



SCORING INDICATORS

Page: 10
April: 2024

COURSE NAME: MODERN PRODUCTION PROCESSES
COURSE CODE: 5023 A

QID: 2109230038

Qn. No	Scoring Indicator	Split score	Sub total	Total Score
PART- A				9
1	Jig	1	1	
2	Compaction	1	1	
3	Faraday's laws of electrolysis.	1	1	
4	Electro discharge machining	1	1	
5	Copper brass copper tungsten alloy	1	1	
6	Three	1	1	
7	Slicing	1	1	
8	Direct Numerical Control (DNC)	1	1	
9	Material Handling, Welding, Spray Painting, Assembling, Machining	1	1	
PART-B				24
1	a. Study of workpiece and finished component size and geometry. b. Type and capacity of the machine, its extent of automation. c. Provision of locating devices in the machine. d. Available clamping arrangements in the machine. e. Available indexing devices, their accuracy. f. Evaluation of variability in the performance results of the machine. g. Rigidity and of the machine tool under consideration. h. Study of ejecting devices, safety devices, etc. i. Required level of the accuracy in the work and quality to be produced.	1 X 3	3	
2	a. Powder production b. Mixing or Blending c. Compaction d. Sintering e. Secondary Operations f. Heat treatment/ Finishing	$\frac{1}{2} \times 6$	3	
3	Organic coatings are also a type of non-metallic coatings provides a barrier between the surface of substrate and its surroundings. It also improves appearance of surface. However, there is no appreciable improvement in mechanical properties of the substrate surface. Organic coatings can be applied to both metallic and non-metallic surfaces. Different organic coatings are: Oil painting, Varnishing, Enamelling, Lacquering, Rubber based coatings, Teflon coatings, Bituminous painting.	1 x 3	3	
4		3	3	

5	<ul style="list-style-type: none"> a. Chemical machining b. Ultrasonic machining c. Electric discharge machining 	1 x3	3	
6	<ul style="list-style-type: none"> i. Machining is accurate and have very high precision ii. Time taken to perform a job is very less iii. Safe to operate iv. Number of operators required to operate a machine are reduced v. Even very complex designs can also be made vi. Wastage generated by CNC machining is low as compared to conventional machining vii. It reduces the number of defective products produced to almost zero viii. It is more efficient and faster compared to conventional machining ix. One operator can supervise more than one machine at a time x. It can work on a wide range of materials 	1 x 3	3	
7	<ul style="list-style-type: none"> a. Turret Type Magazine. b. Drum Type Magazine. c. Chain Type Magazine. 	1 x3	3	
8	The machining Centre in a control machine is an automatic tool changing arrangement that is designed to perform a variety of machining operations, with large number of cutting tools and provided with a continuous path CNC system.	3	3	
9	<ul style="list-style-type: none"> 1. Construct a CAD model. 2. Convert it to STL format. 3. Slicing. 4. Layer by layer printing 5. Finishing 	3	3	
10	<ul style="list-style-type: none"> a. To increase labour productivity b. To reduce labour cost c. To mitigate the effects of labour shortages d. To reduce or eliminate routine and clerical takes e. To improve worker safety. 	1 x 3	3	

PART-C

42

III	SI No	Jig	Fixture	1 x 7	7	7
	1	It guides the cutting tool.	It does not guide the cutting tool.			
2	It is mostly attached to the machine table.	It is always attached to the machine table.				
3	Jig is generally lighter than the fixture.	Fixture is generally heavier than the Jig.				
4	Jig feet is used in its construction.	No such feet are used in its construction.				
5	Bushes are used in a jig for guiding the cutting tool.	Bushes are not used in fixtures.				
6	It is specially used for drilling, reaming & boring operations.	It is specially used for milling, turning, grinding operations.				
7	Jig is widely used on drilling machine.	Fixture is widely used in milling, grinding machines.				
8	Jig is costlier.	Fixture costs less as compared to the jig.				
9	Complex designing.	Less complex designing.				

IV

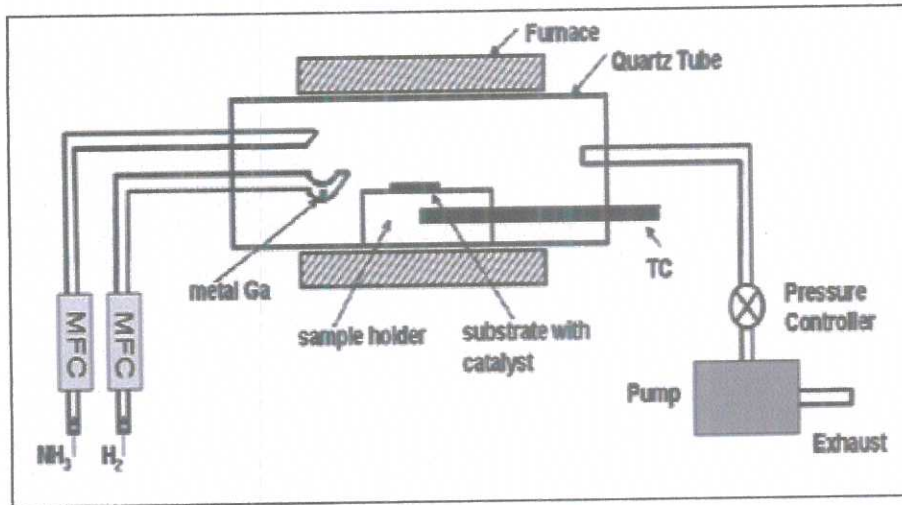


Fig. 3

Chemical vapor deposition (CVD) is a chemical process used to produce high-purity, high-performance solid materials. The process is often used in the semiconductor industry to produce thin films. In a typical CVD process, the wafer (substrate) is exposed to one or more volatile precursors, which react and/or decompose on the substrate surface to produce the desired deposit. Frequently, volatile by-products are also produced, which are removed by gas flow through the reaction chamber.

Micro fabrication processes widely use CVD to deposit materials in various forms, including: monocrystalline, polycrystalline, amorphous, and epitaxial. These materials include: silicon, carbon fibre, carbon nano fibres, filaments, carbon nanotubes, SiO₂, silicon-germanium, tungsten, silicon carbide, silicon nitride, silicon oxynitride, titanium nitride, and various high-k dielectrics. The CVD process is also used to produce synthetic diamonds.

STEPS

1. Substrate Preparation
2. Precursor Selection
3. Gas Delivery
4. Heating
5. Chemical Reactions
6. Film Growth
7. Cooling
8. Gas Removal

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Expl 4

V

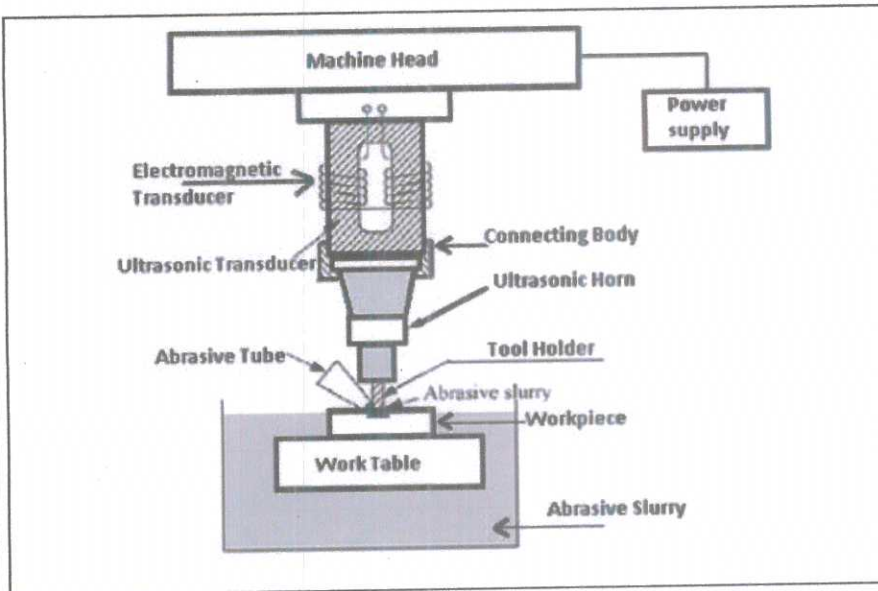
1. Machining of Hard and Brittle Materials
2. Complex and Intricate Geometry
3. Minimal Thermal Damage
4. Low Mechanical Stress
5. Minimal Tool Wear
6. Microfabrication and MEMS Production
7. Environmental Friendliness
8. Versatility in Material Selection
9. High Material Removal Rates
10. Customization and Adaptability
11. Surface Finish
12. Suitability for Delicate and Thin Materials
13. Research and Development
14. Versatility in Tooling
15. Reduced Heat-Affected Zone (HAZ)
16. High Precision in Microscale
17. Enhanced Product Design Freedom
18. Reduced Lead Times

1 x 7

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VI



3

1. **Workpiece Preparation:** Begin with a hard and brittle workpiece, such as ceramics or glass.
2. **Tool Selection:** Choose a tool made of a softer material than the workpiece, usually metal or a softer ceramic.
3. **Abrasive Slurry:** Prepare an abrasive slurry consisting of abrasive particles (e.g., diamond or boron carbide) mixed with a suitable liquid (e.g., water or oil).
4. **Setup:** Position and clamp the workpiece and tool, ensuring precise alignment.
5. **Ultrasonic Vibrations:** Apply high-frequency mechanical vibrations (typically 20 kHz to 50 kHz) to the tool. These vibrations are generated by an ultrasonic transducer and are transmitted to the tool's tip.
6. **Abrasive Erosion:** The vibrating tool tip contacts the workpiece surface while submerged in the abrasive slurry. The abrasive particles impact the workpiece, causing material removal through erosion and abrasion.
7. **Material Removal:** Material is removed from the workpiece's surface as small chips or particles due to the abrasive action. The high-frequency vibrations aid in efficient and precise material removal.
8. **Control:** Monitor and control the machining process to achieve the desired shape and dimensions. Adjust the depth of material removal and tool movement as needed.
9. **Cooling and Cleaning:** The abrasive slurry serves to cool the tool and workpiece during machining, dissipating heat generated by friction. It also carries away the eroded material, helping to maintain a clean cutting zone.

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⇒ VII

Please refer last page

Advantages

VIII

1. Machining of Hard and Brittle Materials
2. Complex Geometry
3. Minimal Thermal Damage
4. Low Mechanical Stress
5. Minimal Tool Wear
6. Microfabrication and MEMS Production
7. Environmental Friendliness
8. Versatility in Material Selection

1 x 4

4

	<p><u>Limitations</u></p> <ol style="list-style-type: none"> 1. Slower Material Removal Rates 2. Higher Initial Setup Costs 3. Complex Programming 4. Limited to Conductive Materials 5. Environmental Concerns 6. Tool Erosion 			1 x 3	3	7
IX	Seq. No	Programme	Explanation	7	7	7
	N 10	G21	Select metric			
	N 20	G40	Cancelling G41 & G42. (Tool radius compensation OFF)			
	N 30	G28 P3 U0 W0	Home position =X, W=Z.			
	N 40	G54	Work coordinate.			
	N 50	G92 S1200	Limiting speed.			
	N 60	G95 F0.1 T0101	Feed is 0.1 per revolution. T0101 is the tool.			
	N 70	G96 S250 M04	Cutting speed & spindle rotation (CW).			
	N 80	G00 Z2.0	Safety distance for Z axis. Tool will move rapidly to Z2.0. That is tool will stop at a distance 2.0 from face.			
	N 90	G00 X26.0 M08	Safety distance for X axis.			
	N 100	G01 X30.0 M08	Tool will move rapidly to 30 mm dia.			
	N 110	G01 Z-40.0	As the diameter of raw material is 25.			
	N 120	G01 X20.0 M08	Tool will move in feed to 20 diameter.			
	N 130	G00 X200 M09	M08-Coolant ON.			
	N 140	G01 Z-75.0	This is the taper movement of tool from (20.0,0.0) to (25.0,-75.0).			
	N 150	G30 P3 U0 W0	In X axis tool will lift upto 25 diameter and in Z axis too will move upto -75.0.			
	N 160	G01 X26.0	Tool will return to safety position with feed.			
N 170	G00 X30 M09	Tool will move to a safety distance of 200 diameter.				
X	Seq. No	Programme	Explanation			
	N 10	T1 M06	Tool change to tool no.1, Automatic tool change			
	N 20	G00 Z1	Rapid positioning, Z= 1 mm (1 mm above the work piece)			
	N 30	G90 G54 G00 X30 Y30	Drilling cycle (G90) Tool rapidly moves (G00) to first drilling position (G54) X=30mm Y=30mm while taking into account Zero-offset-no. 1			
	N 40	G01 Z-27 S1500 F100 M03	Drill starts rotating clockwise with 1500 rpm, feed= 100 mm/min, drill depth 25 mm 2 mm excess)			
	N 50	G00 Z1	Rapid positioning, Z= 1 mm (X= 30 mm, Y= 30 mm)			
	N 60	G00 Y120	Rapid positioning, Y= 120 mm (X= 30 mm, Z=1mm)			
	N 70	G01 Z-27	Drilling second position hole			

	N 80	G00 Z1	Rapid positioning, Z= 1 mm (X= 30 mm, Y= 120 mm)			
	N 90	G00 X120 Y30	Rapid positioning, X= 120 mm (Y= 30 mm, Z=1mm)			
	N 100	G01 Z-27	Drilling third position hole			
	N 110	G80 G00 Z1. M09	Drilling cycle is cancelled with G80 command, Coolant is turned off.			
	N 120	G28 G91 Z0. M05	As operation for this component is finished, so cutting tool is taken to reference position, and spindle rotation is stopped.	7	7	7
XI	<ol style="list-style-type: none"> Enhanced Efficiency: Automation helps industries streamline processes, reduce manual labour, and execute tasks more swiftly and accurately. This leads to increased productivity and efficiency in operations. Cost Reduction: Automation can lower labour costs, minimize errors, and reduce material waste, ultimately resulting in significant cost savings for industries. Improved Quality Control: Automation systems can consistently maintain high product quality and precision, reducing defects and ensuring that products meet the required standards. Safety: Automation can handle hazardous and repetitive tasks, reducing the risk of workplace accidents and ensuring the safety of workers. Increased Production Capacity: Automation allows industries to scale up production without proportionally increasing labour costs, thus meeting growing demands efficiently. Accuracy and Consistency: Machines and robots are capable of performing tasks with pinpoint accuracy and consistency, minimizing variations in output quality. Round the clock Operations: Automation systems can operate round-the-clock, ensuring continuous production without the need for breaks or shift changes. Data Collection and Analysis: Automation systems can gather data in real-time, enabling industries to monitor processes and make data-driven decisions for optimization. Competitive Advantage: Implementing automation can give industries a competitive edge by offering faster production, better quality products, and cost advantages in the market. Adaptation to Market Changes: Automation allows industries to quickly adapt to changing market demands and product variations, staying agile and responsive. Environmental Sustainability: Automation can help reduce energy consumption and waste, contributing to a more sustainable and eco-friendly production process. Labor Shortages: In regions facing labour shortages, automation can help fill gaps in the workforce and ensure continued production. Improved decision-making 			1 X 7	7	7
XII	<ol style="list-style-type: none"> Cartesian Robot (Rectangular Robot): Cartesian robots have three linear joints that move along the X, Y, and Z axes, making them suitable for precise, high-speed movements in a rectangular workspace. They are commonly used in pick-and-place applications, CNC machining, and 3D printing. Cylindrical Robot: Cylindrical robots consist of a rotary base with a single linear joint. This configuration allows for rotation about a vertical axis and 					

vertical movement along the Z-axis. They are often used in tasks like arc welding and material handling in cylindrical workspaces.

3. **Spherical Robot (Polar Robot):** Spherical robots have a polar coordinate system, with a rotating base and two rotary joints that control the orientation and reach of the end effector. They excel in tasks requiring a wide range of motion and are used in applications such as painting, assembly, and inspection.
4. **Articulated Robot (6-Axis Robot):** Articulated robots have six rotary joints, providing a high degree of flexibility and manoeuvrability. They can mimic human arm movements and are widely used in applications such as welding, painting, and material handling.
5. **SCARA Robot (Selective Compliance Articulated Robot Arm):** SCARA robots have two parallel rotary joints for X-Y plane movement and a vertical linear joint for Z-axis movement. They provide fast, precise positioning and are commonly used in assembly and material handling tasks.

Expl.
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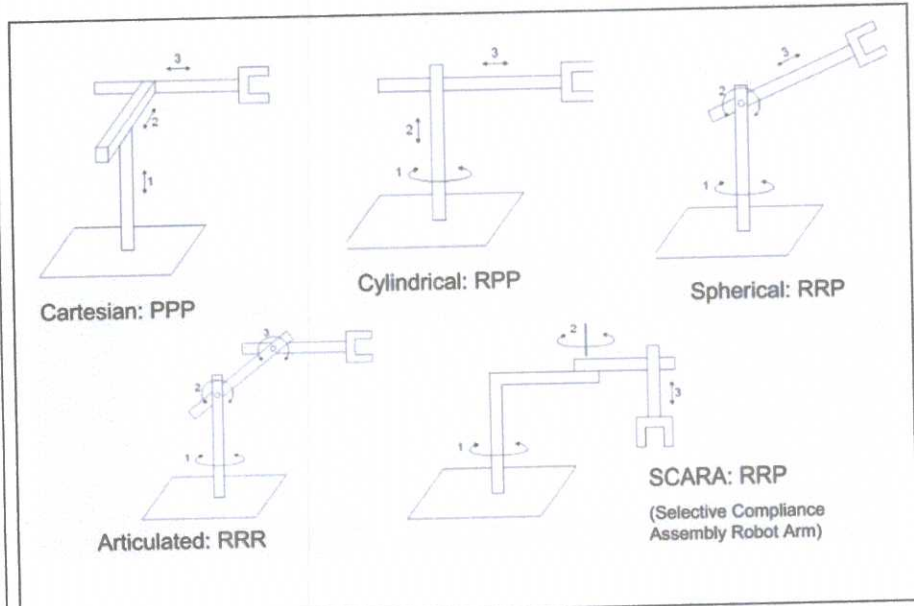


fig.
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XIII

Concept of Group Technology (GT):

Group Technology (GT) is a manufacturing concept based on the idea of classifying similar parts or processes into groups to streamline production. It involves identifying similarities in design, materials, dimensions, or manufacturing processes to create part families or process groups.

Components of Group Technology:

1. Part Families: Parts or products are grouped together based on similarities in attributes.
2. Coding and Classification: Each part is assigned a code based on its attributes for efficient management.
3. Machine Cells: Production facilities are organized into cells, each responsible for specific part families.
4. Standardization: Standardized processes, tooling, and setups ensure consistency and efficiency.
5. Reduced Setup Times: Minimizing setup times by sequencing similar parts reduces downtime.
6. Inventory Management: Smaller batch production reduces inventory levels, saving costs.

Applications of Group Technology:

1. Manufacturing
2. Inventory Reduction
3. Quality Improvement.
4. Flexible Manufacturing
5. Work Cell Organization.
6. Job Shops

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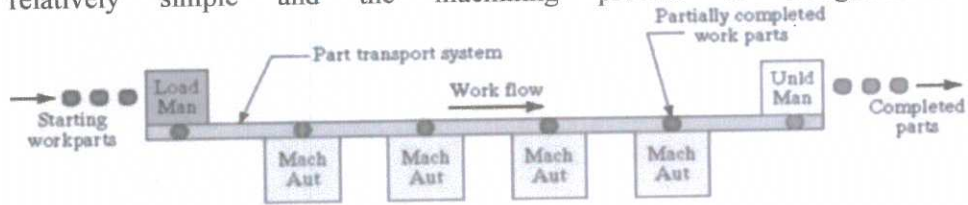
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XIV

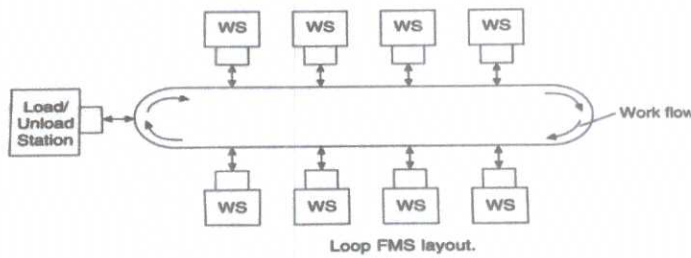
1 Line layout

A linear layout is the simplest type of FMS line layout. The machines are arranged in a straight line, with the material flowing from one machine to the next in a sequential order. Linear layouts are well-suited for applications where the parts are relatively simple and the machining process is straightforward.



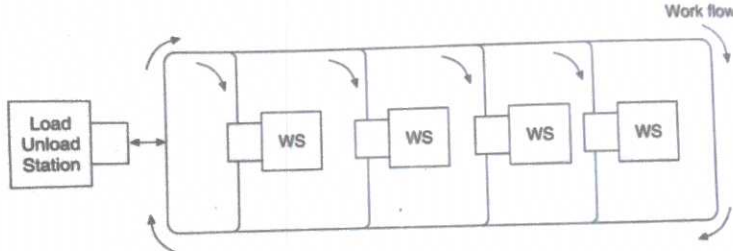
2 Loop layout

A loop layout is similar to a linear layout, except that the machines are arranged in a loop instead of a straight line. This allows the material to be transported back to the beginning of the loop after it has been processed by all of the machines. Loop layouts are well-suited for applications where the parts are more complex and the machining process requires multiple passes through the same machines.



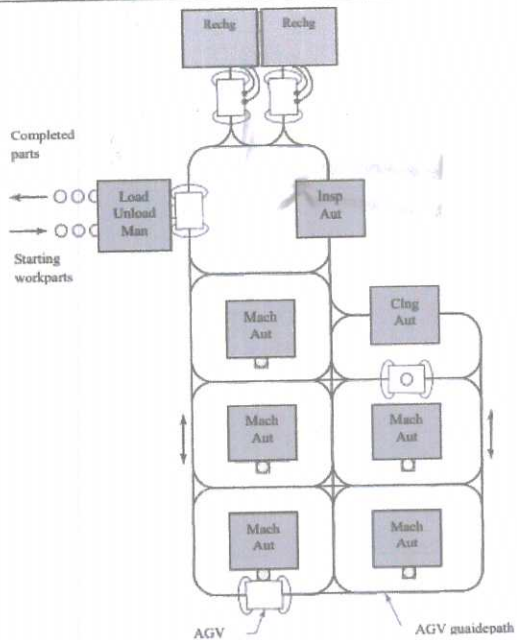
3 Ladder type layout

Ladder type layout consists of rungs on which workstations are located. This reduces the average travel distance thereby reducing the transfer time between workstations.



4. Open field layout

An open field layout is the most flexible type of FMS line layout. The machines are arranged in a random order, and the material can be transported between the machines in any direction. Open field layouts are well-suited for applications where the parts are very diverse and where the machining process is complex and unpredictable.



2 x3

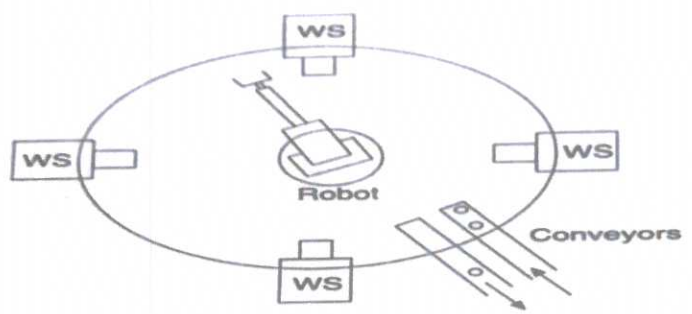
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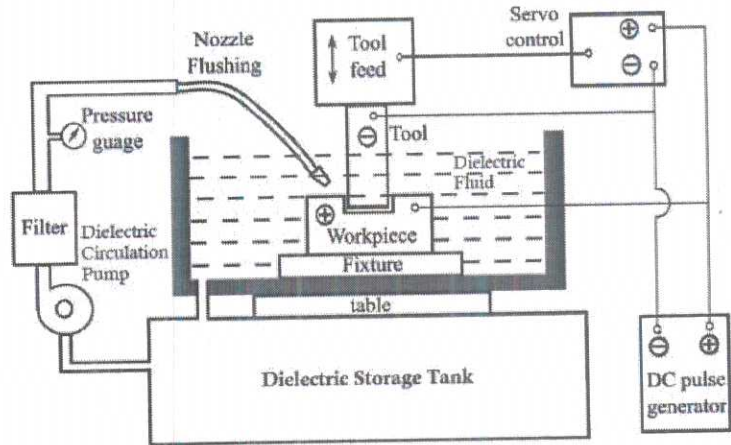
1 for list

5 Robot centred cell

If a handling robot is used in a Flexible manufacturing system cell, the machines are laid out in a circle, such a layout is called circular layout.



VII



Electrical discharge machining works on the principle of metal removal by the combination of electrical and thermal energy. The electrical energy is utilized to create electric spark and heat is produced by erosion of metal.

In electro discharge machining, there is no physical contact between tool and workpiece. It is a non-traditional machining process. In this, the tool electrode is connected to the -ve terminal of the DC power supply and workpiece is connected to the +ve terminal of the DC power supply. So, tool acts as a cathode and workpiece acts as an anode.

There is a spark gap between the tool and workpiece is about 0.05 to 0.25 mm. In the flow of dielectric fluid. The dielectric fluid is works as an insulator and as a conductor. When the DC power supply, the tool electrode generated at the spark and due to this the spark goes to the workpiece by dielectric fluid and machining is done

3

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