Now this high intense electron beam passes through magnetic lenses. There are a series of lenses which take



Care of only convergent electron passes through it. It absorb all divergent electron & low energy electron. It provide a high quality electron beam.

③ The electron beam now passes through electromagnetic lens & deflecting coil. It focus the electron beam at a spot.

④ The high intense electron beam impinges on the w/p where kinetic energy of electrons convert into thermal energy.

⑤ The material is removed from contact surface by melting & vaporization due to this high heat generated by conversion kinetic energy of ~~electrons~~ convert into thermal energy. This whole process take place in a vaccum chamber otherwise these electron collide with air particle bet' path & loses its kinetic energy.

Advantages :-

→ It can be used for produce very small size hole in any shape.
→ It can be machining any material irrespective its hardness & other mechanical properties.
→ It provide good surface finish.
→ Highly reacting material can be easily.

Disadvantages :-

→ High capital cost.
→ High skilled operator required.
→ Low material removal rate.
→ Regular maintenance is required.

Application :-

→ It is used to produce holes in diesel injection nozzle.
→ used in aerospace industries
→ It is used to provide very small size holes about 100 mm to 2 milimeter.

>> AUTOMATION <<

CH-02

- **Defination** :- It is a technology which is used to complete some process by minimizing the human effort.

→ It is the combination of automatic + Machine.
→ In this process machinary are used which are operated through programms to do some useful work.
→ For example :- Watch, metrorail, face unlock, voic to talk etc.

- **Industrial Automation** :-

→ Industrial Automation is the use of control system such as computer or robots, TLC, TLSI, scada etc for handling different process & machinary in an industry to replace a human being.

- **Advantages** :- It reduces haman envolvement & effort.

→ Increases production rate.
→ Increase accuracy.
→ less time consumption.
→ avoid human error.
→ Reducess accident.

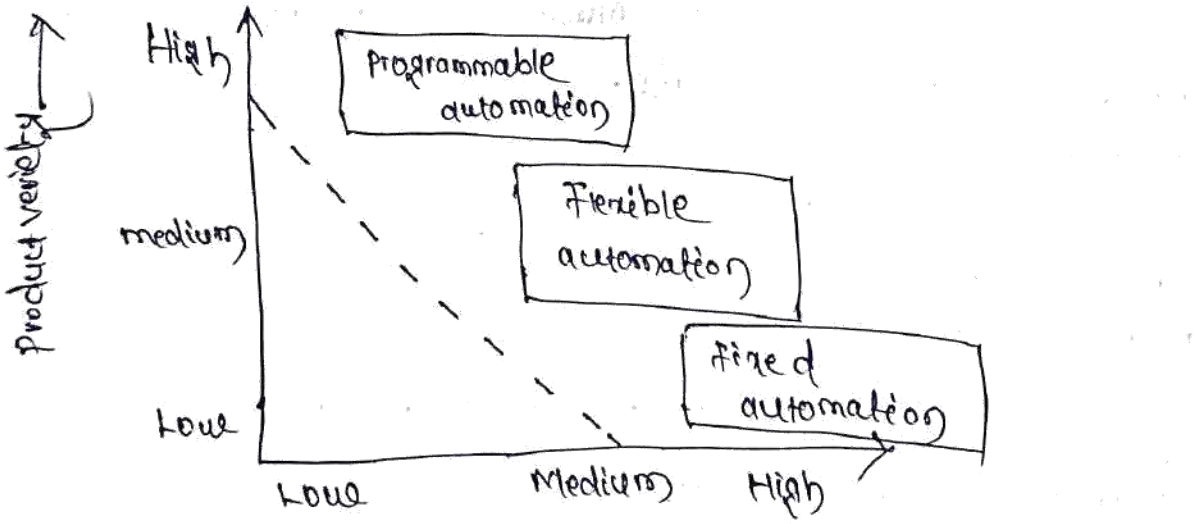
- **Disadvantages** :- High machining setup rate.

→ High maintenance cost.
→ Increases unemployement.
→ Pollution is highly created.
→ High energy consumption
→ High skilled operator.

- **Types of Automation** :-

① Fixed Automation
② Programmable Automation.
③ Flexible automation.

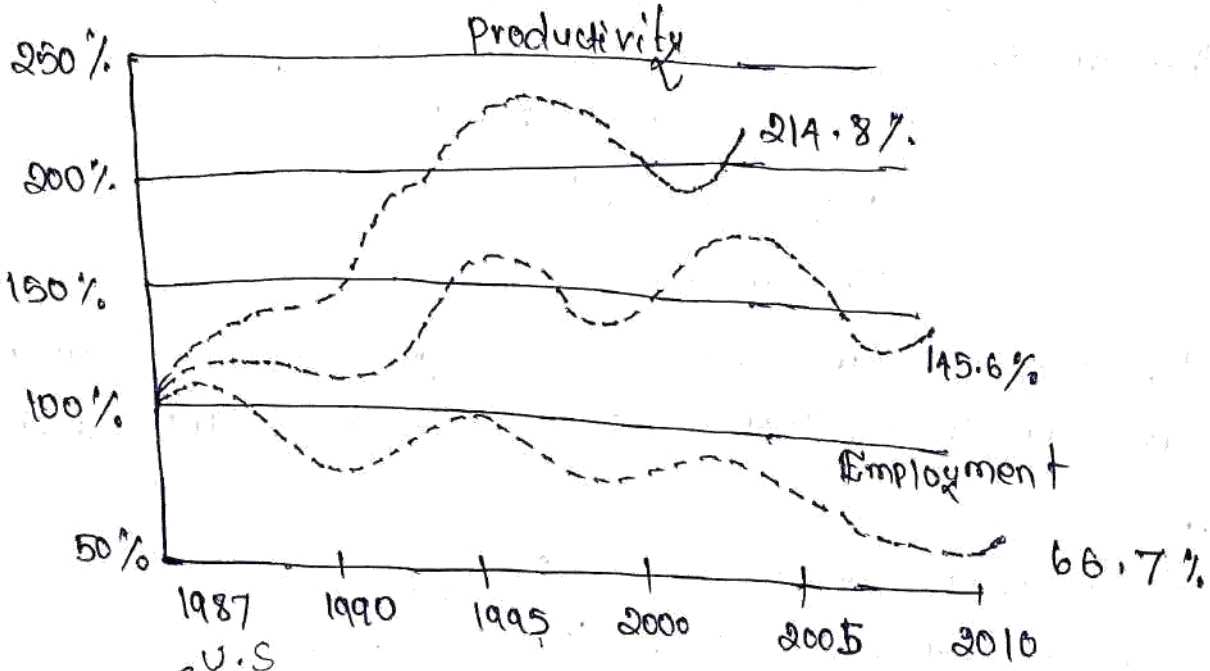
Fixed Automation	Programmable Automation	Flexible automation
1 - Limited / fixed variety of product can be produced.	1 - Large variety of production can be produced.	1 - Medium variety of products.
2 - High production rate.	2 - Low to medium production rate.	2 - Medium production rate.
3 - High quality & precission products can be produced.	3 - High precision & qualitative product cost.	3 - Medium to high production.
4 - Attractive production cost.	4 - High / effective product cost.	4 - Effective production rate
		5 - Ex : FMS



- Need of Automation :-

1) To reduce human effort.
2) To improve production rate.
3) To improve Product variety.
4) To reduce human error.
5) To increase the production hour.
6) To increase/reduce the labour Cost.

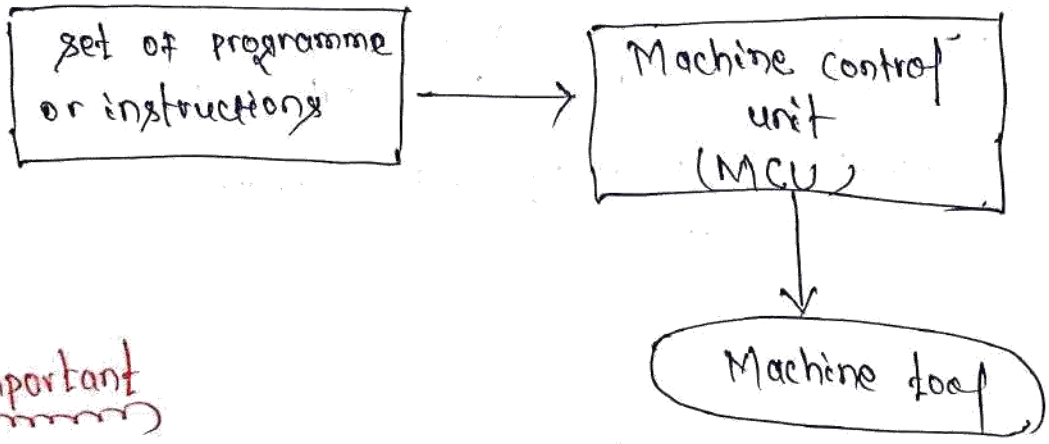
→ To minize the Labour shortage.
→ To reduce routine manual & lorical cost.
→ To improve worker safety.
→ To improve product quality.
→ To reduce manufacturing lead time.
→ To accomplex process that can't be done manually.
→ To avoid the high cost of not automating.



U.S MFG productivity & o/p chart

Numerical Control

- It is a form of programmable automation in which the process is control by numbers, letters & symbols.
- In NC M/C the numbers from a programme of instructions design for a particular job.
- When job change the programme of instructions is also change.
- There are three important of NC system.
  1. programme of instructions.
  2. M/C control unit (MCU)
  3. Machine tool.
- NC Machines are also used in automatic industries for various operations like Milling, drilling, grinding, honning etc.

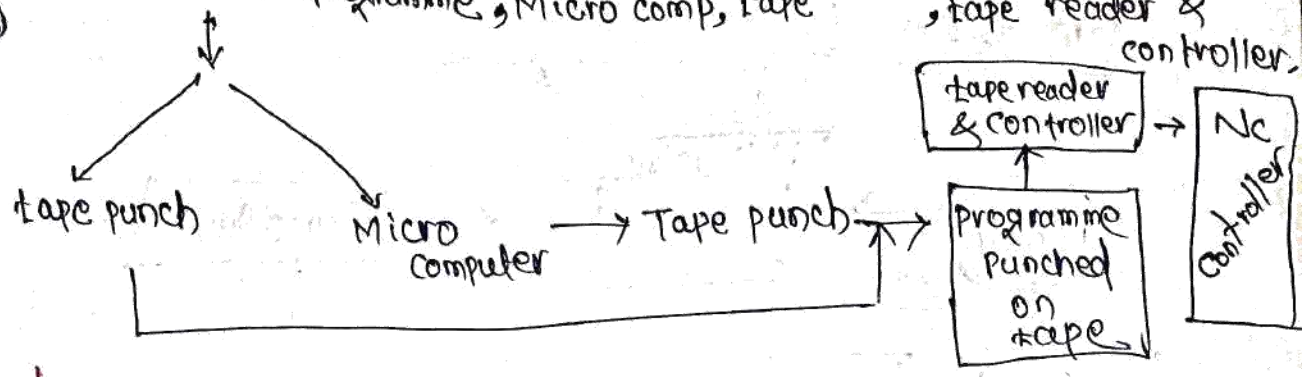


Important

1. set of programme or instructions

- A typical desktop programme gives the instructions to the computers to perform certain functions. The programme of instructions of the NC M/C is the step by step set of instructions that tells the m/c what to do.
- The set of instructions contains the following parts or elements,

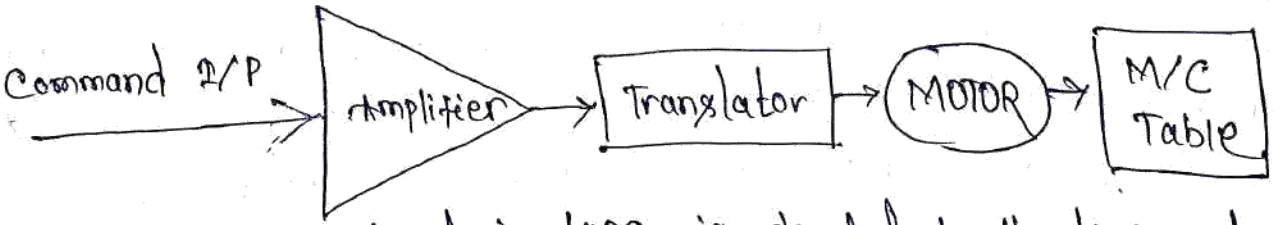
① Part drawing.
② Written NC programme, Micro comp, tape reader & controller.
③



Position & M/C control in NC Machine :-

→ A group of devices, electrical, hydraulic or numetic are used to control the position & motion of the m/c tool. The most common types of control systems are open loop system & closed loop system.

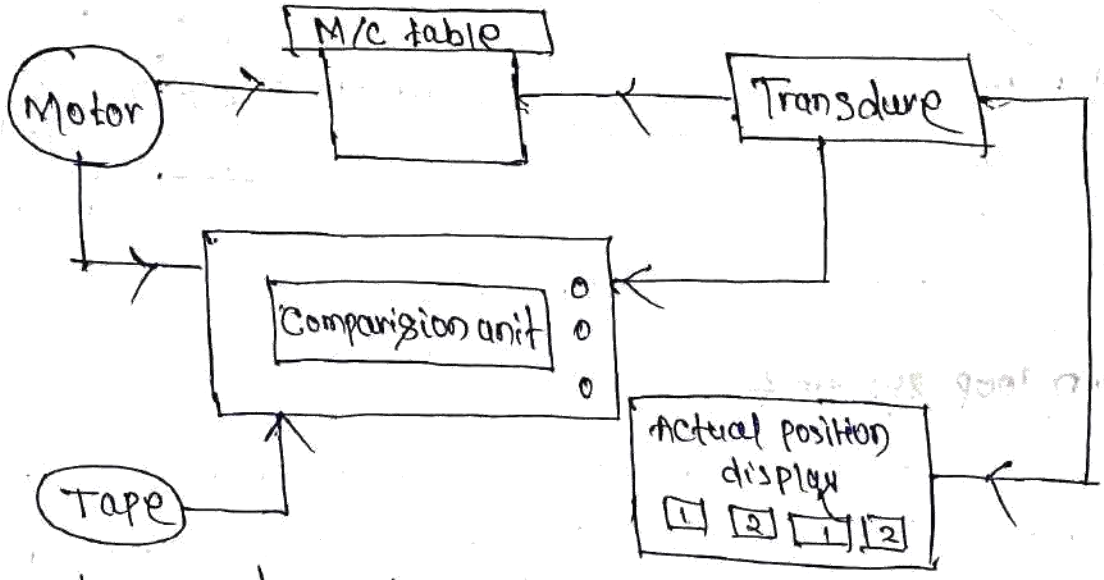
open loop system :- It is a control system that has no means of comparing the O/P with the I/P for control purpose. such that there is no feed back system.



→ The information stored in tape is decoded by the tape reader
→ Tapereader stored the information till the M/C is ready to receive it. Tape reader converts the information into electrical pulses or signals which are sent to control unit.
→ The control unit in term energises the driving control unit which actuates DC Motors to perform the desired function.
→ Driving Motors mainly stepper motors are used in open loop system.

→ A precision lead screw coupled with the motor rotates causing the M/C table to slide.

Closed loop system :-



→ In close loop system along with the components of open loop system a feed back unit is added into the electrical circuit.

→ A large veriety of feedback centers are available for comparing the actual table moment with the desired table movement.

→ In case there is an error the corrective signal is fedback to the driving Motor (Mainly DC servometer) which makes necessary adjustment to Compansate the deviation.

→ In closed loop NC system the accuracy is very high such that the m/c table can slide with an accuracy of 0.0025 mm.

→ Special Motors called servo motors are utilized in closed loop system.

⇒ The Motor types include AC, DC & Hydraulic servos.

→ Hydraulic servo motors are mainly used for large NC Machines as their most power-ful.

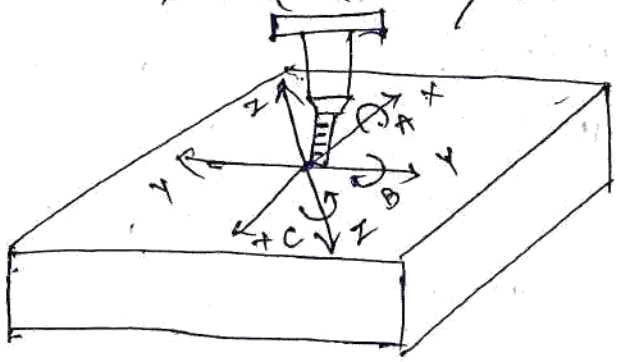
→ The speed of AC or DC Motor is variable & depends upon the current passing through it.

→ Comparing the both control systems close loop control systems are more prefer.

N/C Axis Of Motion :-

→ The location of a N/C tool at any pt of time is controlled by cartecian co-ordinate system. The system is composed of 5 directional lines mitually intersecting 90° with each other.

→ The 5 axes are known as X, Y & Z axis.



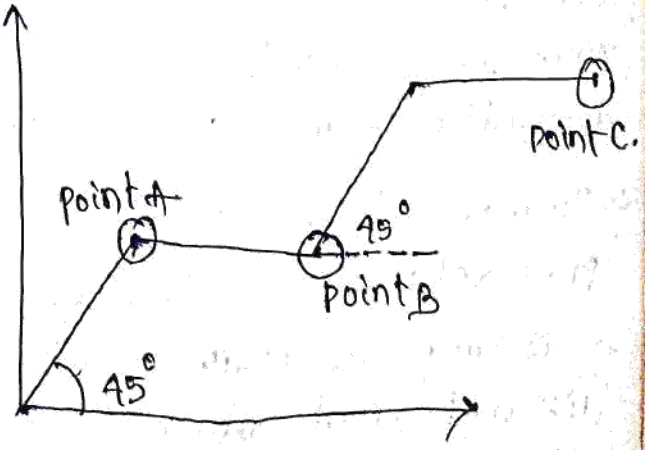
→ There are 5 types of Motion control of tools used in NC system.

1. point to point.
2. straight cut.
3. contouring.

1/ Point to point (PTP)

→ Point to point system is also known as positioning system.

→ It is used for operations that requier first movement to a point followed by a manufacturing operation at that point.



→ NC Drill M/C is an example of ptp system.

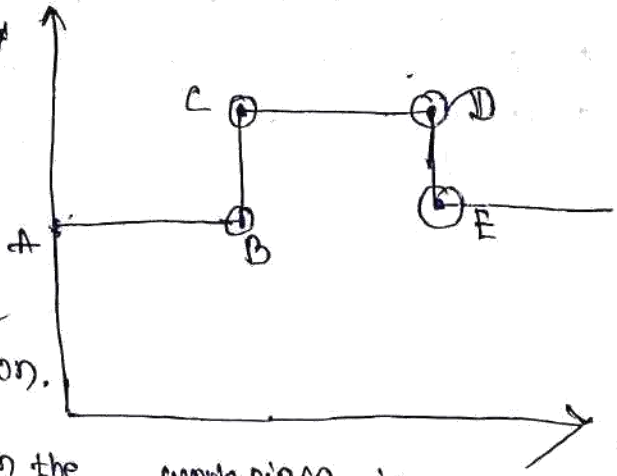
→ In these machines after the drilling M/C is perform the tool is moved to the next location for the operation till the operations are completed.

→ The ptp NC M/cs are the simplest & least expensive & are commonly used in drilling, boring, hole punching etc.

→ In this method the tool moves in x & y axes simantaneously.

2/ Straight cut :-

→ In straight cut motion control system the tool moves parallel to one of the major axis at a desire rate suitable for machining.



→ It is quite appropriate for milling workpieces of rectangular configuration.

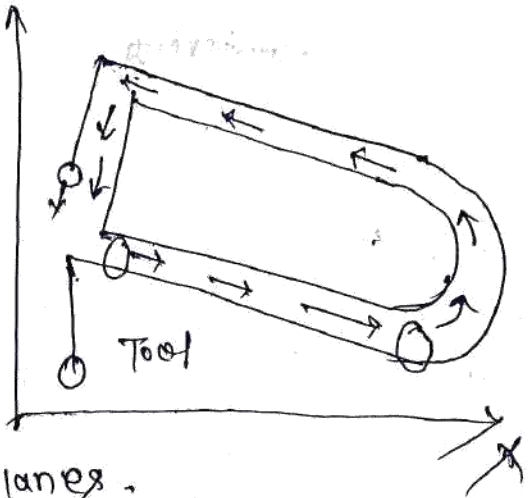
→ In this process no angular cuts on the work piece is possible.

→ Any NC M/c. tool capable of straigh cut movements can perform point to pt operation also.

3/ contouring system :-

→ It is also known as continuous path system.

→ The tool follows the desired shape since the commands are far more destrictive than for the ptp system.



→ The movement of the tool is precisely in control as in all planes.

→ All axes of motion might more simultaneously each one at a different speed while the speed may be changed even with in the path bet^ two given points.

→ Contouring NC M/Cs have a complex circuitry / design which can feed & read information of the tool that are normally programmed with the help of computers. This system is commonly used in milling Machines.

→ Tool Positioning Mode :-

*) Absolute system :-

→ An absolute system is one in which all moving commands are referred to want reference point which is in origin & It is called Zero point.

→ All position command are given as absolute distance from that zero point.

→ The Zero point may be defind as the point outside the w/p or at the corner of the w/p.

→ If a fixture is used it could be a point on the finture or on the M/C table.

→ It is estimated that considerably more than 90% of point to point NC Machines use absolute programming.

*) Incremental system :-

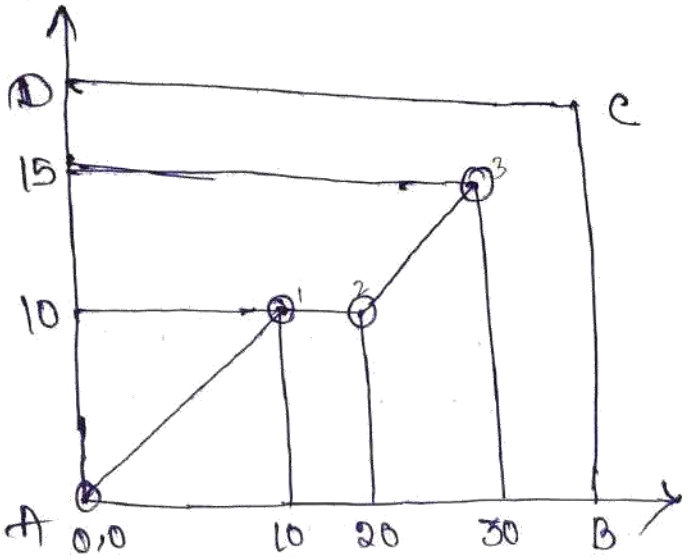
→ An incremental system is one in which the reference point to the next instruction is the end point of the preciding operation.

→ Each Dimensional data is apply to the system as a distance increment measured from the preciding point at which the axis of motion was present.

→ Incremental controls are generally low cost to bill but they are not often used from controlling point to point M/C tools.

→ one Major draw back of incremental system is that if one incremental movement is in error, all over

subsiquent movements become error.



	absolute		Incremental	
*	x mm	y mm	x mm	y mm
1	10	10	10	10
2	20	10	10	0
3	30	15	10	5

NC Part Programming :-

1) Manual Part programming.
2) computer assisted programming.
3) Manual data Input (MDI).

1- Manual part programming :-

→ In manual part programming the data required for machining a part is written in a standard format on a special manuscript.

→ The manuscript is a planning chart or a list of instructions which describes the operations to be done.

→ It is generally used for path to be produce on a point to point machining.

→ Tool part calculations are very simple in this method. When the complete programme is typed all the instructions in the form of cores are checked for accuracy.

→ Here a set of instructions is called NC block. A block is a complete line of information to the NC M/C which consist of the block number, some codes (G-code, m code, T-code etc) & finally at the end it is marked at the end of the block.

→ For ex :- N0030 · G90 G00 X-3.2 · Y-4.2 · S1000 ;

Sequence number (N-code) :-

*) It identifies the block.

*) It increases sequencially through the programme.

Properties codes (G-code) :-

→ It informs the controller what type of motion or action is to be carried out.

→ The mode of moment is indicated by the numerical valve following the G-address.

→ In general a G-code is typed at the beginning of the block after N-code, so that it can set the control for a perticular mode of action.

→ G-code is of two types.

(a) Modal.

(b) Non modal.

→ For modal type G-code specification will remain in effect for all subsequent block unless replaced by another modal G-code.

→ For non-modal type G-code specification will only affect the block in which it contains.

→ for example :-

G02 :- That the next motion will be circular interpulation in clock wise direction. G02 is modal type.

Feed rate (f-code) :-

→ It indicates the rate at which the spindle moves along a programming axis. In English system the feed rate is Inch / min.

→ The feed rate is expressed in Inch/min in metric system. It is mm / min. The feed rate is a modal code & it remains in effect in subsequent block unless a new 'f' code is replaced on the old one.

spindle speed (S-code) :-

It is specified the spindle speed (rotation per min) at which the spindle speed. A numerical valve upto 4 digited is enter the following address 'S'.

→ For ex:- S1500 denoates that the spindle speed is set that 150 RPM.

→ The S code is also a model code.

Tool number :- (T-code)

→ It indicates which tool is to be usual during the operation.

Miscellaneus code (M-code) :-

→ It exicutes various (Numerical control (NC M/C) function that are not related to dimensional or axis movement.

→ The are classified into 2 catagories

① The first catagory consist of thoxe which exicute with the start of motion described in a block.

② The second catagory consist of thoxe which exicute with the completion of motion described in the block.

Machine Zero :-

→ Each CNC M/C has a built in location that is called m/c zero. This pt is typically located at the farthest +ve direction along the x, y & z axis.

→ It can't be changed by anyone after it leaves the original manufacturer.

Work Zero :- Work '0' is normally set at the front face & centre of the job. Here it is shown two axis m/c x-axis (transverse) & z-axis (longitudinal) & the both axis should be made be '0'.

Tool offset :- The word offset refers to the allowance made by the CNC m/c for the diameter & length of the tool to cut the job.

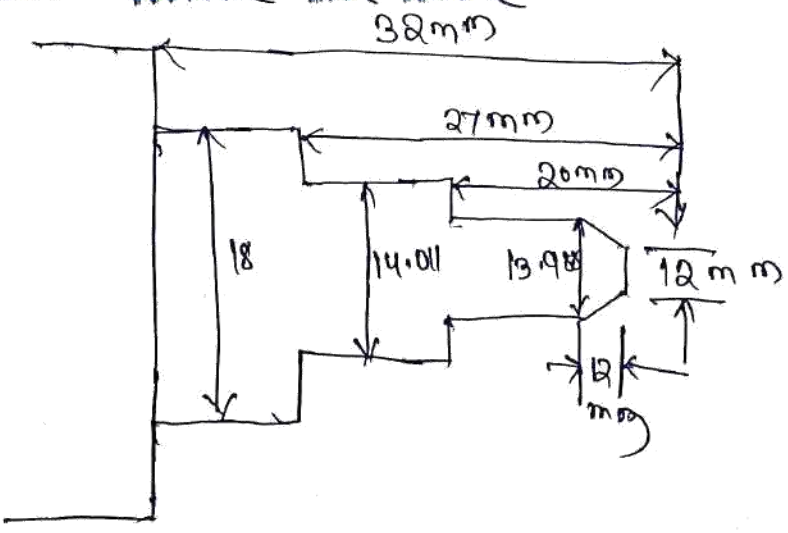
→ Tool offsets are the set of values that move the centre of the cutter to the correct position to cutting a w/p to using a specific tool.

Tool zero :-

→ The zero point set by the tool above the w/p is known as tool zero.

→ It is variable for different w/p.

***) Simple part programme for Lathe :-**



O 0005
T0000
G28 U0 W0
T0303
G92 M04 S850
G96 S100
G00 Z2.0
G00 X25.5
M07
G71 U0.5 R0.5
G71 P10 Q20 U0.1 F0.3
N10 G01 X12.0
G01 X13.988 Z-2.0
G01 Z-20.0
G01 X14.011
G01 Z-27.0
G01 X18.0
N20 G01 Z-32.0
G00 Z2.0
G00 X25.5
G97 T0000 M09
G28 U0 W0
N1 T0303
G92 M04 S850

}

G70 P10 Q20 F0.1
G00 Z2.0
G00 X25.5
G97 T0000 M09
G28 U0 W0
M05
M30
%

CNC

→ CNC M/C is control one machine.

→ CNC computer is an integrated part of the machine.

→ CNC computers are having less processing power.

→ CNC software control only one machine.

→ variety of products can be produced in a definite time.

→ Less production rate as compared to DNC.

DNC

→ DNC computer control more than 1 M/C using local networking.

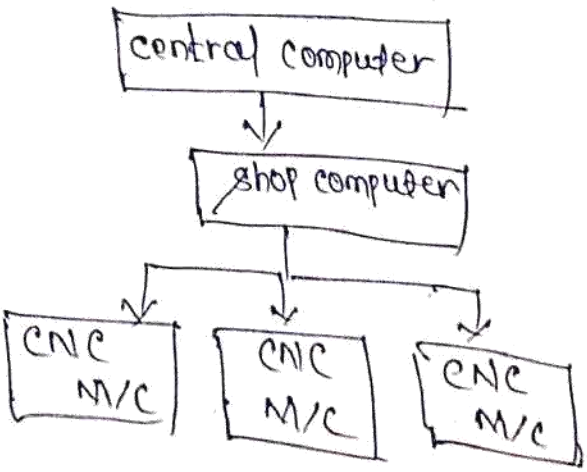
→ DNC computer is located at a distance from the m/c.

→ DNC computers are having high processing powers than CNC. (micro processer are used).

→ DNC software considers management of information through to a group of M/C.

→ unique products can be produced in the diffine time.

→ High production rate as compared to CNC.



→ It is the capability of the system to modify its own operation to achieve the best possible more operation.

→ A general defination of adaptive control emplize that an adaptive control must be capable of performing the

following function. for ex:- feed back control system, feed forward control system etc.

CHAPTER-4

ROBOT TECHNOLOGY

*) Robot is an any automatically operated machine that is used to replace the human effort.

*) A robot is an artificial agence that act like human beings.

*) Robots are usually machines control by a computer programme or electronic circuits. They may be directly control by humans. Most robots do a specific job & they don't always look like human.

→ Robotics :- It is the engineering dealing with the design, construction & operation of robots.

→ Industrial Robots :-

→ The industrial robot is a robot system is used for manufacturing. Industrial robots are automated, programmable & capable of movement mor than 3-axis.

→ Typical application of robots in industry include

- → welding
- → painting
- → Assembly / dis assembly.
- → Plick & place for printed circuit board, packing & levelling.
- → Inspection & quality control.

→ All these process are dawn with high speed & precission

→ They can also assist in material handling.

✱ Field of Application of Robots :-

① Space Industries Robotics :-

→ The research area space robotics deals with the development of intelligent robots for extraterestrial explorations focusing on

(i) Re configurable systems for planetary exploations.

(ii) AI Best methods for autonomus navigation & mission planning in onknown terrain.

(iii) Image evaluation & object recognizaton.

(iv) AI best support systems for scientific experiments.

② Under water Robotics :-

→ This area deals with the development & realization of AI method in under water systems.

→ The main point of research are

① Development of systems for user support in remot control under water vehicles, employing virtual imertion methods.

(ii) Under water applications particularly with state of the art sencer technology such as visual.

(iii) Image evaluation & object recognisation with module & inteligent under water cameras.

(iv) Design & Control of autonomos under water vehicles.

(v) Electric mobility.

(vi) Production & consumer

(v) Agricultraf robotics.

③ Electric Mobility :-

→ In the field of electric mobility we are testing concepts of or electric vehicles, battery charge technologies & the collection vehicle data.

→ We are creating models for intelligent, environmently sound, & integrated urban mobility.

→ Our research focuses around :-

(A) Development & demonstration of innovative vehicle concepts.

(B) Design of new approaches to mobility & traffic control, application support, technology integration.

(C) Data collection by fleet tests with technologically different electric vehicles.

(D) Coordinating of the regional project office of the model region electric mobility Bremen / oldenburg.

④ Logistics, Production & consumer (LPC)

→ In this area, robots are developed to act autonomously & or support humans in intralogistic, Industrial & consumer scenarios.

→ Our research focuses around the new robotics for the industrie 4.0 & beyond :-

(A) Intelligent human-robot collaboration using hybrid teams for production environments.

(B) Development of cognitively enhanced robot capabilities for flexible manufacturing

(C) Modular, novel & safe robots for human-robot collaboration.

(D) Autonomous mobile manipulation for intralogistics & manufacturing scenarios

(E) Innovative robotics solutions for inspections.

(5) Search & Rescue (SAR) & Security Robotics :-

→ In this area robots will be developed to support rescue & security personnel. Main points of our research are :-

(A) Development of highly mobile platforms for indoor & outdoor applications.

(B) Development of autonomous systems that are able to identify potential victims (SAR) or intruders (security).

(C) Embedding for robot systems into existing rescue & security infrastructures.

(D) Autonomous navigation & mission planning.

6) Assistance - & Rehabilitation systems :-

→ This field deals with robotic systems that can support humans in complex, exhausting or often repeated tasks.

→ Application areas are both help during activities of everyday life & medical rehabilitation.

→ support can either take place using systems the human is wearing like.

→ exoskeletons or orthoses, or by service robots performing the task.

core topics include :-

→ concept development, design & construction

→ Intelligent hardware - system architectures.

→ software architectures.

→ embedded biosignal analysis, ex :- using information from :-

- Muscle (EMG)
- eye (eyetracking, EOG)
- or from brain activity (EEG)
- fusion of different sensors.

→ direct online signal processing (hard & software)

→ Robust learning systems capable to adapt.
→ Joint communication layers for better human - m/c interaction.
→ Autonomously acting system.
→ Assist - as - needed.

(7) Agricultral Robotics :-

→ We develop robots for agriculture applications & transfer methods & algorithms from robotics to convectional agricultral machines.
→ Our objective to increase the performance of m/cs & processes & to reduce resource consumption at the same time.
→ Our research is focused on technology applications used in the cultivation of land. primary research topics are :-

(A) Methods for autonomous planning & navigation of outdoor machinery
(B) Methods for environment recognition in agricultral machinary control
(C) Methods of infield logistics to optimize cooperation & resource consumption bet' multiple agricultural machines.
(D) Interoperability at the level of communication, processes & knowledge processing.

Robot Configuration :-

→ The various types of movements, co-ordinate systems & degree of freedoms maintain during the design of a robot is known as configuration.

TYPES :-
- Cartesian configuration
- Polar configuration
- Cylindrical configuration
- Joined arm configuration
- SCARA [selective compliance assembled robot arm] [VLSI / PLC]
- Delta
- 6-Axis.

Imp

Cartesian configuration :-

→ In this configuration there are 3 orthogonal direction x, y & z.
→ x coordinate axis may represents left & right motion
→ y coordinate axis may represents forward & backward func.
→ z coordinat axis represents up & down function.
→ For ex :- over head crain movement

Adv :-
→ Work involve can be increased by travelling along x axis.
→ Linear movement & simple control.
→ High degree of accuracy & repetability due to their structure.
→ Can carry heavier loads.

Disadv :-

→ Movement is limited to only one dir? at a time.

application :-

→ pick & place
→ assembly & sub assembly
→ Nuclear material Handling
→ Welding

cylindrical configuration :-

→ It uses a vertical column & a slide that can be moved up or down along the column.
→ The robot arm is attached to the slide so that it can be moved radially with respect to the column.
→ It contains two linear motions & one rotational motion.
→ Angular motion along vertical axis or translation motion along z axis, radial in or out translation.
→ Adv :- Results in large work volume than a rectangular manipulator.
→ Vertical structure conserves floor space.
→ Capable of carrying large pay loads.

Disadv :-

→ Repetability & accuracy are lower in the dirn of rotary motion.

→ It requires more complicated control system.

Applⁿ :- Assembly, coating applⁿ, diecasting, foundary & forging applⁿ, M/C loading & unloading applⁿ.

Polar configuration :-

→ It uses a arm that can be raised or lower about a horizontal pivot.

→ The pivot is mounted on a rotating base.

→ The various Joints provide the robot with the capability to move its arm with in a spherical space & hence it is also called as spherical coordinat robot.

→ It has one linear & two rotary motions.

→ The ~~ultimat~~ unimate 2000 series is an ex of spherical robot.

Adv :-

→ Larger work envolve that the cylindrical configuration

→ Vertical structure conserves less space

Disadv :- Repetability & accuracy are also lower in rotary motion.

→ It requires more sofisticated control system.

Application :-

→ Die casting

→ foreging

→ glass handling

→ Injection moulding etc.

ROBORT ANATOMY

Introduction:- An industrial robort is a general purpoxe, programmable m/c. It possesses some atmospheric characterxtics, i.e human like chavacteristics that resemble the human physical structure. The robotx also respond to sensory signalx in a manner that is similar to humans. Anthropomorphic characterxtics xuch ax mechanical armx are uxed for varioux industry taskx. Sensory preceptive devicex xuch ax Sensorx allow to the robotx to communicate & interact with other machinex & to take simple decisions. The general commercial & technological adv. of robotx are lixted below.

→ Robotx are good substitutex to the human being in hazardous or uncomfortable work environmentx.

→ A Robot performx itx work cycle with a consistency & repetability which ix difficult for human beingx to attain over a long period of contineous working.

→ Robotx can be programmed. When the production run of the current task ix completed, a robot can be reprogrammed & equipped with the necessary tooling to perform an altogether different task.

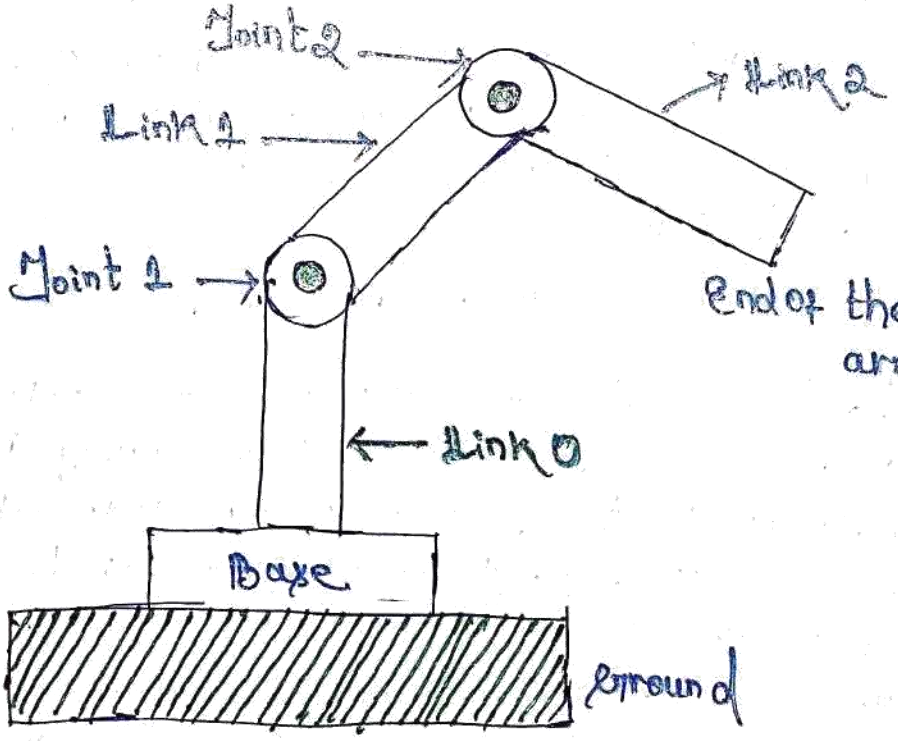
→ Robotx can be connected to the computer xystem & other robotics xystemx. Now a dayx ecobotx can controlled with wire lexx control technologiex. Thix has enhanced the Productivity & efficiency of automation Industry.

** Robot anatomy & related attributex.

- **Jointx & Linkx:-** The manipulator of an industrial robot consist of a xeriex of Jointx & linkx. Robort anatomy dealx with the xtudy of different Jointx & linkx & other aspectx of the manipulator's physical conxtruction. A robotic Joint providex relative motion betn two linkx of the robot. Each Joint or axix, Providex a certain degree-of-freedom (dof) of motion. In moxt the casex only one degree-of-freedom ix associated with each Joint.

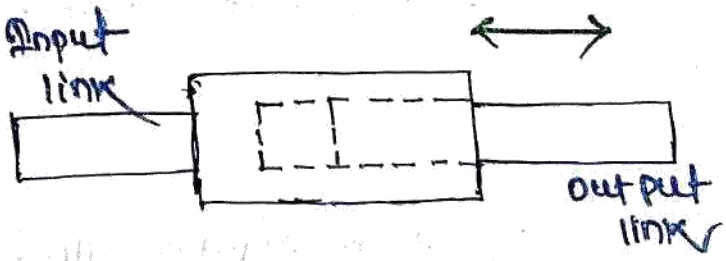
→ Therefore the robot's complexity can be classified according to the total no of degrees-of-freedom they posses.

Each joint is connected to two links, i/p link & o/p link. Joint provides controlled relative movement bet^n the I/P link & output link. A robotic link is the rigid component of the robot manipulator. Most of the robots are mounted upon a stationary base, such as the floor. From this base, a joint-link numbering scheme may be recognized as shown the below fig. The robotic base & its connection to the first joint are termed as link-0. The first joint in the sequence is joint-1. Link-0 is the input link for joint-1, while the o/p link from joint-1 is link-1 which leads to joint-2. Thus link-1 is, simontaneously, the o/p link for joint-1 & the input link for joint-2. This joint-link-numbering scheme is further followed for all joints & link in the robotic system.

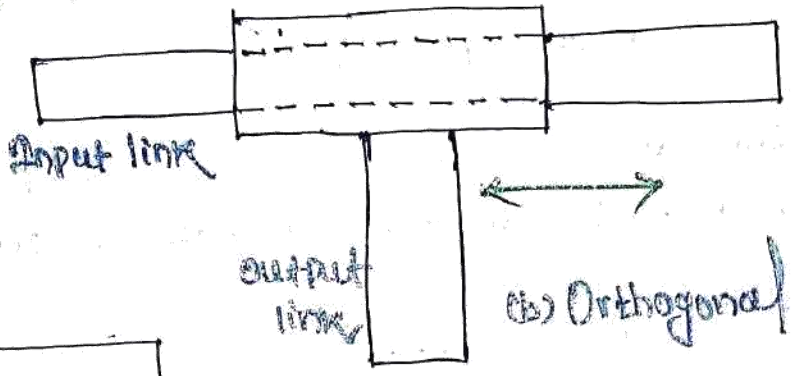


(Joint-link scheme for robot manipulator)

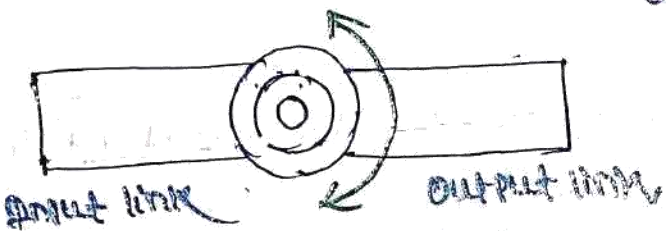
* Nearly all industrial robots have mechanical joints that can be classified into following five types as shown in below fig.



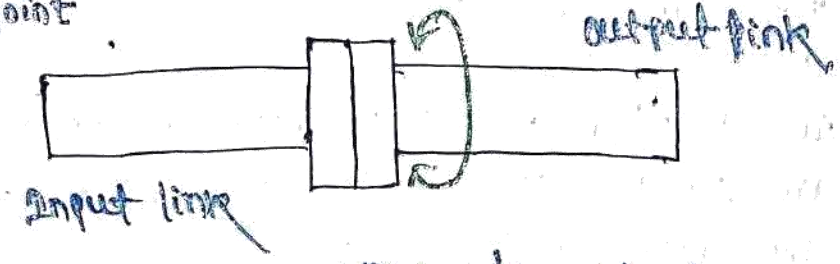
(a) Linear Joint



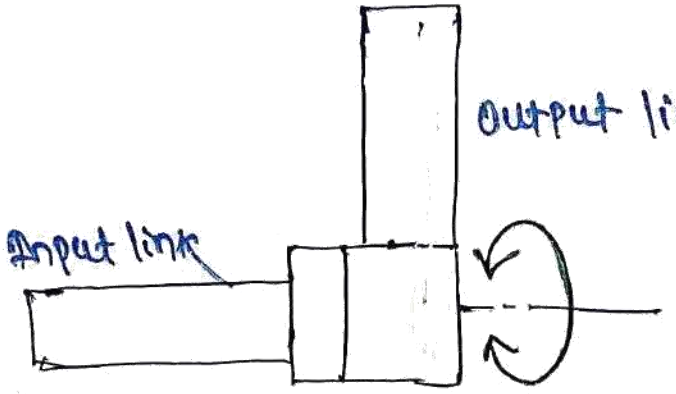
(b) Orthogonal Joint



(c) Rotational Joint



(d) Twisting Joint



(e) Revolving Joint

(a) Linear Joint (L-Joint)

→ This relative movement bet' the Input link & the output link is a translational sliding motion, which the axis of the two links being Parallel.

(b) Orthogonal Joint (U-Joint)

This is also a translation sliding motion but the Input or output links are perpendicular to each other during the move.

(c) Rotational Joint (R-Joint)

→ This type provides rotational relative motion, with the axis of rotation perpendicular to the axes of the Input & output links.

(d) Twisting Joint (T-Joint)

→ This Joint also involves rotary motion, but the axis of rotation is parallel to the axis of the two links.

(e) Revolving Joint (Type V-Joint)

→ In this type, axis of input link is parallel to the axis of rotation of the Joint. However the axis of the output link is perpendicular to the axis of rotation.

FLEXIBLE MANUFACTURING SYSTEM

→ In fms the term flexibility means that the machine is above to process a veriety component without having to adjust machine setup or tool changing.

→ Flexible manufacturing system is characterised by the following main components :

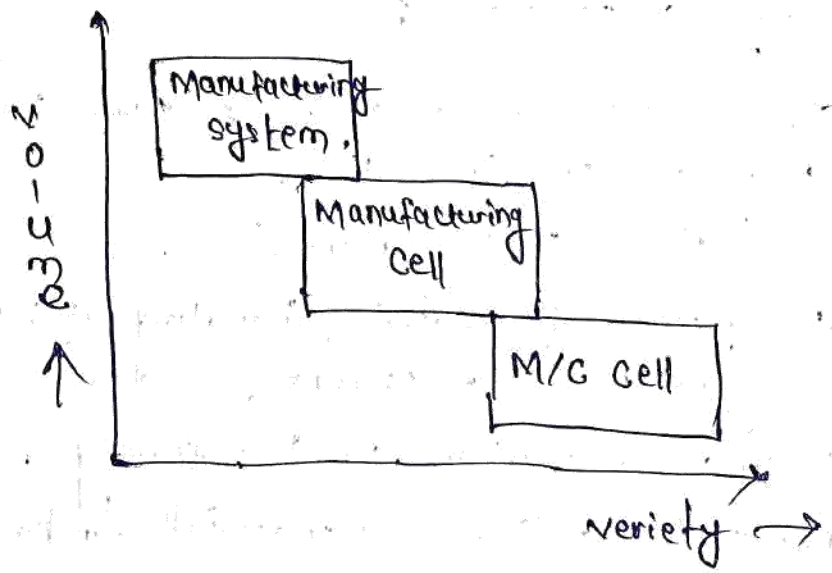
1. Two or more work stations with computer controled machine tool.
   For example : CNC Machine.
2. An automated material handling system for moving the work in process.
3. Advanced mechanism for transferring work in process between the m/c tool & material handling system.
4. storage by an automated storage & retrival system of work in process & tooling.
5. Central computer control of the entire process.

→ Flexible Manufacturing is a highly automated group technology (GT) machine cell consisting of a group of processing work stations, interconnected by an automated material handling & storage system & controlled by a distributed computer.

*) Classification of flexible manufacturing :-

→ It can be classified as according to the number of m/c in the system

① Single m/c cell.
② Flexible manufacturing cell.
③ Flexible manufacturing system.



Single M/C Cell (SMC) :-

→ A single m/c cell consist of one CNC machining centre combined with a parts storage system on attended operation.
→ Completed parts are periodically unloaded on the storage unit & new, raw materials are loaded into it.

Flexible manufacturing cell (FMC) :-

→ It consist of 2 or 3 processing stations mainly CNC machining centers & material handling, storage system.
→ The part handling system is connected to the loading & unloading station.

Flexible manufacturing system (FMS) :

→ A FMS has 4 or more processing work stations connected mechanically by the storage & material handling system & loading or unloading system.

NEED OF FMS :-

→ External changes such as change in product design & production system.
→ optimising the manufacturing cycle time.
→ Reduced production cost.
→ Overcoming internal changes like breakdown etc.
→ To reduce inventry cost, direct labour cost etc.
→ To increase m/c utilization.

SUB---ADVANCE MANUFACTURING & CAD/CAM

SHORT TYPE

1.WHAT IS CAD/CAM?

Computer-aided manufacturing (**CAM**) also known as **Computer-aided Modeling** or **Computer-aided Machining** is the use of software to control machine tools and related ones in the manufacturing of work pieces This is not the only definition for CAM, but it is the most common; CAM may also refer to the use of a computer to assist in all operations of a manufacturing plant, including planning, management, transportation and storage.

2.WHAT IS ELECTROSTATICS PLOTTERS?

An **electrostatic plotter** is a type of plotter that draws images on paper with an electrostatic process. They are most frequently used for Computer-Aided Engineering (CAE), producing raster images via either a Liquid Toner or a Dry Toner model.

Liquid Toner models use toner that is positively charged and thus becomes attracted to paper's negative charge. This occurs after the toner particles pass through a line of electrodes in the form of tiny wires, or nibs.

3.WHAT IS FLAT BED PLOTTERS?

A graphics plotter that contains a flat surface that the paper is placed on. The size of this surface (bed) determines the maximum size of the drawing. Contrast with drum plotter.

4.WHAT IS NUMERICAL CONTROLS?

Numerical control (also **computer numerical control**, and commonly called **CNC**) is the automatedcontrol of machining tools (drills, boring tools, lathes) and 3D printers by means of a computer. A CNC machine processes a piece of material (metal, plastic, wood, ceramic, or composite) to meet specifications by following a coded programmed instruction and without a manual operator.

5.WHAT ARE THE BASIC COMPONENTS OF NC SYSTEM?

There are three important components of the numerical control or NC system. These are:

1) Program of instructions

2) Controller unit, also called as the machine control unit (MCU) and

3) Machine tool

6.WHAT ARE THE APPLICATION OFNC?

The operating principle of NC has many applications. There are many industrial operations in which the position of a workhead must be controlled relative to a part or product being processed. The applications divide into two categories:

(1) machine tool applications and

(2) nonmachine tool applications.

Machine tool applications are those usually associated with the metalworking industry. Nonmachine tool applications comprise a diverse group of operations in other industries. It should he noted that the applications are not always identified bv the name "numerical control";

7.WHAT IS NC PART PROGRAMMING ?

Numerical control part programming is the procedure by which the sequence of processing steps to be performed on the NC machine is planned and documented. It involves the preparation of a punched tape (or other input medium) used to transmit the processing instructions to the machine tool. there are two methods of part programming: manual part programming and computer-assisted part programming. In this chapter we describe both of these methods, with emphasis on the latter.

It is appropriate to begin the discussion of NC part programming by examining the way in which the punched tape is coded. Coding of the punched tape is concerned with the basic symbols used to communicate ...

8.WHAT ARE THE NC PARTPROGRAMMING LANGUAGE?

he **part program** is a sequence of instructions, which describe the work, which has to be done on a part, in the form required by a computer under the control of computer numerical control (CNC) software. It is the task of preparing a program sheet from a drawing sheet. All data is fed into the CNC system using a standardized format. Programming is where all the machining data are compiled and where the data are translated into a language which can be understood by the control system of the machine tool.

9.WHAT ARE THE FUNCTION OF DNC?

There are various advantages provided by DNC system. These are as follows:

1) Easy and Effective programming using DNC Software.

2) Higher level of decision making.

3) Real time control of various machine tools.
4) First step which gives hands on experience for future expansion.
5) Elimination of Punched Tape and Tape Reader.
6) CLFILE- A Convent and more general way of program storage.
7) Elimination of hardwired controller unit on some system.

10.WHAT IS THE BENEFITS OF ADAPTIVE CONTROLS?

In municipal and industrial wastewater treatment, there has been a shift from manual to automatic process control in order to increase efficiency and improve effluent quality. An increasingly popular approach includes installing a variable frequency drive (VFD) to constantly adjust the amount of air injected into the process to control dissolved oxygen, NH_4, and/or NO_3 in the wastewater treatment. This approach works well from a process control standpoint. The additional benefits include: lower power cost and extended service life of the blowers. VFDs offer great flexibility, but they have high purchase costs and there are still many applications in which they can be inefficient.

11.WHAT IS CIM?

Computer-integrated manufacturing (**CIM**) is the manufacturing approach of using computers to control entire production process.[1][2] This integration allows individual processes to exchange information with each other and initiate actions. Although manufacturing can be faster and less error-prone by the integration of computers, the main advantage is the ability to create automated manufacturing processes. Typically CIM relies of closed-loop control processes, based on real-time input from sensors. It is also known as *flexible design and manufacturing*.

LONG TYPE

1. WHAT ARE THE PROBLEMS WITH CONVENTIONAL NC?

Problems with conventional NC There are a number of problems inherent in conventional NC which have motivated machinetool builders to seek improvements in the basic NC system. Among the difficultiesencountered in using conventional numerical control are the following:1.**Part programming mistakes.**In preparing the punched tape, part programmingmistakes are common. The mistakes can be either syntax or numerical errors, and it isnot uncommon for

three or more passes to be required before the NC tape is correct.Another related problem in part programming is to achieve the best sequence ofprocessing steps. This is mainly a problem is manual part programming. Some of thecomputer-assisted part programming languages provide aids to achieve the bestoperation sequences.

2.**No optimal speeds and feeds.**In conventional numerical control, the control systemdoes not provide the opportunity to make changes in speeds and feeds during thecutting process. As a consequence, the programmer must set the speeds and feeds forworst-case conditions. The result is lower than optimum productivity.

3.**Punched tape.**Another problem related to programming is the tape itself. Paper tapeis especially fragile, and its susceptibility to wear and tear causes it to be an unreliableNC component for repeated use in the shop. More durable tape materials, such asMylar, are utilized to help overcome this difficult. However, these materials arerelatively expensive.

4.**Tape reader.**The tape reader that interprets the punched tape is generallyacknowledged among NC users to be the least reliable hardware component of themachine. When a breakdown is encountered on an NC machine, the maintenancepersonnel usually begin their search for the problem with the tape reader.

5.**Controller.**The conventional NC controller unit is hard-wired. This means that itscontrol features cannot be easily altered to incorporate improvements into the unit.Use of a computer as the control device would provide the flexibility to makeimprovements in such features as circular interpolation when better software becomesavailable,

2.WHAT IS DIRECT NUMERICAL CONTROLS(DNC)?

DNC

Direct numerical control (**DNC**), also known as **distributed numerical control** (also **DNC**), is a common manufacturing term for networking CNC machine tools. On some CNC machine controllers, the available memory is too small to contain the machining program (for example machining complex surfaces), so in this case the program is stored in a separate computer and sent *directly* to the machine, one block at a time. If the computer is connected to a number of machines it can *distribute* programs to different machines as required. Usually, the manufacturer of the control provides suitable DNC software. However, if this provision is not possible, some software companies provide DNC applications that fulfill the purpose. DNC networking or DNC

communication is always required when CAM programs are to run on some CNC machine control.

Wireless DNC is also used in place of hard-wired versions. Controls of this type are very widely used in industries with significant sheet metal fabrication, such as the automotive, appliance, and aerospace industries.

Special protocols

A challenge when interfacing into machine tools is that in some cases special protocols are used. Two well-known examples are Mazak's Mazatrol and Heidenhain's LSV2 protocol. Many DNC systems offer support for these protocols. Another protocol is DNC which is found on Fanuc controls. DNC allows advanced interchange of data with the control, such as tooling offsets, tool life information and machine status as well as automated transfer without operator intervention.

Machine monitoring

One of the issues involved in machine monitoring is whether or not it can be accomplished automatically in a practical way. In the 1980s monitoring was typically done by having a menu on the DNC terminal where the operator had to manually indicate what was being done by selecting from a menu, which has obvious drawbacks. There have been advances in passive monitoring systems where the machine condition can be determined by hardware attached in such a way as not to interfere with machine operations (and potentially void warranties). Many modern controls allow external applications to query their status using a special protocol. MTConnect is one prominent attempt to augment the existing world of proprietary systems with some open-source, industry-standard protocols and XML schemas and an ecosystem of massively multiplayer app development and mashups (analogous to that with smartphones) so that these long-sought higher levels of manufacturing business intelligence and workflow automation can be realized.

3.WHAT ARE THE FUNCTIONS OF CNC

Main Parts of CNC Machine

The main parts of the CNC machine are

(i) Input Devices: These are the devices which are used to input the part program in the CNC machine. There are three commonly used input devices and these are punch tape reader, magnetic tape reader and computer via RS-232-C communication.

(ii) Machine Control Unit (MCU): It is the heart of the CNC machine. It performs all the controlling action of the CNC machine, the various functions performed by the MCU are

- It reads the coded instructions fed into it.
- It decodes the coded instruction.
- It implements interpolation (linear, circular and helical) to generate axis motion commands.
- It feeds the axis motion commands to the amplifier circuits for driving the axis mechanisms.
- It receives the feedback signals of position and speed for each drive axis.
- It implements the auxiliary control functions such as coolant or spindle on/off and tool change.

(iii) Machine Tool: A CNC machine tool always has a slide table and a spindle to control of the position and speed. The machine table is controlled in X and Y axis direction and the spindle is controlled in the Z axis direction.

(iv) Driving System: The driving system of a CNC machine consists of amplifier circuits, drive motors and ball lead screw. The MCU feeds the signals (i.e. of position and speed) of each axis to the amplifier circuits. The control signals are than augmented (increased) to actuate the drive motors. And the actuated drive motors rotate the ball lead screw to position the machine table.

(v) Feedback System: This system consists of transducers that act as sensors. It is also called a measuring system. It contains position and speed transducers that continuously monitor the position and speed of the cutting tool located at any instant. The MCU receives the signals from these transducers and it uses the difference between the reference signals and feedback signals to generate the control signals for correcting the position and speed errors.

(vi) Display Unit: A monitor is used to display the programs, commands and other useful data of CNC machine.

4.WHAT ARE THE COMPONENTS IN DNC SYSTEM?

Components Used in DNC Machine

Following are the main components used in CNC machine:

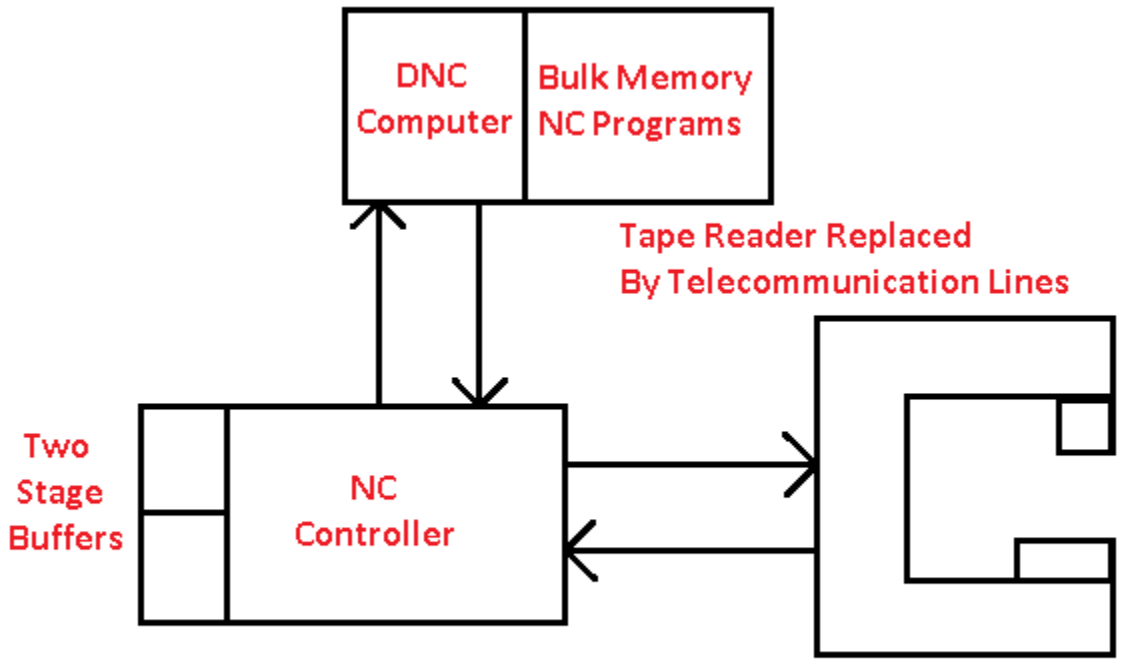
1. Central computer
2. Bulk memory for storing programs
3. Communication network
4. NC machine

Types of DNC system

Following are the main two types of DNC system:

1. Behind the Tape Reader (BTR) system
2. Specialised MCU

1. Behind The Tape Reader (BTR) System

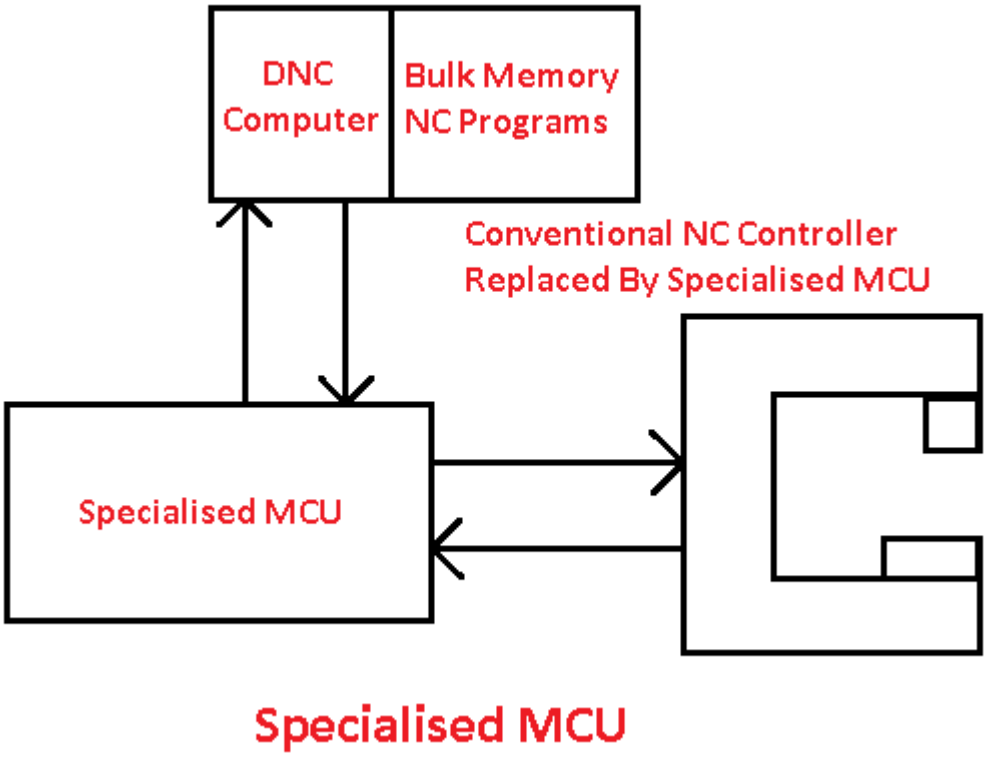


Behind The Tape Reader (BTR) System

In this type of system, the computer is connected directly to the regular NC controller unit. The operation of the system is similar to conventional NC, except for the source of command instructions.

The controller unit employs two temporary storage buffers to get the blocks of instructions from the DNC computer and turn them into machine operations. The one buffer is getting a block of data, the other is providing control instructions to the specific machine tool. This system cost is very low.

2. Specialised MCU



Specialised MCU

In specialised MCU system, replace the normal controller unit with the special machine control unit. The special control unit is created to help communication between machine tools and computers. The specialised MCU configuration achieves a better balance between the accuracy of interpolation and the faster removal rate of the metal than is usually possible with the BTR system.

5. .WHAT ARE THE USE OF ADAPTIVE CONTROLS?

Adaptive control is the control method used by a controller which must adapt to a controlled system with parameters which vary, or are initially

uncertain. For example, as an aircraft flies, its mass will slowly decrease as a result of fuel consumption; a control law is needed that adapts itself to such changing conditions. Adaptive control is different from robust control in that it does not need *a priori* information about the bounds on these uncertain or time-varying parameters; robust control guarantees that if the changes are within given bounds the control law need not be changed, while adaptive control is concerned with control law changing itself.

Parameter estimation[

The foundation of adaptive control is parameter estimation, which is a branch of system identification. Common methods of estimation include recursive least squares and gradient descent. Both of these methods provide update laws which are used to modify estimates in real time (i.e., as the system operates). Lyapunov stability is used to derive these update laws and show convergence criteria (typically persistent excitation; relaxation of this condition are studied in Concurrent Learning adaptive control). Projection (mathematics) and normalization are commonly used to improve the robustness of estimation algorithms.

Classification of adaptive control techniques

In general, one should distinguish between:

1. Feedforward adaptive control
2. Feedback adaptive control

as well as between

1. Direct methods
2. Indirect methods
3. Hybrid methods

Direct methods are ones wherein the estimated parameters are those directly used in the adaptive controller. In contrast, indirect methods are those in which the estimated parameters are used to calculate required controller parameters.[1] Hybrid methods rely on both estimation of parameters and direct modification of the control law.

MRAC

MIAC

There are several broad categories of feedback adaptive control (classification can vary):

- Dual adaptive controllers – based on dual control theory
  - Optimal dual controllers – difficult to design
  - Suboptimal dual controllers
- Nondual adaptive controllers
  - Adaptive pole placement
  - Extremum-seeking controllers
  - Iterative learning control
  - Gain scheduling
  - Model reference adaptive controllers (MRACs) – incorporate a *reference model* defining desired closed loop performance
    - Gradient optimization MRACs – use local rule for adjusting params when performance differs from reference. Ex.: "MIT rule".
    - Stability optimized MRACs
  - Model identification adaptive controllers (MIACs) – perform system identification while the system is running
    - Cautious adaptive controllers – use current SI to modify control law, allowing for SI uncertainty
    - Certainty equivalent adaptive controllers – take current SI to be the true system, assume no uncertainty
      - Nonparametric adaptive controllers
      - Parametric adaptive controllers
        - Explicit parameter adaptive controllers
        - Implicit parameter adaptive controllers
  - Multiple models – Use large number of models, which are distributed in the region of uncertainty, and based on the responses of the plant and the models. One model is chosen at every instant, which is closest to the plant according to some metric.

Adaptive control with Multiple Models

Some special topics in adaptive control can be introduced as well:

1. Adaptive control based on discrete-time process identification
2. Adaptive control based on the model reference control technique[3]
3. Adaptive control based on continuous-time process models

4. Adaptive control of multivariable processes [4]
5. Adaptive control of nonlinear processes
6. Concurrent learning adaptive control, which relaxes the condition on persistent excitation for parameter convergence for a class of systems

Adaptive control has even been merged with intelligent techniques such as fuzzy and neural networks and the new terms like fuzzy adaptive control has been generated.

Applications

When designing adaptive control systems, special consideration is necessary of convergence and robustness issues. Lyapunov stability is typically used to derive control adaptation laws and show .

- Self-tuning of subsequently fixed linear controllers during the implementation phase for one operating point;
- Self-tuning of subsequently fixed robust controllers during the implementation phase for whole range of operating points;
- Self-tuning of fixed controllers on request if the process behaviour changes due to ageing, drift, wear, etc.;
- Adaptive control of linear controllers for nonlinear or time-varying processes;
- Adaptive control or self-tuning control of nonlinear controllers for nonlinear processes;
- Adaptive control or self-tuning control of multivariable controllers for multivariable processes (MIMO systems);

Usually these methods adapt the controllers to both the process statics and dynamics. In special cases the adaptation can be limited to the static behavior alone, leading to adaptive control based on characteristic curves for the steady-states or to extremum value control, optimizing the steady state. Hence, there are several ways to apply adaptive control algorithms.

6. WHAT ARE THE ADVANTAGES OF DNC

DNC SYSTEMS

1. . DIRECT NUMERICAL CONTOL SYSTEMS ELSON PAUL V S1 M . Tech (Production & Industrial Engineering) Admission No: 11209

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2. _ Involves data connection and processing from the machine tool back to the computer. 2 The tape reader is omitted. Also, defined by EIA as: DNC is a system connecting a set of NC machines to a common memory for part program or machine program storage with provision for on- demand distribution of data to machines. DNC is a manufacturing system in which a number of machines are controlled by a computer through direct- connection and in real time.DNC
3. Components1. Central computer2. Bulk memory which stores the NC part programs.3. Telecommunication lines4. Machine Tools. 3
4. _Principle 4
5. No limitation for the number or size of programs stored 5♣ No tape readers are used♣ Computer can be used for program editing♣ Programs in full or segment can be transferred to NC machines♣ Various machine tools can communicate with the computer in real time♣ Two way information flow take place in real time♣ Part program of all machine tools are stored in the memory of the central computer and transmitted on direct transmission lines on demand♣ A central computer connected to a number of machine tools and control them♣
6. The configuration of the DNC system can be divided into: 1.DNC system without satellite computer. 2.DNC system with satellite computer. Satellite computers are minicomputers and they serve to take some of the burden off central computer. Each satellites controls several machine tools. 6
7. 1.DNC system without satellitecomputer 7
8. 2.DNC system with satellitecomputer 8
9. There are two alternative system configurations by which the communication link is established between the control computer and the machine tool. 1.Behind the Tape Reader (BTR) system. 2.Special Machine Control Unit. 9Two Types of DNC
10. _ Cost is very less. 10 One buffer is receiving a block of data, the other is providing control instructions to machine tool. The controller unit uses two temporary storage buffers to receive blocks of instructions from the DNC computer and convert them into machine actions. Except for the source of the command instructions, the operation of the system is very similar to conventional NC. The

computer is linked directly to the regular NC controller unit.□1.Behind the Tape Reader (BTR) system

12. The special MCU configuration achieve a superior balance between accuracy of the interpolation and fast metal removal rates than is generally possible with the BTR system. 12□ The special control unit is designed to facilitate communication between the machine tool and the computer.□ Replace the regular controller unit with a special machine control unit.□2.Special Machine Control Unit.

11. The functions which a DNC system is designed to perform: 1.NC without punched tape. 2.NC part program storage. 3.Data collection, processing, and reporting. 4.Communication 13□Functions of DNC

12. The program storage subsystem must be structured to satisfy several purposes: 1.The program must be made available for downloading to the NC machine tools. 2. The subsystem must allow for new programs to be entered, old programs to be deleted, and existing programs to be edited. 3. The storage subsystem must be structured to perform certain data processing and management functions, such as file security, displays of programs, and manipulation of data 14□NC part program storage

13. These data must be processed by the DNC computer, and reports are prepared to provide management with information necessary for running the plant. 15□ The data concerned are: Tool usage Machine utilization Production piece counts□ The purpose of this functions is to "monitor" production of the factory.□Data collection, Processing, and Reporting.

14. The essential communication links in DNC are between the following components of the system: Central computer and machine tools Central computer and NC part programmer terminal Central computer and bulk memory 16□A "Communication Network" is required to accomplish the previous functions of DNC.□Communication

15. Convenient editing and diagnostic features. 17□ Reporting of shop performance.□ Greater computational capability and flexibility□ Convenient storage of NC part programs in computer files□ Elimination of punched tapes and tape readers□Advantages of DNC System

16. DNC concepts represents a first step in the development of production plants which will be managed by computer systems. This

establishes the framework for the evolution of computer automated factories 18Conclusion

7.WHAT ARE THE ADVANTAGES OF CIM?

Many benefits can be obtained from the successful implementation and operation of a CIM system in a manufacturing company. The benefits can be classified into three kinds: technical, management, and human resources quality.

Technical Benefits

Technical benefits obtained from implementation CIM system are:

1. *Reducing inventory and work-in-progress:* This can be accomplished through the utilization of an MRPII or ERP system. Careful and reliable material purchasing planning and production planning can to a great extent eliminate high inventory and work-in-progress level, hence reducing capital overstock and even waste through long-term material storage.

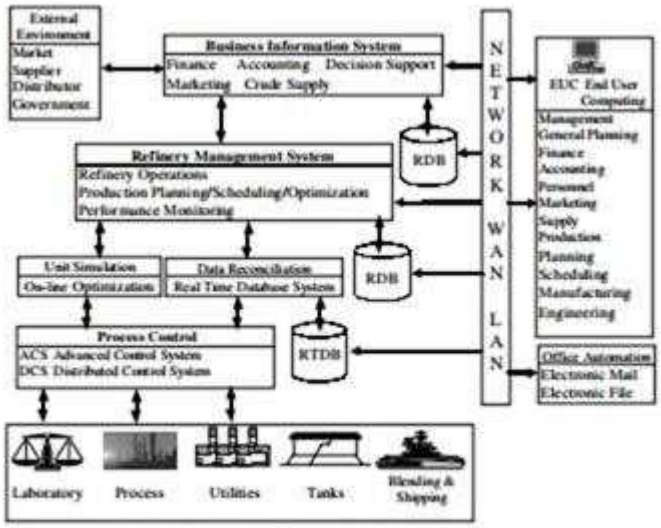

Figure 37 Advanced Computing Environment.

2. *Improving production efficiency:* Through the integration of a production system, planning system, and material supply system, the production processes can be operated in a well- organized way and hence production can be carried out with the shortest possible waiting times and machine utilization greatly increased. Through the integration of CAD, CAPP, and CAM systems, the setup time for NC machines can be reduced significantly. The improvement of production efficiency will bring economic returns from investment in the CIM system.

3. *Improving product quality:* The integration of the company's business processes, design pro- cesses, and production processes will help in improving product quality. TQM can be put into effect in the CIM integrated environment.

4. *Reducing cost:* This is the direct effect obtained from the above three benefits.

5. *Improving product design ability:* Through the integration of CAD, CAPP, and CAM systems, by using the current engineering method, the product design ability of the company can be significantly improved. New and improved products can be designed and developed in a shorter time, and the company can win the market competition with these products.

8.WHAT IS FLEXIBLE MANUFACTURING SYSTEMS?

A **flexible manufacturing system** (**FMS**) is a manufacturing system in which there is some amount of flexibility that allows the system to react in case of changes, whether predicted or unpredicted. This flexibility is generally considered to fall into two categories, which both contain numerous subcategories.

The first category, *routing flexibility*, covers the system's ability to be changed to produce new product types, and ability to change the order of operations executed on a part. The second category is called *machine flexibility*, which consists of the ability to use multiple machines to perform the same operation on a part, as well as the system's ability to absorb large-scale changes, such as in volume, capacity, or capability.

Most **FMS** consist of three main systems. The work machines which are often automated CNC machines are connected by a material handling system to optimize parts flow and the central control computer which controls material movements and machine flow.

The main advantages of an FMS is its high flexibility in managing manufacturing resources like time and effort in order to manufacture a new product. The best application of an FMS is found in the production of small sets of products like those from a mass production.

Advantages

- Reduced manufacturing cost

- Lower cost per unit produced,
- Greater labor productivity,
- Greater machine efficiency,
- Improved quality,
- Increased system reliability,
- Reduced parts inventories,
- Adaptability to CAD/CAM operations.
- Shorter lead times
- Improved efficiency
- Increase production rate

Disadvantages

- Initial set-up cost is high,
- Substantial pre-planning
- Requirement of skilled labor
- Complicated system
- Maintenance is complicated

9. WRITE ADVANTAGES AND DISADVANTAGES OF NC?

ADVANTAGES--

1. CNC machines can be used continuously 24 hours a day, 365 days a year and only need to be switched off for occasional maintenance.

2. CNC machines are programmed with a design which can then be manufactured hundreds or even thousands of times. Each manufactured product will be exactly the same.

3. Less skilled/trained people can operate CNCs unlike manual lathes / milling machines etc.. which need skilled engineers.

4. CNC machines can be updated by improving the software used to drive the machines

5. Training in the use of CNCs is available through the use of 'virtual software'. This is software that allows the operator to practice using the CNC machine on the screen of a computer. The software is similar to a computer game.

6. CNC machines can be programmed by advanced design software such as Pro/DESKTOP®, enabling the manufacture of products that cannot be made by manual machines, even those used by skilled designers / engineers.

7. Modern design software allows the designer to simulate the manufacture of his/her idea. There is no need to make a prototype or a model. This saves time and money.

8. One person can supervise many CNC machines as once they are programmed

they can usually be left to work by themselves. Sometimes only the cutting tools need replacing occasionally.

1. **9.** A skilled engineer can make the same component many times. However, if each component is carefully studied, each one will vary slightly. A CNC machine will manufacture each component as an exact match.

DISADVANTAGES—

1. CNC machines are more expensive than manually operated machines, although costs are slowly coming down.

2. The CNC machine operator only needs basic training and skills, enough to supervise several machines. In years gone by, engineers needed years of training to operate centre lathes, milling machines and other manually operated machines. This means many of the old skills are been lost.

3. Less workers are required to operate CNC machines compared to manually operated machines. Investment in CNC machines can lead to unemployment.

4. Many countries no longer teach pupils / students how to use manually operated lathes / milling machines etc... Pupils / students no longer develop the detailed skills required by engineers of the past. These include mathematical and engineerin

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