

Assignment 3

Explain with the help of block diagram hierarchical structure of computer in the factory of future:

- * The hierarchical structure of computer in the factory of the future is typically organized to enable seamless communication, efficient decision-making and control decision-making, and control across various layers of the factory system. It incorporates multiple levels, each with its specific purpose - from high-level planning to low-level control of machines. Below is a detailed explanation of the hierarchical structure along with a block diagram.

levels in the hierarchical structure:-

① Enterprise level (Top Level)

- * Function: Handles business planning, enterprise resource management (ERP), and strategic decision-making.
- * Role: Manages orders, supply chains, and oversees factory processes.

②

Plant Management Level:

- * Function: Supervise factory operations and monitors production performance.
- * Role: Converts business plans from the enterprise level into operational tasks for the factory floor.

③ Supervisory Control Level:

- * Function: Oversees production processes and controls multiple machines or production lines.
- * Role: Provides feedback to the plant management level and sends instructions to the control level.

④ Control level (Machine level)

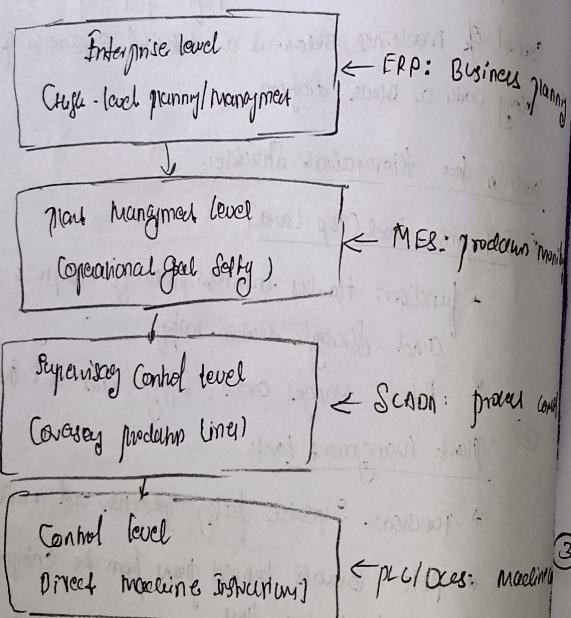
function: Controls individual machines and processes

Role: Receives instructions from the supervisory level and ensures machine operates correctly.

⑤ Field level (Sensory and Actuational level):

function: Performs real-time data acquisition and communicates with machines

Role: Acts as the interface between physical systems and the control system.



double main flexible manufacturing systems and its advantages.

A flexible Manufacturing System (FMS) is an automated manufacturing setup consisting of interconnected workstations, robots and material handling systems capable of quickly adapting to changes in production requirements.

Components of FMS:

- * **Computerization:** CNC machines or other automated tools.
- * **Material Handling System:** Conveyors, robots, or automated guided vehicles (AGVs).
- * **Computer Linked System:** Co-ordinates operations and optimizes production.

Advantages:

- * **Flexibility:** accommodates different product types and volumes.
- * **Improved productivity:** Reduces downtime and increases efficiency.
- * **Reduced lead times:** from design to delivery.
- * **Cost efficiency:** minimizes labor costs and production waste.
- * **Better quality:** Automated systems consistency in product quality.

What is transfer system? Explain transfer system and fast conveyor system in detail.

Transfer Systems:

These are systems used to move materials or parts from different stages of manufacturing processes.

Folies Convoy System:

- * Uses cylindrical shells to support materials
- * Roll can be powered (using motor) or gravity-driven.
- * Suitable for heavy materials or grains
- * Advantages: low energy consumption, durable and low maintenance

Rect Convoy System:

- * Utilizes a continuous loop of material (rocks, fabric) driven by motor
- * Best for lighter products or bulk medical supplies
- * Advantages: versatile, smooth, operates at low starting forces

4) Explain Head-Change FMS in detail.

Head-changing FMS refers to a system where machining tools are equipped with multiple heads (tool attachments) that can be swapped automatically to perform different machining operations, such as drilling, milling, and grinding.

Grinding

- * How it works? - Tool changing mechanism replaces heads on tool after wearout

Advantages:

- minimizes downtime
- reduces the need for manual intervention
- enhances machine versatility

Ques. Does variable-mission manufacturing system work? Explain in detail

Definition:-

A manufacturing system capable of dynamically adapting its configuration to accommodate varying production types and flows.

How it Works:

- * Sensors: Collect real-time data from production equipment.
- * AI and Integration: Analyze the data to optimize workflow and scheduling.
- * Automation: Machines reconfigure themselves based on the required mission.

Applications:

- * used in industries like automotive and aerospace for customized production

Advantages:

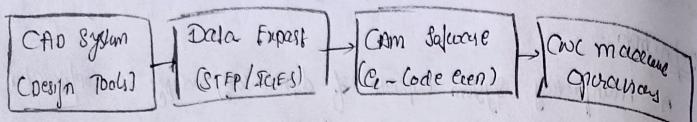
- * Increases flexibility in production lines
- * Supports low-volume, high-mix manufacturing
- * Reduces setup times

⑥ What is CAD/CAM Systems with a brief of complete CAD/CAM Systems.

Definition:

- * CAD (Computer-Aided Design): Software used for creating digital product designs
- * CAM (Computer-Aided Manufacturing): Software that converts CAD designs into machine instructions

Complete CAD/CAM layout:-



* Applications -

- * CAD/CAM Systems are widely used in product design, prototyping, and manufacturing industries such as automotive and electronics.

? Explain the Japanese Unmanned factory concept in detail

Content:-

- * factories operate with minimal human intervention using robots & centralised control systems.

Example:- Fanuc's factory, where robots manufacture other robots

Features

- * "Light-out" manufacturing: fully automated factories that can run 24x7
- * High precision and efficiency: robots execute consistent processes quickly
- * Advanced robotics and material handling: assembly and quality inspection.

Explain the features of the factory concept:

The features of the factory represent a paradigm shift in manufacturing by leveraging emerging technologies to create smarter, more sustainable and efficient production environments. These features aim to address modern challenges such as high customization demand, faster production cycles and environmental sustainability.

Key features of the factory of the future

① IoT and edge computing:-

- * what is it: - The Internet of things (IoT) allows devices and machines to connect, share data and monitor operations. Edge computing processes data closer to the source rather than sending it to a central cloud.

Benefits:-

- * how it works: - machinery equipped with sensors gather real-time data, which is processed locally (edge) or sent to a central platform.

② AI Integration:-

- * what is it: - Artificial Intelligence (AI), is used to analyse data optimise workflows and enable predictive maintenance.

- * how it works: - An algorithm processes large amounts of data from IoT sensors to identify inefficiencies or predict potential failures before they occur.

③ Sustainability:

- + what it is:- Sustainability focus on reducing waste energy consumption and carbon emissions while adopting eco-friendly production methods.
- * how it works:- factories use renewable energy sources (Solar, Wind) and green-efficient practices. Circular economy principles are implemented to reuse materials and reduce waste.

④ Human-Robot Collaboration:-

- + what it is:- Human-robot collaboration involves robots and humans working together to complete tasks more efficiently. Robots take on repetitive or dangerous tasks, allowing humans to focus on higher-level functions.
- * how it works:- Collaborative robots are designed to work alongside humans safely. AI allows these robots to adapt to human behavior and provide assistance as needed.

⑤ Create short notes:-

→ FMSs in Japan:

- * Japan has been a global leader in adopting flexible manufacturing systems (FMSs) due to its emphasis on automation, robotics, and efficiency. These systems are designed to reduce production costs while maintaining high-quality output.

FANUC (factory automation)

- * FANUC (factory automation, Numerical control) operates a fully automated "lights-out" factory in Fuji, Japan.
- * Key features:
 - Robots manufacture tasks with minimal human intervention.
 - Centralized monitoring and control via a lot-based system.
 - Self-operation with minimal downtime.

⑥ The Yamazaki FMS:-

- Developed by Yamazaki Mazak. See Yamazaki Mazak manufacturing system
- In design for high-mix-low-volume production environments
- * Multi-tasking machine tools capable of handling various operations like milling, turning, and grinding.
- * Automated tool changes and robotic material handling systems.
- * Integration of CAD/CAM systems to streamline design-to-production workflows.

⑦ Okuma's FMS:

- Okuma's flexible manufacturing system integrates CNC machine, robotics, and automated guided vehicle (AGV) to achieve high precision, fully automated production lines.

- Key features

- * CNC machine connected via Centrifugal Conveyors
- * Robotic arm for material handling and assembly.
- * AGVs transport parts and materials between Workstations