Set A

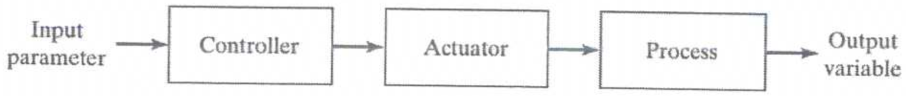
Scoring Indicators

COURSE NAME: Computer Integrated Manufacturing

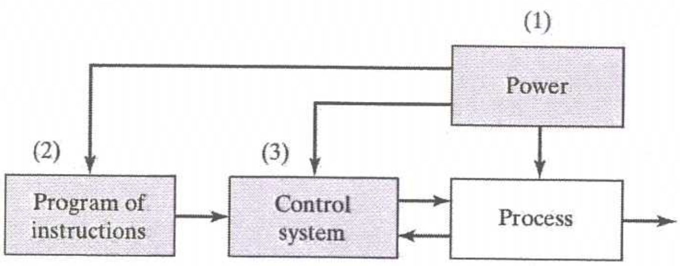
QID - 21022400023

COURSE CODE : 6021B

Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			9
I. 1	1. Pressure Sensors 2. Proximity Sensors 3. Flow Sensors 4. Level Sensors 5. Position Sensors 6. Force Sensors 7. Light Sensors 8. Sound Sensors 9. Chemical Sensors	Any 2 * 1/2	1	
I. 2	Closed-loop control system		1	
I. 3	Computer-Aided Design		1	
I. 4	Keyboard Mouse Graphics tablet Joystick Scanner digital camera drawing tablet	Any 2 * 1/2	1	
I. 5	Selectively Compliant Arm for Robotic Assembly.		1	
I. 6	A Master Production Schedule (MPS) is a key planning tool used in manufacturing that outlines the production plan for specific products, their quantities, and the timelines for their production.		1	
I. 7	Coordinate Measuring Machines		1	

I. 8	In fixed routing, the work units always flow through the same sequence of workstations. This means that the work units are identical, or similar enough that the processing sequence is the same.		1	
I. 9	• Conventional measuring and gaging instruments • Coordinate measuring machines (CMMs) and related techniques to measure mechanical dimensions • Stylus-type surface texture measuring machines to measure surface characteristics such as roughness and waviness • Electrical contact probes for testing integrated circuits and printed circuit boards.	Any 2 * 1/2	1	
	PART B			24
II. 1	an open-loop control system operates without the feedback loop, as in Figure. In this case, the controls operate without measuring the output variable, so no comparison is made between the actual value of the output and the desired input parameter.  **Figure** An open-loop control system.		3	
II. 2	(1) DC motors, (2) AC motors, (3) stepper motors, and (4) linear motors.	Any 3	3	
II. 3	a) Fixed automation b) Programmable automation c) Flexible automation	Any 3	3	
II. 4	The cycle through which a product goes through from development to retirement is called the product life cycle. The product development cycle starts with developing the product concept, evolving the design, engineering the product, manufacturing the part, marketing and servicing.		3	
II. 5	AutoCAD, Solid works, CATIA, Qcad	Any 3	3	
II. 6	Material requirements planning (MRP) is a planning technique, usually implemented by computer, that translates the MPS of end products into a detailed schedule for the raw materials and parts used in those end products.		3	

	It ensures that the right materials, in the right quantities, at the right time to meet production demands while minimizing inventory costs.			
II. 7	DNC is a manufacturing system where multiple Computer Numerical Control (CNC) machines are directly linked to a central computer. This central computer serves as a hub for managing files, transmitting programs, and providing real-time data between the machines. **Components of a DNC System:** • **Central Computer:** The heart of the DNC system, typically with robust storage for programs and data. • **CNC Machines:** The machines on the shop floor are equipped with CNC controllers. • **Communication Network:** Reliable connection between the central computer and CNC machines, often using wired (Ethernet) or wireless technologies. • **DNC Software:** Specialized software installed on the central computer that manages the system.		3	
II. 8	• Mechanical grippers, consisting of two or more fingers that can be actuated by the robot controller to open and close on the work part • Vacuum grippers, in which suction cups are used to hold flat objects • Magnetized devices, for holding ferrous parts • Adhesive devices, which use an adhesive substance to hold a flexible material such as a fabric • Simple mechanical devices, such as hooks and scoops. The tools to perform processing operations on the work part		3	
II.9	1) Single Station Cell, 2) Multistation Fixed Routing, 3) Multistation Variable Routing		3	
II.10	A carousel storage system is an automated storage and retrieval system (AS/RS) consisting of a series of bins, baskets, or shelves mounted on an oval-shaped track that is driven by a motor. The carousel rotates vertically, bringing stored items directly to an operator at an access point.	Any 3	3	

	Components: • **Rotating Carrier:** The oval track with attached bins, shelves, or baskets that store the items. • **Drive System:** A motor and chain mechanism that rotates the carrier. • **Access Point(s):** Designated location(s) where an operator loads and retrieves items from the carousel. • **Control System:** Computer software that manages the system, including inventory tracking, order processing, and controlling the rotation of the carousel.			
	PART C			42
III	An automated system consists of three basic elements: (1) power to accomplish the process and operate the system, An automated system is used to operate some process, and power is required to drive the process as well as the controls. The principal source of power in automated systems is electricity. (2) a program of instructions to direct the process, and The actions performed by an automated process are defined by a program of instructions. (3) a control system to actuate the instructions. The control element of the automated system executes the program of instructions. The control system causes the process to accomplish its defined function, which is to perform some manufacturing operation.  **Figure** Elements of an automated system: (1) power, (2) program of instructions, and (3) control systems.	Fig. 4 Explanation: 3	7	7
IV	There are five levels of automation.		7	7

	1. Device level: This is the lowest level in the automation hierarchy. It includes the actuators, sensors, and other hardware components that comprise the machine level. 2. Machine level: Hardware at the device level is assembled into individual machines. Examples include CNC machine tools and similar production equipment, industrial robots, powered conveyors, and automated guided vehicles. 3. Cell or system level: This is the manufacturing cell or system level, which operates under instructions from the plant level. A manufacturing cell or system is a group of machines or workstations connected and supported by a material handling system, computer, and other equipment appropriate to the manufacturing process. 4. Plant level: This is the factory or production systems level. It receives instructions from the corporate information system and translates them into operational plans for production. Likely functions include order processing, process planning, inventory control, purchasing, material requirements planning, shop floor control, and quality control. 5. Enterprise level: This is the highest level, consisting of the corporate information system. It is concerned with all of the functions necessary to manage the company: marketing and sales, accounting, design, research, aggregate planning, and master production scheduling.			
V	The automation migration strategy is a phased approach. It involves systematically transitioning from manual or existing processes to automated solutions in a step-by-step manner. Phase 1: Manual production using single-station manned cells operating independently. This is used for the introduction of the new product for reasons already mentioned: quick and low-cost tooling to get started. 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 labour and increase the production rate. Work units are still moved between workstations manually.		7	7

	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 labour and increase the production rate.			
VI	1. **Specialization of operations**. The first strategy involves the use of special-purpose equipment designed to perform one operation with the greatest possible efficiency. 2. **Combined operations**. This is accomplished by performing more than one operation at a given machine, thereby reducing the number of separate machines needed. 3. **Simultaneous operations**. A logical extension of the combined operations strategy is to simultaneously perform the operations that are combined at one workstation. 4. **Integration of operations**. This strategy involves linking several workstations together into a single integrated mechanism, using automated work-handling devices to transfer parts between stations. 5. **Increased flexibility**. This strategy attempts to achieve maximum utilization of equipment for job shop and medium-volume situations by using the same equipment for a variety of parts or products. 6. **Improved material handling and storage**. A great opportunity for reducing nonproductive time exists in the use of automated material handling and storage systems. 7. **On-line inspection**. Inspection for quality of work is traditionally performed after the process is completed. 8. **Process control and optimization**. This includes a wide range of control schemes intended to operate the individual processes and associated equipment more efficiently. 9. **Plant operations control**. It attempts to manage and coordinate the aggregate operations in the plant more efficiently.	Any 7	7	7

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<td>10. Computer-integrated manufacturing (CIM). CIM involves extensive use of computer systems, databases, and networks throughout the enterprise to integrate the factory operations and business functions.</td>
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<tr><th>Feature</th><th>Sequential Engineering</th><th>Concurrent Engineering</th></tr>
<tr><td>Approach</td><td>Tasks are completed in a linear, one-after-the-other fashion.</td><td>Tasks are tackled simultaneously, with information and feedback flowing between teams throughout the process.</td></tr>
<tr><td>Workflow</td><td>Design -> Manufacturing -> Testing -> Production</td><td>Design, Manufacturing, Testing, and Production are addressed concurrently with continuous communication and feedback loops.</td></tr>
<tr><td>Teamwork</td><td>Limited interaction between different engineering disciplines (design, manufacturing, etc.).</td><td>Teams from various disciplines collaborate and work together throughout the process.</td></tr>
<tr><td>Information flow</td><td>Information flows in one direction, from design to manufacturing, testing, and production.</td><td>Information flows bidirectionally between teams, allowing for adjustments and improvements based on feedback from later stages.</td></tr>
<tr><td>Flexibility</td><td>Less flexible, changes made later in the process can be costly and time-consuming.</td><td>More flexible, changes can be incorporated throughout the process with less disruption.</td></tr>
<tr><td>Lead Time</td><td>Generally longer due to potential rework and delays caused by late-stage issues discovered in testing or production.</td><td>Can potentially shorten lead time by identifying and addressing issues earlier in the process.</td></tr>
<tr><td>Cost</td><td>Can lead to higher overall costs due to potential rework and production delays.</td><td>Can potentially reduce costs by minimizing rework and avoiding late-stage design changes.</td></tr>
<tr><td>Suitable for</td><td>Stable, low-volume production with minimal change requirements.</td><td>Complex products, high-volume production, or situations requiring flexibility and rapid innovation.</td></tr>
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<td>VIII</td>
<td>Rapid prototyping (RP) is a process of creating physical models of a three-dimensional (3D) design directly from a computer-aided design (CAD) file. There are three main types of rapid prototyping: liquid-based, solid-based, and powder-based.
Liquid-based RP
Liquid-based RP systems use a liquid resin that is cured by a laser beam or other light source to create the desired object. The most common liquid-based RP system is stereolithography (SLA).
Solid-based RP
Solid-based RP systems use a solid material, such as a filament or sheet, that is melted or fused to create the desired object. The most common solid-based RP system is fused deposition modeling (FDM).
Powder-based RP
Powder-based RP systems use a powder material that is bonded together to create the desired object. The most common powder-based RP system is selective laser sintering (SLS).</td>
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IX	1. **Variant Techniques:** • Variant techniques involve the creation of a family of related parts or products that share common features or characteristics. In variant-based CAPP, a set of rules or templates is established to cover a range of products with similar manufacturing processes. These rules define the sequence of operations and parameters for each process step. • **Advantages:** • Simplified Planning: Variant techniques simplify the planning process by allowing the reuse of existing plans for similar parts. • Efficiency: Once a process plan is established for a particular variant, it can be easily adapted for new variants with minimal effort. • Consistency: The consistency in process planning helps in maintaining quality and reducing errors. 2. **Generative Techniques:** • Generative techniques involve the automatic generation of process plans based on the product's geometric and functional requirements. In generative CAPP, computer algorithms analyze the geometric and functional characteristics of a product and generate a process plan accordingly. This can involve heuristic approaches, expert systems, or artificial intelligence techniques. • **Advantages:** • Adaptability: Generative techniques can adapt to a wide range of product variations and complexities. • Optimization: Algorithms can optimize process plans by considering factors such as cost, time, and resource utilization. • Customization: Generative techniques are well-suited for customized or low-volume production where each product may have unique features.		7	7
X	**Group Technology (GT),** also known as cellular manufacturing or cell production, is a manufacturing philosophy that involves organizing similar parts or products into groups, known as part families. This grouping is based on similarities in design, manufacturing processes, and production		7	7

	requirements. The primary objective of Group Technology is to improve efficiency, reduce lead times, and enhance overall productivity in manufacturing processes. Here are some key aspects and benefits of Group Technology: Benefits of Group Technology: 1. Reduced Setup Time: 2. Lower Work-in-Progress (WIP): 3. Improved Flow and Layout: 4. Enhanced Flexibility: 5. Better Quality Control: 6. Reduced Lead Times: 7. Skill Enhancement: 8. Cost Savings:			
XI	The applications of Industrial robotics are 1. Manufacturing and Assembly: 2. Material Handling and Packaging: 3. Welding and Metal Fabrication: 4. Painting and Coating: 5. Machine Tending: 6. Quality Inspection: 7. Palletizing and Depalletizing: 8. Pick and Place:		7	7
XII	The advantages of CNC machines are the following 1. Precision and Accuracy 2. Complexity and Flexibility 3. Repeatability 4. Reduced Human Error 5. Higher Productivity 6. Efficient Material Utilization 7. Versatility 8. Cost Efficiency 9. Integration with CAD/CAM Systems 10. Improved Safety		7	7

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<tr><th>Feature</th><th>Contact Inspection</th><th>Non-Contact Inspection</th></tr>
<tr><td>Principle</td><td>Physical contact with the object using probes or gauges.</td><td>Utilizes various technologies like light, sound waves, or X-rays to inspect the object without physical touch.</td></tr>
<tr><td>Measurement type</td><td>Primarily measures dimensional features (length, width, height, etc.) and surface properties (roughness, texture).</td><td>Can measure dimensional features, surface properties, internal characteristics (flaws, cracks, voids), and even material composition.</td></tr>
<tr><td>Accuracy and precision</td><td>Generally high accuracy and precision, especially for simple geometries.</td><td>Accuracy and precision can vary depending on the technology and application, but often offers good results.</td></tr>
<tr><td>Speed</td><td>Can be slower, especially for complex geometries requiring multiple contact points.</td><td>Often faster due to no physical contact needed.</td></tr>
<tr><td>Destructive potential</td><td>Can potentially damage delicate or soft materials depending on the contact force and type of probe/gauge.</td><td>No risk of damaging the object since there's no physical contact.</td></tr>
<tr><td>Cost</td><td>Generally lower upfront cost for simple equipment like calipers or gauges.</td><td>Can be more expensive due to the advanced technology involved (e.g., laser scanners, X-ray systems).</td></tr>
<tr><td>Ease of use</td><td>Often easier to use for basic measurements with minimal setup requirements.</td><td>May require more training for operating and interpreting results from advanced non-contact systems.</td></tr>
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An Automated Storage and Retrieval System (AS/RS) is a computer-controlled system that automates the storage and retrieval of goods from defined storage locations. AS/RS is widely used in warehouses and distribution centers to efficiently manage and handle inventory. The primary goal of an AS/RS is to increase the speed, accuracy, and efficiency of material handling and storage operations. Here are the key components and features of an Automated Storage and Retrieval System:
Components:

Racking System:
AS/RS typically involves a high-density racking system with shelves, bins, or pallet positions. These storage locations are organized in vertical stacks, utilizing the height of the facility to maximize storage capacity.

Automated Storage and Retrieval Machines (AS/RS Machines):
These are robotic devices designed to move vertically and horizontally within the racking system. They retrieve items

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	from storage locations and deposit them at the desired location. 3. **Conveyor Systems:** • Conveyor systems are often integrated into AS/RS to facilitate the movement of goods to and from the storage area. They assist in the seamless transfer of items between the AS/RS and other parts of the warehouse. 4. **Control System:** • The control system is the brain of the AS/RS. It manages and coordinates the movements of the AS/RS machines, conveyor systems, and other components. It ensures optimal storage and retrieval processes based on real-time inventory data. 5. **Sensors and Safety Systems:** • AS/RS systems are equipped with sensors to detect obstacles, monitor inventory levels, and ensure the safety of both the system and personnel working in the facility. 6. **User Interface:** • A user interface or warehouse management system allows operators to input commands, monitor system status, and retrieve information about inventory levels and transactions.			