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5. What is an Interrupt System and Interlock in Computer Process Control? Explain

Interrupt System:

An Interrupt System is a mechanism in computer process control where the CPU is notified immediately when a specific event occurs, temporarily suspending the current task to handle the event.

Working:

- When a sensor/device detects a critical condition (like over-temperature), it sends an interrupt signal.
- The CPU pauses current execution, saves its state, and executes an interrupt service routine (ISR).
- Once the event is handled, the CPU resumes the previous process.

Advantages of Interrupts:

- Immediate response to critical events
- Reduces the need for constant polling
- Improves real-time performance of control systems

Interlock in Process Control:

An Interlock is a safety mechanism designed to prevent the execution of unsafe actions in a process.

Purpose:

- Ensures safe operation by enforcing conditions before allowing actions.
- Can be hardwired (using relays) or software-based.

Example:

- In a boiler, if the pressure exceeds limit, the interlock will shut down the burner.
- A motor wont start unless the safety door is closed.

Types:

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- Safety Interlocks: Prevent hazards.
- Process Interlocks: Maintain correct process sequence.
- Mechanical/Electrical Interlocks: Use hardware components.
- Software Interlocks: Logic coded in PLC or control software.

Summary:

Interrupts handle event-driven actions, while interlocks enforce safe sequencing and conditions in automation systems.

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6. Difference Between Control System in Process Industries and Discrete Manufacturing Industries (10 Points)

S.No	Process Industries	Discrete Manufacturing Industries
1	Handles continuous processes (chemical, oil, gas)	Handles individual parts and products
2	Uses continuous control systems	Uses discrete control systems
3	Variables change continuously (e.g., temperature, flow)	Variables are binary/logical (e.g., on/off, presence)
4	Common control: PID, DCS, SCADA	Common control: PLC, CNC, robots
5	Requires real-time process monitoring	Requires sequence control and logic
6	Focus on fluid control	Focus on mechanical operations
7	Uses analog sensors and actuators	Uses digital sensors, proximity switches
8	Examples: Refinery, food processing	Examples: Car manufacturing, packaging
9	Control system is centralized and redundant	Control system is often modular or distributed
10	Requires 24/7 uptime	Often involves batch or shift-based operation

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7. Write Capabilities of Computer Control Systems

Computer-controlled systems play a critical role in automation due to their flexibility, intelligence, and precision.

Major Capabilities:

1. Monitoring and Data Logging:
   - Continuously monitor variables (temperature, speed, etc.) and record data for analysis.

2. Real-Time Control:
   - Quick processing of inputs and generation of outputs for precise control.

3. Fault Detection & Diagnosis:
   - Detect abnormal events or failures and alert or take corrective actions.

4. Process Optimization:
   - Optimize process parameters using feedback and algorithms.

5. Communication:
   - Interface with other systems (SCADA, PLC, HMI, ERP) using protocols like Modbus, OPC.

6. Scheduling and Coordination:
   - Manage task sequences, machine scheduling, and material flow.

7. Flexible Programming:
   - Easily reprogrammed to adapt to new processes or changes.

8. Human-Machine Interface (HMI):
   - Provide operators with graphical interfaces to control and monitor processes.

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9. Alarm and Safety Handling:

- Manage critical situations and execute emergency stop actions.

10. Integration:

- Seamlessly integrates with robotics, sensors, AI, and IoT systems.

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8. Explain Requirements of Control Systems

For a control system to function effectively in an industrial environment, it must meet several technical and operational requirements:

Technical Requirements:

1. Accuracy and Precision:
   - Must maintain the process variable at or near the desired value.

2. Stability:
   - The system should not oscillate or become unstable after disturbances.

3. Speed of Response:
   - Quick response to input or environmental changes is essential.

4. Reliability:
   - Should work continuously without failures.

5. Robustness:
   - Must handle variations or disturbances in the process.

6. Scalability:
   - Should be expandable for future needs or upgrades.

7. Real-time Operation:
   - Inputs should be processed within required time constraints.

Functional Requirements:

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1. Sensor and Actuator Interface:

   - Connect to and control field devices.

2. Feedback Mechanism:

   - Must have a loop for comparing actual vs. desired values.

3. Programmability:

   - Should allow users to define logic, thresholds, and sequences.

4. User Interface (HMI):

   - Clear and intuitive interface for operator interaction.

5. Communication:

   - Support for standard protocols and networking with other systems.

Safety and Compliance:

- Must follow industrial standards (IEC, ISO).
- Include interlocks, fail-safes, and alarms to prevent hazards.