



## Winter – 12 Examination

Subject Code : 12154

Model Answer

**Q.1a.** Attempt any THREE of the following

i) Write product application of EDM (at least 04 applications 01 each) **04**

- Ans.
1. Manufacturing tools having complicated profiles.
  2. Stamping tools like stamping Die.
  3. Dies and moulds like extrusion dies; wire drawing dies, plastic moulds.
  4. Thin electronics parts.
  5. Aero space parts.
  6. Refractory materials, carbides hardened steel production components.

ii) Differentiate between subroutine and canned cycle. (any four differences) (01 each) **04**

- | Ans. | Subroutine  | Canned Cycle   |
|------|---|--|
|      | 1. Subroutines are subprograms. Denoted by letter L followed by number e.g. L 110   | 1. Canned cycle are fixed cycles are turning, milling, boring cycles.            |
|      | 2. Subroutines are used for certain fixed sequence or frequently repeated patterns. | 2. Canned cycles are used for repetitive and commonly used machining operations. |
|      | 3. M 98 and M 99 codes are used to starts and exist the subroutine.                 | 3. G 81 to G 89 codes are reserved for canned cycle.                             |
|      | 4. Subroutines are stored in the memory under separate program number.              | 4. Canned cycles are stored in the memory under G code address.                  |

iii) Write the characteristics features of single spindle automats and give its applications. **04**

Ans. Single spindle automats operate on a single component at a time it includes. (02 for features at least 04 nos., 02 for applications)

- i) Work spindle
- ii) Control shafts
- iii) Cross-slides
- iv) Turret and its slides or indexing mechanism
- v) Feed mechanism.

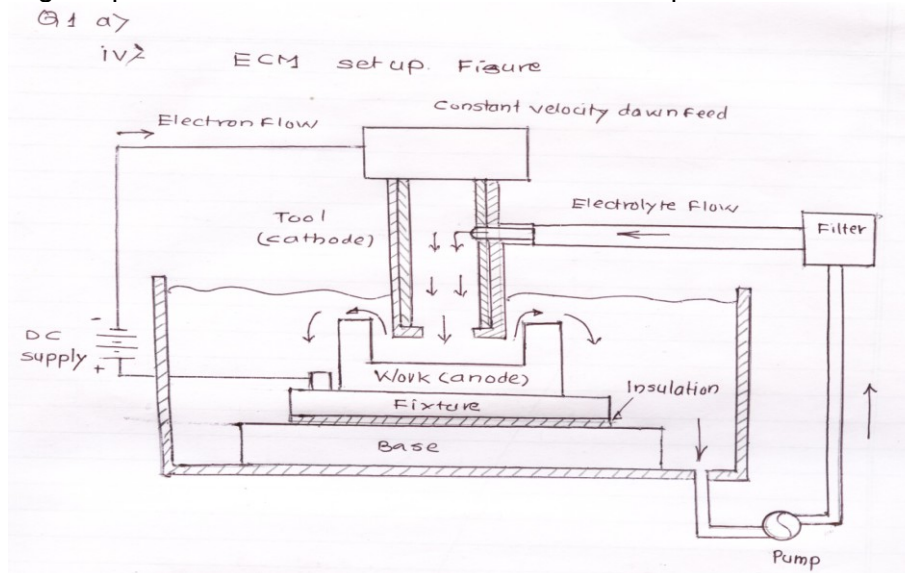
Commonly used examples are automatic cutting off machines, Swiss type automatic screw machines.

Applications:-

- 1) Automatic cutting off machines are used to produce short components requiring turning, forming, drilling, threading, cutting off.
- 2) Swiss type machines are used for machining slender parts of small diameter, manufacturing screw bolts pins from bar.

iv) Explain the principle and working if ECM with neat sketch. **04**  
(01 for principle, 03 for working with sketch)

- Ans. Principle of ECM :- The principle of ECM process is based on Faraday's law of electrolysis. Metal is removed by controlled dissolution of anode of an electrolysis cell.  
Working :- The figure shows a typical set up of ECM the machining set up consists of a tank and electrolyte. The tool and workplace are held close to each other with a very small gap (0.5mm) between them. A mild dc voltage of about 3 to 30 volts is applied between the two and an electrolyte continuously pumped in to the gap. Due to applied voltage current flows through the electrolyte. Workplace is acts as anode while tool is acts as cathode. The electrochemical reaction taking place due to flow of ions results in the removal of metal from the work piece in the form of sludge. This sludge is taken away from the gap by flowing electrolyte along with it. The work piece is held stationary during the process while the tool is fed at a constant speed in a linear direction.





**Q.1b.** Attempt any ONE of the following. (03 for applications at least three, 03 for explanation) **06**

i) What are the various applications of LBM? Explain the application of LBM for welding

Ans. Applications of LBM

- 1) Drilling small holes in hard materials e.g. surgical needles.
- 2) Cutting complex profiles on thin and hard materials.
- 3) Cutting or engraving patterns on thin films.
- 4) Trimming of carbon resistors.
- 5) Welding of thin specimens.

Explanation - Laser beam welding :-

Laser beam welding is a versatile process capable of welding carbon steels, HSLA steels, aluminum and titanium.

Laser beam welding is a technique of joining multiple pieces of metals through the use of a laser. The beam provides a concentrated heat source allowing for narrow, deep welds and high welding rates. The laser beam welding has high power density (about 1 megawatt/cm<sup>2</sup>) resulting in a small heat affected zones and high heating and cooling rates. The spot size of the laser can vary between 0.2 mm to 13 mm. The quality of the laser weld is excellent. The process is frequently used in high volume applications like automotive industry.

ii) What are the main parameters to be considered while selecting a particular non-traditional machining process? Explain with suitable example. **06**  
(04 for parameters at least 04, 02 for example)

Ans. The common parameters to be consider while selecting a particular no-traditional process are

1. Physical properties of work material.
2. Type of operation required.
3. Shape and size required to be produced.
4. Process capabilities such as expected tolerance, surface finish, metal removal rate; power requirement.
5. Process economy.

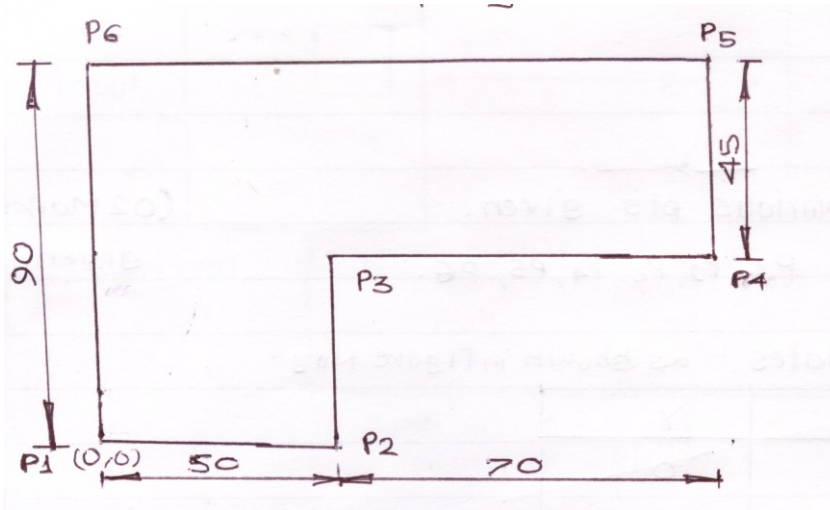
Example :- Manufacturing a plastic mould by EDM process.

Plastic mould is required hard material, which is difficult to machine by conventional machining method. Good surface finish & close tolerances  $\pm 0.05$  to  $\pm 0.003$  are required. Which can be maintained keeping low MRR in EDM. EDM is economical as compare to other non-conventional processes. Complicated shape and size is not possible to manufacture with conventional machining process. High surface finish can be maintained by keeping MRR low.

**Q.2a.** Attempt any TWO of the following.

**16**

- a) Explain major preparatory codes used in part programming and write the program for the job shown in Figure No.1 (03 for preparatory codes, 05 for program, if correct positions are given 02 can be given)



The major preparatory codes used by in the program for Figure No.1 are as follows.

Codes	Functions
G 21	Input dimensions are given in mm.
G 94	Feed rate given in mm per minute.
G 90	Absolute dimensioning.
G 00	Rapid traverse.
G 01	Linear interpolation.

### PROGRAM

```
010 Billet size x 140 y 100 z+10
020 Tool Def. D 6 T01
030 Edge move x 0, y0
040 G 21, G 94
050 G 90
060 M 03 S 1000
070 G 00 x 0 y 0
080 G 01 x 50 y 0 F 50
090 G 01 x 50 y 45
0100 G 01 x 120 y 45
0110 G 01 x 120 y 90
0120 G 01 x 0 y 90
0130 G 01 x 0 y 0
0140 G 00 x z 25
0150 M 03
0160 M 30
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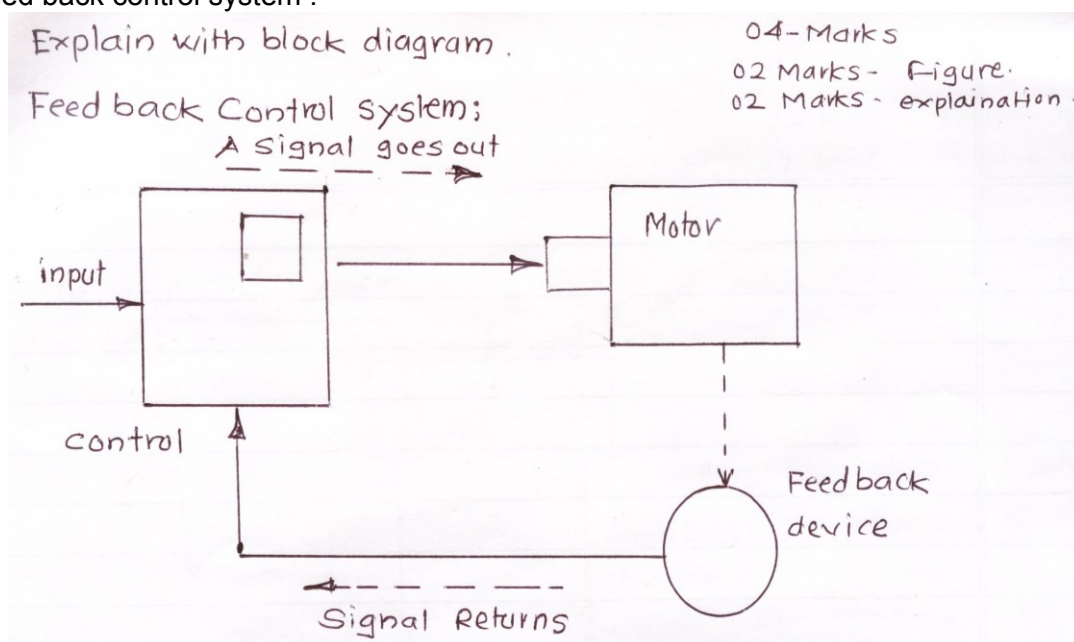
If positions of various pts given.

Positions of pts P1, P2, P3, P4, P5, P6.

Point	X	Y
P1	0	0
P2	50	0
P3	50	45
P4	120	45
P5	120	90
P6	0	90

- 2.b) Explain with block diagram  
1) Feed back control system :

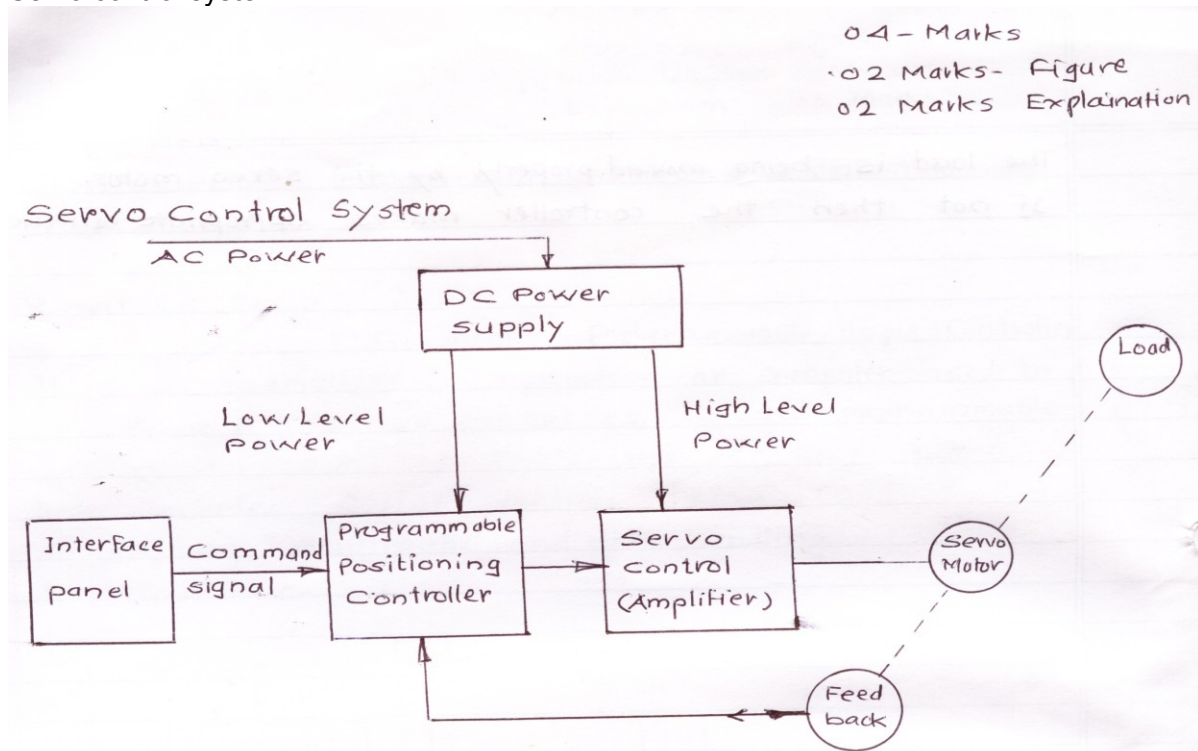
04



The above figure shows, feed back control system. Feed back control system is a closed loop control system. Which is characterized by presence of feed back devices. Techogenrators and rotary as well as linear transducers are used as a velocity and position feed back devices respectively. In this system displacement can be achieved to a very high degrees of accuracy. The feed back from the monitoring device is compared with the input signal and slide position is regulated by the servo system until it agrees with the desired position. Feed back control systems are more reliable, accurate, effective and suitable for all kinds of operations.

2) Servo control system

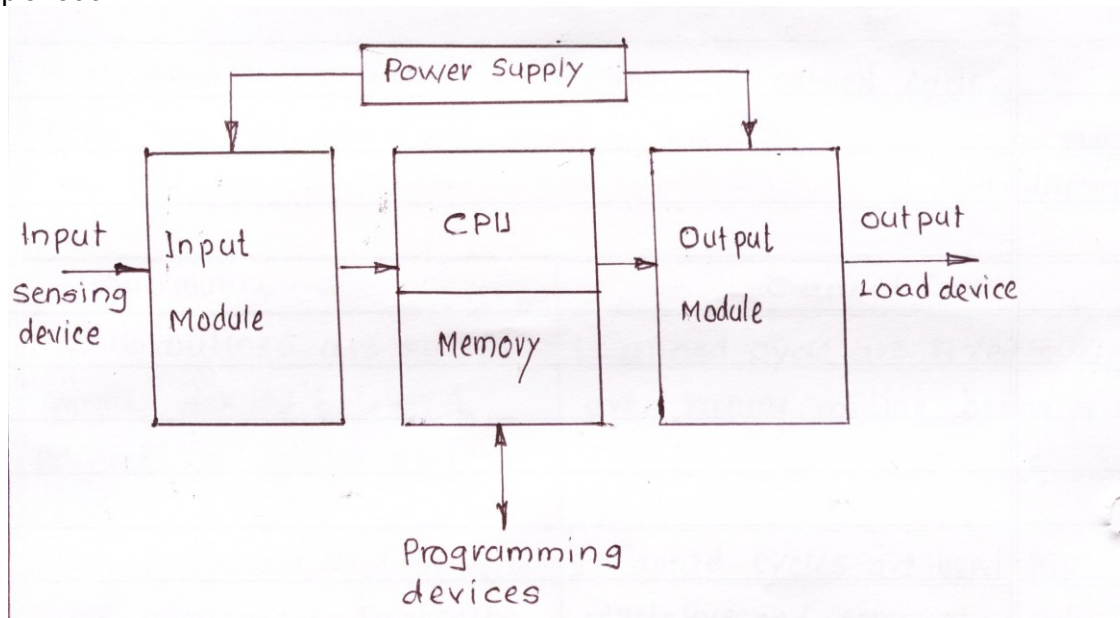
04



The above figure shows block diagram of servo control system. In servo control system, a command signal is issued from the user's interface panel, which comes in to the servo's positioning controller. Positioning controller stores information about various jobs or functions. It has been programmed to activate the motor or load e.g. change in speed or position. Then signal passes in to the servo control or amplifier section. In the section low power level signals are amplified to higher speeds to provide torque for moving the heavy loads.

The servomechanism consists several devices. As load moves, techometer or encoder providing feed back signal to the positioning controller whether the motor is doing the proper job positioning controller checks this feed back signal and determine whether the load is being moved properly by the servo motor. If not then the controller makes appropriate corrections.

- c) What is PLC? Explain with suitable block diagram working of PLC.
- Ans. PLC means programmable logic controller. It is a specialized microprocessor or computer used to control machine and processes. It uses programmable memory to store instructions and specific functions that includes ON/OFF control, timing, counting, sequencing, arithmetic and data handling. (02 what is PLC, 03 block diagram. 03 explanation)  
Explanation:-



The above figure shows block diagram of PLC. PLC consists of input module, processor (CPU), output module, and programming devices. Input module is a interface between input field devices and controller while output module is interface between controller and output field devices.

The processor is the brain of PLC. It consists of microprocessor for implementing the logic and controlling the communication among the modules. The processor is designed to enter the desired circuit in relay ladder logic form. It not only accepts input data from various sensing devices but also execute the stored the program and sends appropriate output commands to control devices.

PC is used as a programming device. The loaded software allows user to crate, edit document, store and trouble shoots of program. The PC communicates with PLC process through data communication cables.

Q.3. Attempt any FOUR of the following.

16

- a) State the prime requirements of any tool material for EDM.
- Ans. Prime requirements of tools material for EDM. Each requirement 1 mark (any4)
- 1) It should be good conductor of electricity.
  - 2) It should have low wear rate.
  - 3) It should have high thermal conductivity.
  - 4) It should have good machinability.
  - 5) It should have high melting point.
  - 6) It should be cheap and easily available.



b) Explain the functions of the dielectric fluid used in EDM.

Ans. Each function 1 mark (any4)

- 1) It should act as a conductor, once breakdown voltage is reached.
- 2) It should act as an insulator.
- 3) It should clean the spark gap by carrying away the molten metal.
- 4) It should cool the tool, work piece & spark region.
- 5) It should deionise the spark gap after discharge has occurred.

c) Write the importance of automatic tool changer and tool magazine.

Ans. Automatic tool changer importance – (2mark)

To improve utilization of machining centre, it is necessary to minimize the idle motion of tool.

The tool must be replaced quickly for next machining operation.

ATC are used where number of tools are used for different machining operations.

They allow tool changing without the intervention of the operator.

Tool change operation is performed in less than 4 seconds.

Tool magazine – (2mark)

Tool magazine is used to store the tools required during machining operation.

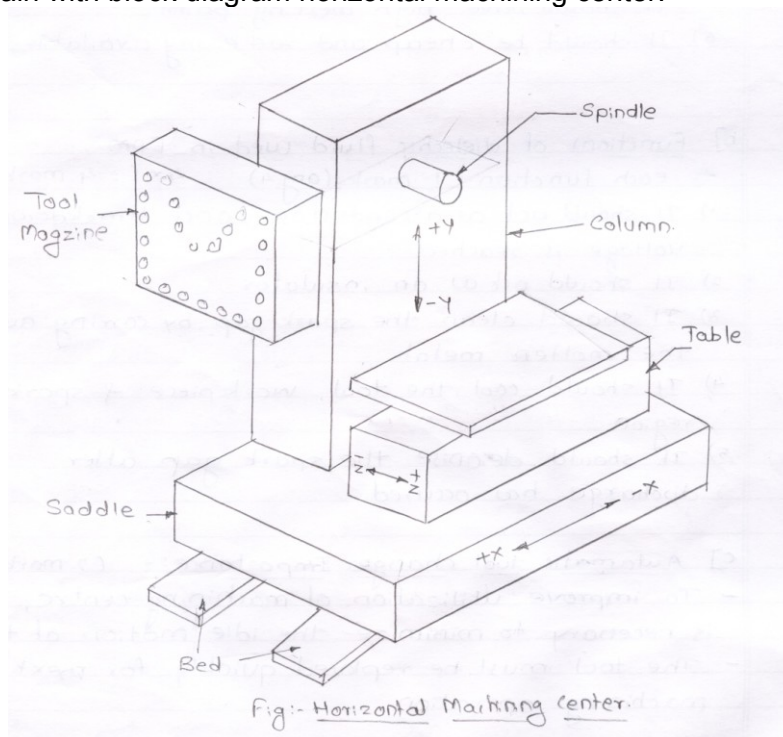
Storage capacity of magazine starts with about 12 to 200 or even more.

The tools in the tool magazine are identified by the tool number using the same number as in the part program.

The magazine varies in size & shape depending on the capacity of machine.

Type – i) Drum type ii) Chain type.

d) Explain with block diagram horizontal machining center.



02



These machines have horizontal machining axis.

This is the redesign of CNC milling machine with ability to perform variety of operation.

The saddle provides x-axis movement.

The column provides y-axis movement.

Spindle and table provides z-axis movement.

- e) Explain with neat diagram working of AJM process. State two applications.  
Ans. Abrasive Jet Machining.

Working :- (2marks)

The process consists of a mixture of fine abrasive particles, usually about 0.025 mm in diameter and gas at high pressure.

This stream of mixture directed through a nozzle on to the surface of the work piece.

The abrasive particles impinge on the work piece at high speed.

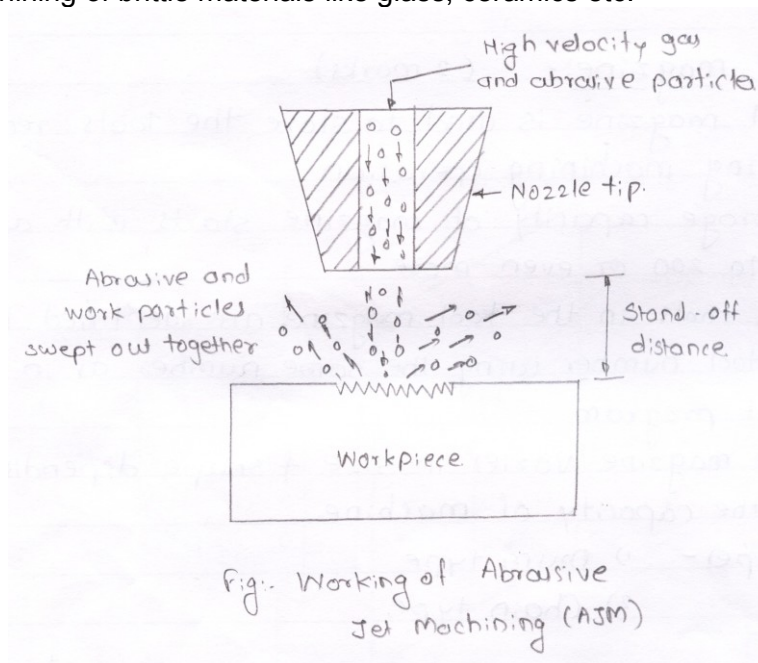
It causes a small fracture of the work surface.

Which results in removal of metal.

The gas stream carries both the abrasive particles & the fractured particles away.

Applications :- (1mark) (any two)

- 1) Fine drilling & micro welding.
- 2) Machining of semiconductors.
- 3) Machining of intricate profiles.
- 4) Machining of brittle materials like glass, ceramics etc.



(01 mark)



**Q.4a.** Attempt any THREE of the following.

i) What are different type of maintenance? Explain any one.

Ans. Types of maintenance. (2marks)

- 1) Preventive maintenance.
- 2) Predictive maintenance.
- 3) Breakdown maintenance.
- 4) Corrective maintenance.
- 5) Scheduled maintenance.

Explain any one (2marks)

ii) What is meant by SPM? Give applications of SPM.

Ans. SPM (Special Purpose Machine) (2 marks)

It is defined as a machine tools that perform same operations on every components & different operations on the same component such that all the components produced are interchangeable.

Application of SPM (2 marks) (any 4)

- 1) Gun drilling machine.
- 2) Automatic screw cutting machine.
- 3) Gear hobbling.
- 4) Copying machine.
- 5) Transfer machine.
- 6) Cutting off machine.

iii) Explain the need of repair cycle analysis in maintenance of machine tools.

Ans. Needs of repair cycle analysis (4 marks) (any 4)

- 1) To carrying out inspection, repair and complete overhaul of the machine.
- 2) To know the inspection repair turn comes.
- 3) To determine no. of maintenance required.
- 4) To determine quantity of spare parts requires.
- 5) To determine list of material required.
- 6) To estimate annual repair cost of machine tool.

iv) Explain the different functions of preventive maintenance.

Ans. Functions of preventive maintenance. (4 marks) (any 4)

- 1) To prevent the failure of equipment before it actually occurs.
- 2) To record equipment deterioration, to repair or replace the worn parts.
- 3) To minimize loss of production by preventing breakdown.
- 4) To provide safety to operators & workers.
- 5) To ensure availability of equipment & ready for use.
- 6) To maintain the optimum productive efficiency & to maintain operational accuracy of the equipment.



b) Attempt any ONE of the following.

i) What is repair complexity? State effect on deciding the maintenance schedule.

Ans. Repair Complexity (4 marks)

It indicates the complexity of a machine tool.

It is a relative index to give a comparative idea of the complexity of a machine.

Repair complexity is indicated by figures.

It helps in deciding the duration between the individual repairs & in turn the repair cycle.

Also the cost of repair, manpower required, and spares required etc. depends upon the complexity of machine tool.

It changes with change in specification.

Its value increases with increase in capacity of the machine.

Ex. Repair complexity for a center lathe is 5.

Effect on deciding maintenance schedule :- (2 marks)

Tells about requirement of materials.

Tells about requirement of time.

Tells to buy components required.

Tells about material, labour & overall cost.

ii) How will you classify SPM? Give examples in each category.

Ans. Classification of SPM

SPM are broadly classified into two types

1) Machine in which work piece remains at one position. (2 marks)

In such case, the machine may perform either one operation as more operations simultaneously.

The job is loaded at the performed & work piece is unloaded.

Ex. Automatic screw cutting machine, capstan lathe, turret lathe. (1 mark)

2) Machine in which work piece moves from one station to another. (2 marks)

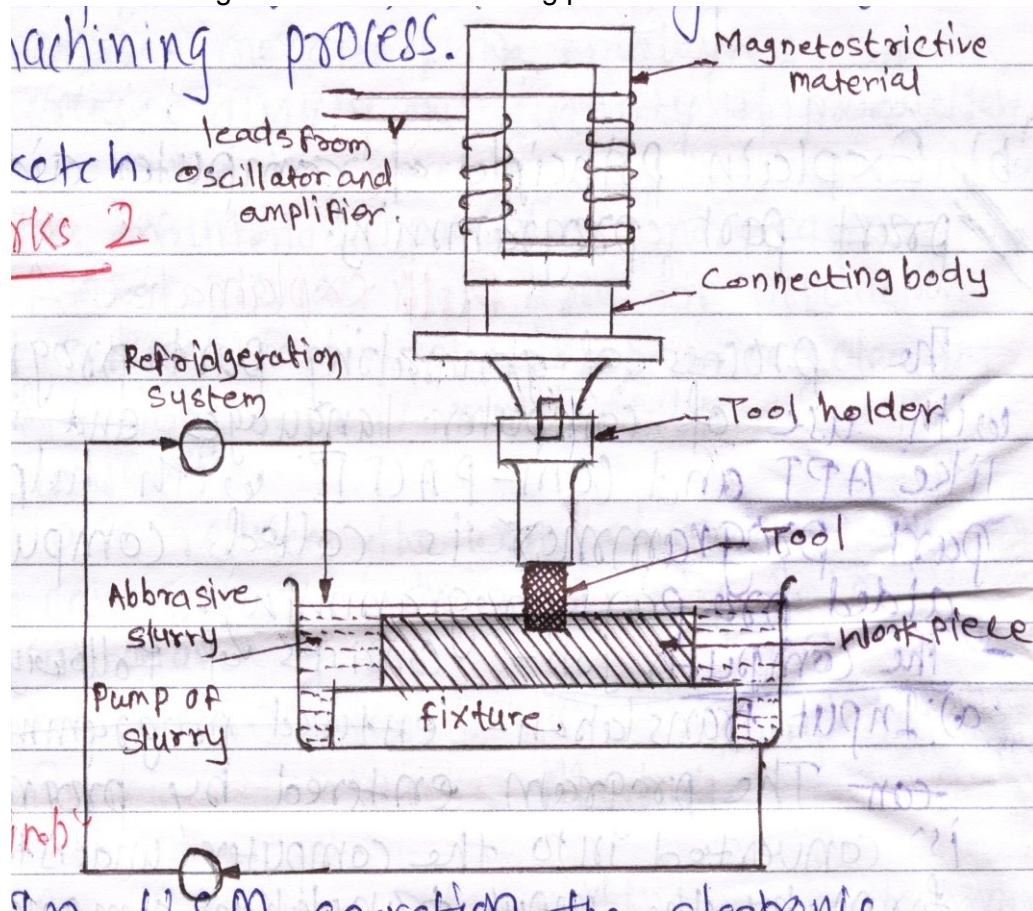
The entire job is not machined on one workstation.

The work piece is loaded at one station, some operation is performed & moved to another station.

The work piece is unloaded at the last station.

Ex. Transfer machine. (1 mark)

- Q.5** Attempt any FOUR of the following. 16  
a) Explain with neat diagram ultrasonic machining process. 02  
Ans.



In USM operation the electronic oscillator and amplifier converts the available electrical energy of low frequency to high frequency power of the order of 20 KHz, which is supplied, to the transducer. The transducer operates by magnetostriction. The magnetostrictive material produces longitudinal vibratory motion of the tool. The amplitude of these vibrations transmitted to the penetrating tool through a mechanical focusing device, which provides intense vibration of the desired amplitude at tool end.

As the tool vibrates with a specific frequency an abrasive slurry a mixture of abrasive grains and water is made to flow under pressure through the tool and work piece interface. Due to the impact force of vibration through the microscopic grain causes the abrasion to remove the work material. The tool has the same shape as the cavity to be machined.



b) Explain principle of computer aided part programming.

Ans. Full explanation 4 marks

The process of generating part programmes with use of computer languages like APT and COM-PACT II with help of part programmer is called computer aided part programming.

The computer job – consists of following steps.

- Input translation – The program entered by programmer is converted into the computer understandable form by the input translation component.
- Arithmetic calculations – This component helps in solving the mathematics required to generate the part surface.
- Cutter offset compensation – The program is written for component outline. But the actual cutter path depending on the cutter diameter is determined by the computer.
- Post processor – This unit prepares the separate computer program used for a specific machine tool.

Part programmers job

- Defining the component geometry – Any part composed of the basic geometric shape of line and circle. The programmer job is to identify each entity and dimension it.
- Specifying the operation sequence and the tool path – The next job of the programmer is to construct the path that should be followed by cutter. The tool path involves details steps involved in cutter movement.

c) How housekeeping as a part of maintenance program is useful for the organization?

Ans. Each parts ½ mark

It reduces number accidents.

It increases, life of machines tools and equipments buildings.

Increases morale of the employee.

Increases quality and quantity of production.

Saves time in searching any tools or equipments.

Makes maintenance procedure more easier.

It provide more area for production.

It reduces cost of cleaning because, cleaning after long time is much costlier and time consumes.

It also reduces the work of maintenance hence we can say that house keeping is part of maintenance of the machine.

d) What is cutter radius compensation?

Ans. Explanation 3 marks

At the time of writing a part programme a cutter of suitable diameter is selected and programmer is developed for centre line of the cutter. But when actual machining is done, if a cutter of smaller diameter is used, it will result in a larger work piece and vice versa.

The difference in the programmed diameter of the cutter and the diameter of the actual cutter is accounted for by cutter radius compensation.



The difference diameter of the cutter is entered in to the control system. The control system will then generate a new cutter path. The new path will be separated from programmed cutter path by difference in the radius of programmed cutter and actual cutter it is necessary to indicate whether compensation is to be made to right or to the left the tool when machining.

The following are three G codes for cutter radius compensation.

G 41 – To shift programmed cutter path to left.

G 42 – To shift programmed cutter path to right.

G 40 – Cancel cutter radius compensation.

e) What are the elements of control system? (elements 02 marks, explanation 02)

Ans. The basic elements of any control system are given below.

- i) Process or system :- It is the assembly of various physical components many variables may be involved in process which are required to control or regulate. Ex. Flow of liquid in a tank or of the tank.
- ii) Measurement :- To control the variable there must have information about the variable it self. This information can be found by measurement of the variable. This measurement is performed by some sensor, mechanical signature, and electric display.
- iii) Error detector :- Error is the difference between actual value and set value. A comparator or error detector is used to compare these value and forwarded to controller.
- iv) Controller :- Controller examines, the detected error which are received from comparator and then determines the action to be taken required to bring the controlled variable to set point value.
- v) Control Element :- The element which used to take action for implementing the decision taken by the controller is called as control element. It takes input from the controller and transfers to the process.

- f) Why axis identification is necessary in CHC machine system? Explain the axis identification in milling with simple diagram.

Ans. Necessity of axis identification. (01 mark)

CNC machine have two or more slide ways disposed at right angles to each other along with the slides are displaced. Each slide is fitted with control system, so it is necessary for giving commands to the control system, the axis have to be identified.

Explanation 3 marks.

Z axis always along with spindle.

+ Z cutting tool move away from W.P.

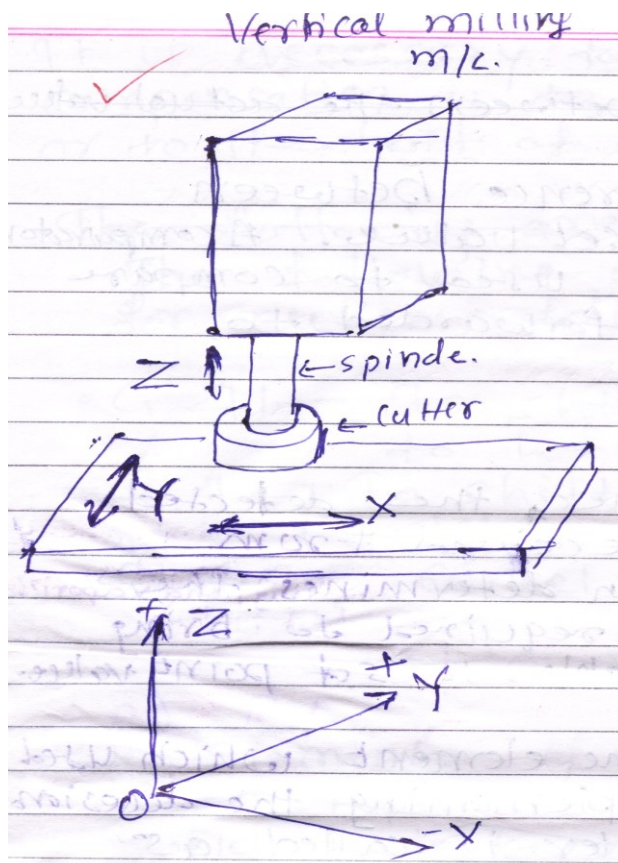
- Z cutting tool move towards W.P.

X axis this is always horizontal and parallel to the surface of W.P.

+ X right side.

- X left side.

Y axis it is perpendicular to X and Z axis which represent cross travel in case of vertical milling m/c.





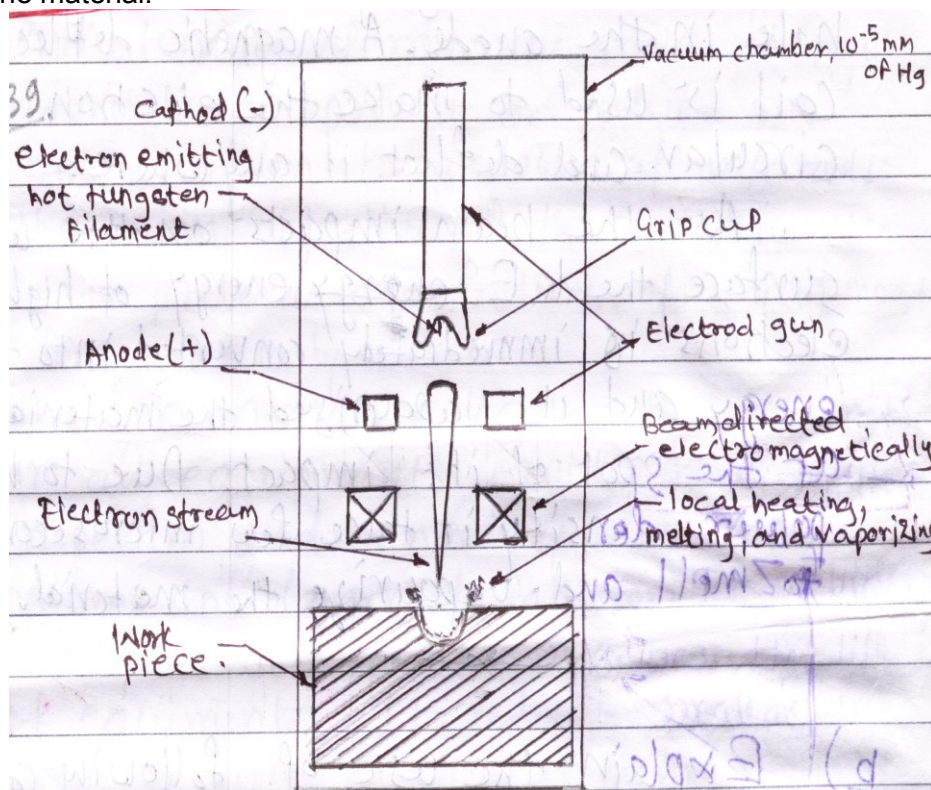
Q.6. Attempt any FOUR of the following.

a) With neat sketch explain the working principle of EBM. (sketch 02, working principle 02)

Ans. Working principle :- A beam of electron is emitted from the electron gun which is basically a triode consisting of 1) A cathode which is hot tungsten filament at  $2500^{\circ}\text{C}$  emitting high negative potential. 2) A grid cup negatively biased with respect to the filament. 3) An anode which is heated at ground potential, and which the high electrons pass.

The gun is supplied with electronic current from a high vol. D.C. source. The flow of electrons is controlled by negative bias applied to the grid cup. The electrons passing through the anode are accelerated to two thirds of vel. of light by applying 50 to 150 KV. At the anode, and this speed is maintained till they strike the work piece. Due to pattern of the electronic field produced by the grid cup, the electrons are focused and made to flow in the form of converging beam through a hole in the anode. A magnetic deflection coil is used to make the electron beam circular and deflect it any where.

As the beam impacts on the work piece surface the K.E. energy of high velocity electrons is immediately converted into thermal energy and it vaporized the material at the spot of its impact. Due to high power density it takes few microsecond to melt and vaporize the material.



b) Explain the use of following codes

Ans. Each 1 mark.

G 00 – Rapid traverse of cutting tool. Without any machining.

G 01 – Linear interpolation as given feed rate in programme.

G 02 – Circular interpolation as given feed rate clockwise.

G 90 – Absolute programming or absolute dimensioning.



- c) How preventive maintenance is better than breakdown maintenance?  
Ans. Full explanation 4 marks.  
Preventive maintenance is the planned maintenance of machine tools at regular intervals to prevent or reduce the sudden breakdown of m/c tools. The main objective of this maintenance is to prevent the failure of equipment before actually occurs. This maintenance locates the weak spots in all equipments, provides them regular inspection and minor repairs which reduces the danger of failure. It provides safety to the operator, increases the life of equipments. It reduces breakdown time because all procurement is done as scheduled and this minimizes loss of production. It also identifies the equipments requiring high maintenance cost.
- d) Define limit switches and proximity switches and state its functions.  
Ans. Definition – 2 marks, function – 2 marks.  
Limit switches - A limit switch is mechanical device that uses physical contact to detect a target. It consist of switch body and operating head.  
Proximity Switches – It is a device to defect the presence of target without making the physical contact with the target. It is close or open electric or electronic circuit.  
Functions of limit switch –  
1) To control the movement of mechanical part.  
2) To provide the function of making and breaking electrical contacts and consequently electrical circuits.  
3) It interlocks mechanical motion with an electrical circuits.  
Function of Proximity Switches –  
1) To measure the position of machine components without physical contacts.  
2) Detecting a noise.  
3) Detecting a open or closed door.  
4) Detecting a shadow.
- e) Define part programming. Give the meaning of following codes. (def. 01, code 01each)  
Ans. Define of part programming – Part program defined as the way in which the blocks of instructions are planned and written such that after its execution on the CNC machine the required shape is obtained on the work piece in minimum possible time. OR  
- Part program is a set of instructions the machine tool about the processing steps to be performed the manufacture of component.  
- Meaning of codes.  
1) G 28  
2) G 40 – cutter compensation cancel.  
3) M 02 – program stop.

----- The End -----