

SCHEME OF VALUATION				
REVISION 2021		Course Code:6021B		
Course Title: <b>COMPUTER INTEGRATED MANUFACTURING</b>				
Qs. No:	Scoring Indicators	Split Score	Sub Total	Total
<b>I</b>	<b>PART-A</b>			
1	Computer Integrated Manufacturing (CIM)		1	1
2	Automation		1	1
3	Sensors		1	1
4	New Product Development		1	1
5	Plotter, Printer, CRT Display, Vector Display, Storage Tube, Raster Display, LCD Display, Plasma display, Digital Light Processing-DLP etc.	1/2 x 2	1	1
6	CAM-Computer Aided Manufacturing CAPP-Computer Aided Process Planning	½ x 2	1	1
7	Selective Compliance Articulated/Assembly Robot Arm		1	1
8	Material handling		1	1
9	Contact type		1	1
<b>II</b>	<b>PART-B</b>			
1	The factors considered while implementing CIM are, 1. Availability of resources such as manpower, equipment etc. 2. Purpose and goal of implementation of CIM. 3. Emerging technologies and their availabilities. 4. Desired level of integration.	3 points	3	3
2	<b>Levels of Automation</b> The concept of automated system can be applied to various levels of factory operation. <b>Device level</b> This is the lowest level in automation hierarchy. It includes sensors, actuators and other hardware components. The devices are connected into the individual control loop of the machine. <b>Machine level</b> Hardware at the device level is assembled into individual	5 points	3	3

	<p>machines. Eg: CNC machine tools, industrial robots, powered conveyers etc .Control function at this level includes performing the sequence of steps in the program of instructions in the correct order and making sure that each step is properly executed.</p> <p><b>Cell or system level</b></p> <p>This is the manufacturing level or system level, which operates under instructions from the plant level. A manufacturing cell or system is a group of machines or work station connected and supported by a material handling system, computers and other equipment appropriate to the manufacturing process.</p> <p><b>Plant level</b></p> <p>This is the factory or production system. It receives instructions from cooperate information system and translate them into operational plans for production. Likely functions include order processing, process planning, inventory control, purchasing, MRP, shop floor control and quality control.</p> <p><b>Enterprise level</b></p> <p>This is the highest level consisting of cooperate information system. It is concerned with all of the functions necessary to manage the company like marketing, sale, accounting, research, master production schedule etc.</p>			
3	<p><b>USA Principle:</b></p> <p>The USA Principle is a common sense approach to automation projects. Similar procedures have been suggested in the manufacturing and automation trade literature, but none has a more captivating title than this one.</p>	3 points (3x1)	3	3

<p>USA stands for</p> <ol style="list-style-type: none"> <li>a. Understand the existing process</li> <li>b. Simplify the process</li> <li>c. Automate the process</li> </ol> <p><b>Understand the Existing Process.</b> The obvious purpose of the first step in the USA approach is to comprehend the current process in all of its details. What are the inputs? What are the outputs? What exactly happens to the work unit between input and output? What is the function of the process? How does it add value to the product? What are the upstream and downstream operations in the production sequence, and can they be combined with the process under consideration?</p> <p><b>Simplify the Process.</b> Once the existing process is understood, then the search can begin for ways to simplify. This often involves a checklist of questions about the existing process. What is the purpose of this step or this transport? Is this step necessary? Can this step be eliminated? Is the most appropriate technology being used in this step? How can this step be simplified? Are there unnecessary steps in the process that might be eliminated without detracting from function?</p> <p><b>Automate the Process.</b> Once the process has been reduced to its simplest form, then automation can be considered. The possible forms of automation include those listed in the ten strategies. An automation migration strategy might be implemented for a new product that has not yet proven itself.</p>			
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4	<p><b>Product development</b></p> <p>Product development refers to the complete process of taking a product from idea to market. It also describes the process of renewing an existing product or introducing an old product to a new market. This includes identifying market needs, conceptualizing the product, building a product map, launching a product and collecting feedback.</p> <p>New product development specifically refers to create a new product from scratch and bringing it to a market. The process doesn't end until the product life cycle is over. The product development process can continue by collecting feedback and iterating on the product and developing new versions.</p>	Any 3 points (3x1)	3	3
5	<p><b>Advantages of CAD</b></p> <ul style="list-style-type: none"> <li>▪ Improved productivity of the designer</li> <li>▪ Improved quality of the design</li> <li>▪ Better communications</li> <li>▪ Creating the manufacturing database</li> <li>▪ Highly accurate design (error free)</li> <li>▪ Precious time is saved.</li> <li>▪ Reduced engineering personnel requirements.</li> <li>▪ Customer modifications are easier to make.</li> <li>▪ Faster response to requests for quotation.</li> <li>▪ Designs have more standardized.</li> <li>▪ Better knowledge of cost involved.</li> <li>▪ Cost saving in tool design.</li> </ul>	Any 6 points (1/2x6)	3	3

6	<p><b>Benefits of GT</b></p> <ol style="list-style-type: none"> <li>Reduced material handling.</li> <li>Reduced tool set-up time.</li> <li>Reduced work- in- process.</li> <li>Promotes standardization of tooling, fixture and setups.</li> <li>Simplified process planning and production scheduling.</li> <li>Better work satisfaction. Better product quality and productivity.</li> </ol>	Any 6 points (1/2x6)	3	3
7	<p><b>Machining center</b></p> <p>A machining center is an advanced computer controlled machine tool that can be used for performing a variety of machining operations and process. Unlike traditional machine that feature turrets or other mechanisms of manual tool change, a machining center consists of an automatic tool changing mechanism, allowing for multiple cutting tools to be utilized during the machining process. This enable quick changes in the cutting tool, thus improving production efficiency and reducing cycle time The core of an machining center lies in its versatility , accuracy and ability to handle complex operations like milling, turning, boring, drilling etc.</p> <p><b>Components:</b></p> <ul style="list-style-type: none"> <li>Main spindle area</li> <li>Taper feed mechanism</li> <li>Automatic tool changer (ATC) system</li> <li>Tool magazine</li> <li>Automatic pallet changer (APC) system</li> <li>Chip and coolant handling system</li> <li>Over load and wear detectors</li> <li>Automatic door operation mechanism</li> </ul>	Any 3 points (3x1)	3	3

8	<p>The number of independent movement which the wrist can perform in 3D work envelope relative to robots base is called degree of freedom of the robot. The robot can have three orthogonal translation sand three rotations about the orthogonal axes. Hence, a robot should have six degree of freedom so that it can reach anywhere in the work volume.</p>		3	3
9	<p><b>Carousel storage systems</b></p> <p>A carousel storage system is series of bins or baskets fastened to carries that are connected together and revolve around a long, oval track system. The track system is similar to a trolley conveyor system. Its purpose is to position bins at a load/unload station at the end of the oval. The operation is similar to the powered overhead rack system used by dry cleaners to deliver finished garments to the front of the store. The typical operation of the storage carousel is mechanized rather than automated. The load/unload station is manned by a human worker who activates the powered carousel to deliver a desired bin to the station. One or more parts are removed from the bin, and the cycle is repeated.</p>	Any 3 points (3x1)	3	3
10	<p><b>Noncontact inspection methods</b></p> <p>Noncontact inspection methods utilize a sensor located at a certain distance from the object to measure or gage the desired features. The noncontact inspection technologies can be classified into two categories:</p> <p><b>1. Optical</b></p> <p>Optical inspection technologies use light to accomplish the measurement or gauging cycle. There are a variety of optical sensing techniques used for inspection work.</p> <ul style="list-style-type: none"> <li>• Machine vision</li> </ul>		3	3

	<ul style="list-style-type: none"> <li>• Scanning laser beam devices</li> <li>• Photogrammetry</li> </ul> <p><b>2. Non optical</b></p> <p>Non optical inspection technologies utilize energy forms other than light to perform the inspection. These other energies include various electrical fields, radiation and ultrasonic.</p>			
<b>PART-C</b>				
III	<p>The elements of CIM are:</p> <ol style="list-style-type: none"> <li>1. Manufacturing elements such as CNC/DNC/FMS</li> <li>2. Rot work cells</li> <li>3. Material handling devices</li> <li>4. Tool handling devices</li> <li>5. Computer controlled inspection equipment</li> <li>6. Computers/Servers</li> <li>7. CAD/CAM work stations</li> <li>8. Printers ad plotters</li> <li>9. Bar code readers</li> <li>10. Outer peripheral devices</li> </ol>	7 points	7	7
<b>OR</b>				
IV	<p><b>Reasons for Automation of system:</b></p> <ol style="list-style-type: none"> <li>1. To increase labour productivity. Automating a manufacturing operation usually increase production rate and labour productivity This means greater output per hour of labour input.</li> <li>2. To reduce labour cost. Ever-increasing tabor cost has been and continues to be the trend in the world's industrialized societies. Consequently, higher investment in automation has become economically justifiable to replace manual operations. Machines</li> </ol>			7

	<p>are increasingly being substituted for human labour to reduce unit product cost.</p> <ol style="list-style-type: none"> <li>3. To minimise the effect of labour shortage. There is a general shortage of labor in many advanced nations and this has stimulated the development of automated operations as a substitute for labour.</li> <li>4. To reduce or eliminate routine manual and clerical tasks. An argument can be put forth that there is social value in automating operations that are routine, boring, fatiguing. Automating such tasks serves a purpose of improving the general level of working condition.</li> <li>5. To improve worker safety. By automating a given operation and transferring the worker from active participation in the process to a supervisory role, the work is made safer.</li> <li>6. To improve product quality. Automation not only results in higher production rates than manual operations; it also performs the manufacturing process with greater uniformity and conformity to quality specifications. Reduction of fraction defect rate is one of the chief benefits of automation</li> </ol>			
V	<p><b>Sensors</b></p> <p>Sensors are essential components of robotic systems, providing robots with the ability to gain a perception of their environment. Sensors gather data about the robot's surroundings, including the position and orientation of objects around it and the robot itself. The robot's control system then uses this information to decide how to interact with its environment. Here are some of the most commonly</p>	Exp: 1 mark	1	7

<p>used sensors in end effectors:</p> <p><b>Proximity sensors:</b> Proximity sensors are used to detect the presence or absence of objects in the proximity of the end effector. These sensors can detect various targets, including metal, plastic, and even liquids.</p> <p><b>Force/torque sensors:</b> Force/torque sensors measure the amount of force or torque being applied to the robot or to the objects it interacts with. These sensors are often used in robotic grippers to measure the force required to grip an object or in robotic arms to measure the force required to move an object.</p> <p><b>Cameras:</b> Vision sensors use cameras and other imaging technologies to provide visual feedback on the position, orientation, and movement of the end effector and the objects it interacts with. These sensors are often used in applications requiring precise positioning and manipulation. Cameras are also used for object recognition, tracking, navigation, and obstacle avoidance. Cameras for end effectors can even have 3D and thermal imaging capabilities if the application demands.</p> <p><b>Light sensors:</b> Light sensors can detect the presence or absence of light and are used to provide feedback on the position of objects in low-light environments.</p> <p><b>Magnetic sensors:</b> Magnetic sensors or hall effect sensors are used to detect the presence of magnetic fields. They can detect the position and orientation of objects that contain magnets.</p> <p><b>Range Sensors:</b> Range sensors are used to measure the distance between the robot's end effector and objects near it.</p>	<p>Any 6 points (6x1)</p>	<p>6</p>	
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<b>OR</b>				
VI	<p><b>Automation Migration Strategy:</b></p> <p>Phase 1: Manual production using single-station manned cells operating independently. This is used for introduction of the new product for reasons already mentioned: quick and low-cost tooling to get started.</p> <p>Phase 2: Automated production using single-station automated cells operating independently. As demand for the product grows, and it becomes clear that automation can be justified, then the single stations are automated to reduce labor and increase production rate. Work units are still moved between workstations manually.</p> <p>Phase 3: Automated integrated production using a multi station automated system with serial operations and automated transfer of work units between stations. When the company is certain that the product will be produced in mass quantities and for several years, then integration of the single-station automated cells is warranted to further reduce labor and increase production rate.</p> <p>Details of automation migration strategy vary from company to company, depending on the type of product they make and the manufacturing process they perform.</p> <p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>• It allows introduction of the new product in shortest possible time, since production is based on manual work station are the easiest to design and implement.</li> <li>• It allows automation to be introduced gradually as</li> </ul>	5 marks	7	7
		2 marks		

	<p>demand for the product grows.</p> <ul style="list-style-type: none"> <li>• It avoid the commitment to a high level o automation from the beginning, since there is always risk that demand for the product will not justify it.</li> </ul>			
	<b>OR</b>			
<b>VII</b>	<p><b>Geometric modeling techniques</b></p> <ol style="list-style-type: none"> <li>1. Wire frame model</li> <li>2. Solid model</li> <li>3. Surface model</li> </ol> <p><b>1. Wire frame model</b></p> <ul style="list-style-type: none"> <li>▪ Simplest and oldest method of modeling the object.</li> <li>▪ Considered as networks of interconnected lines to represent the edges of the physical objects being modeled.</li> <li>▪ A typical wire frame may consist of points, lines, arcs, circles and curves.</li> </ul> <p><b>Three types</b></p> <ol style="list-style-type: none"> <li>1. 2 D modeling <ul style="list-style-type: none"> <li>✓ Only x,y coordinates</li> <li>✓ Used for flat surfaces</li> </ul> </li> <li>2. 2.5 D modeling <ul style="list-style-type: none"> <li>✓ Resemble like 3D but no sidewalls details</li> </ul> </li> <li>3. 3D modeling <ul style="list-style-type: none"> <li>✓ Has x,y &amp; z coordinates</li> <li>✓ Used to model a solid model of an object completely.</li> </ul> </li> </ol> <p><b>2. Surface modeling</b></p> <p>Surface modeling is more sophisticated than wireframe modeling in that it defines not only the edges of a 3D object, but also its surfaces.</p> <ul style="list-style-type: none"> <li>✓ Objects are defined by their bounding faces.</li> <li>✓ It consists of wireframe entities plus surface entities.</li> <li>✓ Surface model = wireframe entities + surface entities</li> <li>✓ It is a set of faces (no thickness)</li> <li>✓ It defines geometry but no topology.</li> <li>✓ Shading &amp; colouring is possible</li> </ul>			

	<p><b>Surface Entities</b></p> <p>Similar to wireframe entities, existing CAD/CAM systems provide designers with both analytic and synthetic surface entities.</p> <p>Analytic entities include :</p> <ul style="list-style-type: none"> <li>✓ Plane surface</li> <li>✓ Ruled surface</li> <li>✓ Surface of revolution</li> <li>✓ Tabulated cylinder</li> </ul> <p>Synthetic entities include</p> <ul style="list-style-type: none"> <li>✓ Bezier surface,</li> <li>✓ B-spline surface</li> </ul> <p><b>3. Solid modelling</b></p> <p>Solid models give designers a complete descriptions of constructs, shape, surface, volume, and density.</p> <ul style="list-style-type: none"> <li>✓ Solid modeling is the most powerful 3D modeling technique.</li> <li>✓ The object is defined by vertices, edges, surfaces, weights and volume within the defined boundary.</li> <li>✓ The boundary of model separates interior and exterior of model object.</li> <li>✓ It is complete, valid, unambiguous representation of model</li> <li>✓ Store both geometrical and topological information</li> <li>✓ Use of solid modeling in design and manufacturing is rapidly increasing because of the,</li> </ul> <ul style="list-style-type: none"> <li>✓ – reduced computing cost</li> <li>✓ – fast computing hardware</li> <li>✓ – Improved user interfaces</li> <li>✓ – Software improvements</li> </ul>			
	<b>OR</b>			
<b>VIII</b>	<p><b>Classification of Rapid Prototyping Technologies</b></p> <p>Rapid Prototyping technologies are classified based on the initial form of its material i.e., the base material of prototype or part to be built. Thus, rapid prototyping technologies are classified into 3 categories.</p>		7	7

	<p><b>Solid Based Rapid Prototyping System</b></p> <p>Solid based rapid prototyping systems are meant to encompass all the forms of materials in solid state. The solid form can include the shape in the form of a wire, laminate, pellets or a roll. Solid-based rapid prototyping systems works on the following principles:</p> <ol style="list-style-type: none"> <li>i. Cutting and Glueing / Joining method.</li> <li>ii. Melting and Solidifying / Fusing method.</li> </ol> <p>These processes are different from one another, though some of them use the laser in the process of fabricating prototypes. They all utilize solid in one form or the other, as the primary medium to create a prototype.</p> <p><b>Liquid Based Rapid Prototyping System</b></p> <p>Liquid based rapid prototyping systems have the initial form of its material in liquid state. The base material can include a resin or a polymer. Liquid based rapid prototyping systems works on the principle of 'Photo curing' under which three methods are possible.</p> <ol style="list-style-type: none"> <li>i. Single laser beam method</li> <li>ii. Masked lamp method</li> <li>iii. Two laser beam method</li> </ol> <p>Most of these systems build parts in a vat of photo-curable resin, an organic resin that solidifies under the exposure to laser radiation, in UV range. The laser cures the resin near the surface, forming a hardened layer. The formed layer is lowered by an elevation control system to allow the next layer of resin to be similarly formed over it. This continues until the entire part is completed. Under liquid based rapid Prototyping system, stereo lithography is very unique and patented process which combines CAD, CAM, CAE, Laser Scanning, Optical Scanning technologies including</p>			
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	<p>chemistry to fabricate 3D solid models from 3D CAD data.</p> <p><b>Powder Based Rapid Prototyping</b></p> <p>System Powder particles are by-and-large to the particles of solid state in a strict context. However, intentionally it is categorized outside the solid-based rapid prototyping systems to refer powder in grain form. All the powder based rapid prototyping systems works on the principle of Joining/Binding. The method of joining / binding differs for all the systems, in that some employ a laser while others use a binder/glue to achieve the joining effect. Binder material is deposited on to selected regions of layer of powder particles to produce a layer of powder particles that are completely bonded at the selected regions. Iterations would fabricate the desired part. Post-processing is highly required to remove the un-bonded powder particles.</p>			
IX	<p><b>Computer Aided Process Planning</b></p> <p>Whenever we go for the effective manufacturing of a product, it is required to plan the process for manufacturing for effective utilization of manpower, machine, material and time. Since we have advanced technology and software. These works are totally depends on the computer and therefore it is called Computer Aided Process Planning.</p> <p>There are two types of process planning</p> <p><b>1. Variant Computer Aided process Planning</b></p> <p>In Retrieval type, manufactured parts are used to divided into part families, this is done by manufacturing characteristics. after this, we used to store the plane about to establish a standard process plan for each part family. This plan can be retrieved at any time to use for the same family. Aafter this, we need to give a code number to it by this CAPP</p>	1	7	7
		3		

	<p>program used to find the required family matrix and compress it.</p> <ul style="list-style-type: none"> <li>• This planning method is also known as data retrieval method.</li> <li>• The process plan for a new part is generated by really, identifying and retrieving an existing plan for a similar part after making the necessary modification.</li> <li>• The part is also known as master part.</li> <li>• Master part information is stored in the data base.</li> <li>• Part coding using Group Technology</li> </ul> <p><b>2. Generative Approach of Computer Aided Process Planning</b></p> <ul style="list-style-type: none"> <li>• This used to create the plan for process depend on logical procedure and geometric data. this does not use retrieving or any other type that stored in the database.</li> <li>• In this type for making a sequence planning it does not require human assistance. This is used for solving complex problems and it has the high number of programmers in it to operate this it required high skilled persons.</li> <li>• In this there are different types of stages, the first stage is this used to store technical knowledge and logic in process planning.</li> <li>• The second stage it required developments in the description like computer compatibility, CAD, group technology etc..</li> <li>• The third stage is used to solve complex problems</li> </ul>			
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	<p>by using logic etc.</p> <ul style="list-style-type: none"> <li>In generative process planning process plans are generated by the means of decision logic, formulae, technology algorithms etc.</li> <li>Main aim is to convert a part from raw material to the finished state.</li> </ul>			
	<b>OR</b>			
X	<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>CNC machine can produce jobs with highest accuracy and precision than any other manual machine. It eliminates human errors.</li> <li>It can be operated for 24 hours of a day. Higher flexibility also.</li> <li>The parts manufactured by it have the same accuracy. There is no variety in parts manufactured by CNC machines.</li> <li>A highly skilled operator is not needed to run a CNC machine.</li> <li>A semi-skilled operator can also operate accurately and more precisely.</li> <li>Operators can easily make changes and improvements and reduce the delay time and Reduce inspection cost.</li> <li>It has the capability to produce a complex design with high accuracy in minimum possible time with minimum wastage.</li> <li>Modern design software allows the designer to emulate the creator of his idea.</li> </ul> <p><b>Disadvantages</b></p> <p>Following are the disadvantages of CNC Machine:</p> <ul style="list-style-type: none"> <li>The cost of a CNC machine is much higher than a manually operated machine.</li> <li>The initial cost is high.</li> <li>The parts of the CNC machines are costly.</li> <li>Maintenance costs are significantly higher in the</li> </ul>	<p>Any 4 points (4x1)</p>	<p>4</p>	<p>7</p>
		<p>Any 3 points (3x1)</p>	<p>3</p>	

	<p>case of CNC.</p> <ul style="list-style-type: none"> <li>• It does not eliminate the need for costly tools.</li> <li>• CNC machine requires skilled programmers.</li> <li>• It is not suitable for small scale production</li> <li>• Maintenance cost is more.</li> </ul>			
XI	<p><b>Master Production Schedule (MPS)</b></p> <p>The production quantities of the major product lines listed in the aggregate plan must be converted into a very specific schedule of individual products. This is known as Master Production Schedule (MPS).</p> <p>It is a list of the products to be manufactured, when they should be completed and delivered, and in what quantities. The master schedule must be based on an accurate estimate of demand and a realistic assessment of the company's production capacity.</p> <p>Products included in the MPS divide it into three categories:</p> <p><b>Firm Customer Order</b></p> <p>In this case, the company is usually obligated to deliver the item by a particular date that has been promised by the sales department.</p>	Expla. 7 marks	7	7

	<p><b>Forecasted Demand</b></p> <p>In this category, product quantities are based on statistical forecasting technique applied to previous demand patterns, estimates by the sales staffs, and other sources.</p> <p><b>Spare Parts</b></p> <p>This consists of repair parts that will either be stocked in the company's service department or sent directly to the customer.</p> <p>Proportion in each category varies for different companies, and in some cases one or more categories are eliminated. Companies producing assembled products generally handle all the three types. Some companies exclude the third category since it does not represent end products. The MPS is generally considered to be a medium-range plan since it takes into account the lead times to order raw material and components, produce parts in the factory, and then assemble the end product.</p> <p>The changes are not allowed within about a 6 week horizon because of the difficulty in adjusting production schedules within such a short period. However, schedule changes are allowed beyond 6 weeks to cope with changing demand patterns or the introduction of new product.</p>			
	<b>OR</b>			
XII	<p><b>Classification on the Basis of Physical Configurations</b></p> <p>On the basis of physical configuration industrial robots are classified in four different types. They are:</p> <p>(i) Cartesian configuration,</p> <p>(ii) Cylindrical configuration,</p>			7

- (iii) Polar configuration, and
- (iv) Jointed-arm configuration.

**Cartesian Configuration**

Robots having cartesian configurations consist of links connected by linear joints (L). As the configuration has three perpendicular slides, they are also called rectilinear robots. Robot having a similar configuration is known as Gantry Robots. Its structure resembles a gantry-type crane.

**Cylindrical Configuration**

In the cylindrical configuration, robots have one rotatory (R) joint at the base and linear (L) joints succeed to connect the links. The space in which this robot operates is cylindrical in shape, hence the name cylindrical configuration.

**Polar Configuration**

Polar robots have a work space of spherical shape. In general, the arm is linked to the base with a twisting (T) joint and rotatory (R) and or linear (L) joints. The designation of the arm for this arm can be TRL or TRR. Robots with the description of TRL are also called spherical robots. Those having the designation of TRR are called as articulated robots. It resembles a human arm in terms of configuration.

**Jointed-Arm Configuration**

The combination of cylindrical and articulated configurations is known as jointed-arm configuration. The arm of the robot is connected to the base with a twisting joint. Rotatory joints are used to connect the links in the arm. Generally, the rotation takes place in the vertical plane. Popular robot falling under this category is called SCARA (Selective Compliance Assembly Robot Arm). It is basically used for the assembly purpose.

Exp: 5  
marks

XIII	<p><b>Automated Storage and Retrieval Systems (AS/RS)</b></p> <p>To get right parts, pallets, fixtures, and tools to the right place at the right time, an efficient system for their storage and retrieval together with a material transportation system is required.</p> <p>An integrated FMS, AGVS, and AS/RS system provides an efficient production system for manufacturing low- to medium- volume and middle- to high-variety products.</p> <p><b>Function of storage systems and definition of AS/RS</b></p> <p>Receiving, identification and sorting, dispatching to storage, placing in storage, storage, retrieving from storage, order accumulation, packing, shipping, and record keeping for raw materials, purchased parts, work in process, finished product, pallets, fixtures, tools, spare parts, rework and scrap, office supplies, and so forth have traditionally been considered the functions of storage systems.</p> <p>An AS/RS attempts to achieve these functions by automating most of these procedures in a cost-effective and efficient manner. In general, an AS/RS performs a basic set of operations without human intervention, regardless of the specific type of system that is employed.</p> <ol style="list-style-type: none"> <li>1. Automatic removal of an item from a storage location</li> <li>2. Transportation of this item to a specific processing or interface point</li> <li>3. Automatic storage of an item in a predetermined location, having received an item from a processing or interface point</li> </ol>	Exp: 4 marks	7	7
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**AS/RS components**

An automated storage and retrieval system comprises the following:

1. A series of storage aisles having storage racks
2. Storage and retrieval (S/R) machines, normally one machine per aisle, to store and retrieve materials
3. One or more pickup and delivery stations where materials are delivered for entry to the system and materials are picked up from the system.

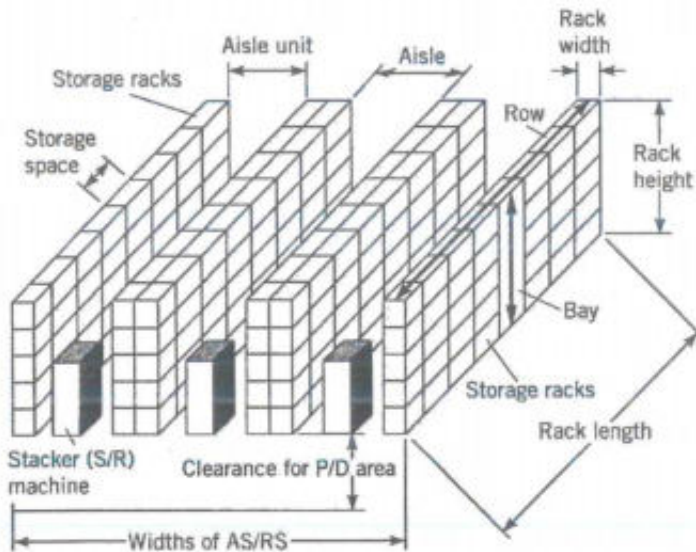


Fig:  
3  
marks

**OR**

**Coordinate Measuring Machine**

XIV

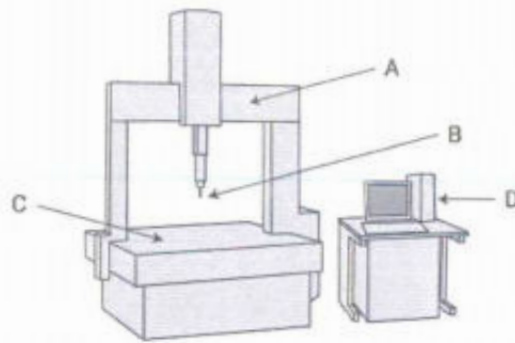
Conventionally, measurements were taken visually using hand tools or an optical comparator. However, these tools require significant time and have limited accuracy. On the other hand, a coordinate measuring machine (CMM) measures the height, width, and depth of the part uses

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coordinate processing technology. In addition, such machines can automatically measure the target, record the measured data, and obtain GD&T measurements. A coordinate measuring machine (CMM) is either a contact model that uses touch probes, a spherical object used to perform measurements, or a non-contact model, which uses other methods such as cameras and lasers. Some models designed for the automotive industry can even measure targets larger than 10 m (30 ft) in size.

Typically, most CMMs are bridge or gantry-types as seen in the diagram. The spherical contact point attached to the tip of the probe is applied to the object on the stage, and the coordinate values in three dimensions (X, Y, Z) are specified and measured. It is mainly used for three-dimensional measurement of dies such as automobile parts and various mechanical parts, three-dimensional objects such as prototypes, and measurement of differences from drawings.



#### CMM Accessories

1. Stylus/probe tip
2. Granite table
3. Fixtures
4. Air Compressors and Dryers
5. Software

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