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Answer Key (IA3) Set A

PART – A (5 x 2 = 10 Marks)

1. **Define AGV.** (CO2, UND)
Answer:
An Automated Guided Vehicle (AGV) is a mobile robot used in production systems to transport materials autonomously, guided by magnetic strips, lasers, or vision systems.
2. **Define Automation.** (CO2, REM)
Answer:
Automation is the use of technology to perform tasks with minimal human intervention, enhancing efficiency and consistency in manufacturing processes.
3. **Mention the purpose of Amplification in DAS.** (CO3, UND)
Answer:
Amplification in Data Acquisition Systems (DAS) boosts weak sensor signals to a level suitable for accurate processing and digitization.
4. **Smart Metering using IoT. Define.** (CO3, APP)
Answer:
Smart metering using IoT involves connected devices that monitor and manage energy or resource usage (e.g., electricity, water) in real-time, enabling remote data collection and optimization.
5. **Mention purpose of factory digitalization.** (CO3, APP)
Answer:
Factory digitalization integrates IoT, AI, and data analytics to enhance production efficiency, enable real-time monitoring, and support data-driven decision-making.

PART – B (2 x 13 = 26 Marks & 1 x 14 = 14 Marks)

6. **(a) Enumerate types of AGVs used in Production system.** (13 Marks, CO2, REM)
Answer:
Types of AGVs in production systems:
- **Unit Load AGVs**: Carry single loads like pallets (e.g., in automotive assembly).
- **Forklift AGVs**: Lift and transport heavy materials (e.g., in warehouses).
- **Tow/Tugger AGVs**: Pull multiple carts (e.g., for material delivery).
- **Assembly Line AGVs**: Move products between workstations (e.g., in electronics).
- **Light Load AGVs**: Handle small parts (e.g., in pharmaceutical production).

Description: AGVs use navigation technologies like laser or magnetic guidance, reducing manual labor and improving material flow.

(OR)

(b) IoT Smart Energy Management. Illustrate it. (13 Marks, CO2, ANA)
Answer:
Concept: IoT smart energy management uses connected devices to monitor and optimize energy consumption in production systems.
Components:

- Sensors (e.g., current, voltage sensors).
- Microcontrollers (e.g., Arduino for data processing).
- Communication modules (e.g., Wi-Fi for cloud connectivity).
- Cloud platform for analytics.

Working: Sensors measure energy usage of machines, data is sent to the cloud, and analytics identify inefficiencies (e.g., high idle power). Actions like scheduling or equipment tuning are triggered.

Example: A factory uses IoT to reduce energy waste by 15% by optimizing HVAC and machine schedules.

Analysis: This system lowers costs and supports sustainability by reducing energy consumption.

7. **(a) Mention the challenges in implementing cybersecurity in IoT devices and suggest practical solutions to overcome these challenges.** (13 Marks, CO3, APP)

   Answer:

   Challenges:

- **Weak Authentication**: Many IoT devices use default passwords, enabling unauthorized access.
- **Data Privacy**: Unencrypted data transmission risks leaks.
- **Firmware Vulnerabilities**: Outdated software exposes devices to attacks.
- **Resource Constraints**: Limited processing power restricts security measures.

Solutions:

- Use strong, unique passwords and multi-factor authentication.
- Implement end-to-end encryption (e.g., TLS for data transfer).
- Regular firmware updates and patch management.
- Deploy lightweight security protocols (e.g., MQTT with authentication).

Application: These measures protect IoT-enabled production systems, as seen in secure smart factory deployments.

(OR)

(b) Industrial Automation using Robots. Case study it. (13 Marks, CO3, APP)

Answer:

Case Study: **Fanuc Robotics in Automotive Manufacturing**

- **Context**: Fanuc robots automate welding and assembly at Toyota's plants.
- **Implementation**: IoT-enabled robots with sensors monitor performance and quality. Data is sent to a cloud platform for real-time analytics, optimizing robot tasks.
- **Outcome**: Reduced production time by 20%, improved weld precision, and lowered defects by 15%.

Application: Robots enhance speed, accuracy, and scalability in industrial automation, integrating with IoT for predictive maintenance and efficiency.

8. **(a) Define Predictive Maintenance and Analyse the importance of Predictive Maintenance in production system.** (14 Marks, CO3, ANA)

   Answer:

   Definition: Predictive maintenance uses IoT sensors and analytics to predict equipment failures before they occur, scheduling maintenance proactively.

   Importance:

- **Reduced Downtime**: Anticipates failures (e.g., motor vibration sensors predict bearing issues).
- **Cost Savings**: Minimizes unplanned repairs (e.g., 30% cost reduction in heavy industries).
- **Improved Safety**: Prevents hazardous failures.

- **Extended Equipment Life**: Optimizes maintenance schedules.

Analysis: By analyzing sensor data (e.g., temperature, vibration), predictive maintenance enhances reliability and efficiency, as seen in GE's turbine monitoring systems.

(OR)

(b) IoT Smart Inventory Management – How it is useful in decrease the cost during manufacturing - Case study it. (14 Marks, CO3, ANA)

Answer:

Concept: IoT smart inventory management uses sensors and connectivity to track inventory in real-time, optimizing stock levels and reducing waste.

Cost Reduction:

- Minimizes overstocking/understocking with accurate demand forecasting.
- Reduces material waste through timely reordering.
- Automates inventory tracking, lowering labor costs.

Case Study: **Bosch's Smart Inventory System**

- **Context**: Bosch implemented IoT for inventory in its automotive parts factory.
- **Implementation**: RFID tags and IoT sensors track parts, feeding data to a cloud platform for real-time visibility.
- **Outcome**: Reduced inventory holding costs by 25% and stockouts by 40%.

Analysis: IoT-driven inventory management streamlines manufacturing, ensuring just-in-time supply and cost efficiency.
