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Elective 4 (Electronics).

Industrial Electronics

Terminal Examination

Total Marks : 50

Attempt All Questions.

Question No 1. 10

A. Consider a lubricating oil tank in Industrial Plant having 2 sensors, one is put near to the bottom and one near to top, to fill the tank, motor A will pump oil to tank until the high level sensor turns on, at that point the motor A turns OFF. Motor A is turned ON when the level fall below the low level sensor. Explain the states of PLC operating cycle with help of neat ladder diagrams. **CLO-3**

Question No 2 20

A. Write some benefits of Industrial Automation **CLO-2**
B. Briefly explain the components and functions of SCADA system **CLO-2**

Question No 3 20

A. Differentiate between Hardwired control systems and PLC system **CLO-3**
B. What are the function of SCADA systems **CLO-2**

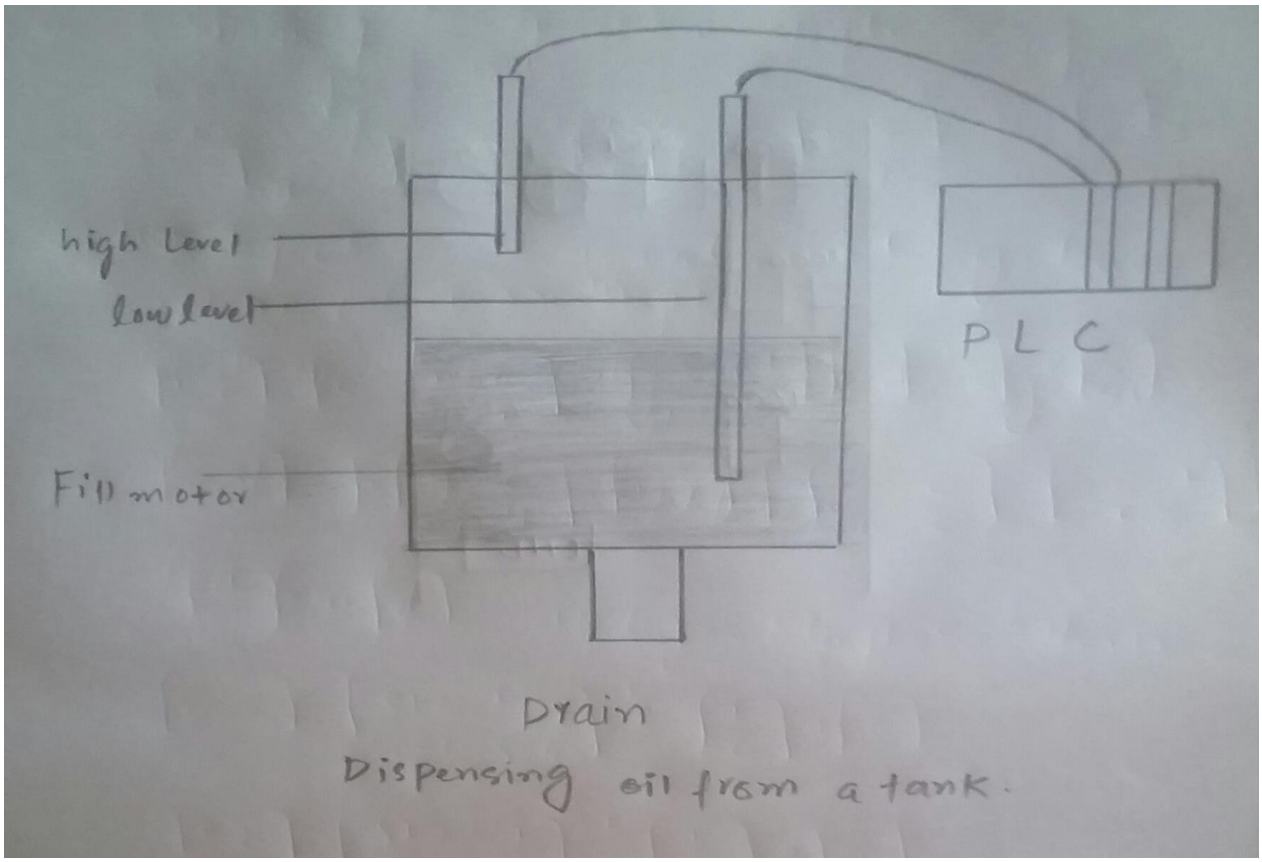
.Good Luck.

Question No 1.

(A).
Consider a lubricating oil tank in Industrial Plant having 2 sensors, one is put near to the bottom and one near to top, to fill the tank, motor A will pump oil to tank until the high level sensor turns on, at that point the motor A turns OFF. Motor A is turned ON when the level fall below the low level sensor. Explain the states of PLC operating cycle with help of neat ladder diagrams.

Answer:

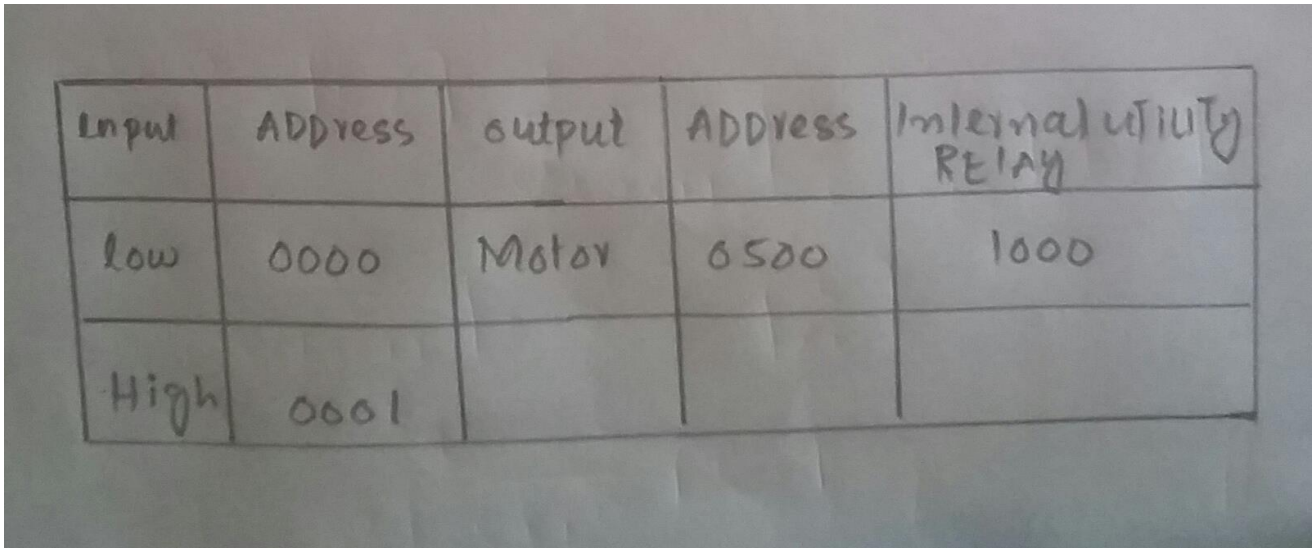
We are controlling lubricating oil being dispensed from a tank. This is possible by using two sensors. We put one near the bottom and one near the top, as shown in the picture below.



Here, we want the fill motor to pump lubricating oil into the tank until the high level sensor turns on. At that point we want to turn off the motor until the level falls below the low level sensor. Then we should turn on the fill motor and repeat the process. Here we have a need for 3 I/O (i.e. Inputs/Outputs). 2 are inputs (the sensors) and 1 is an output (the fill motor).

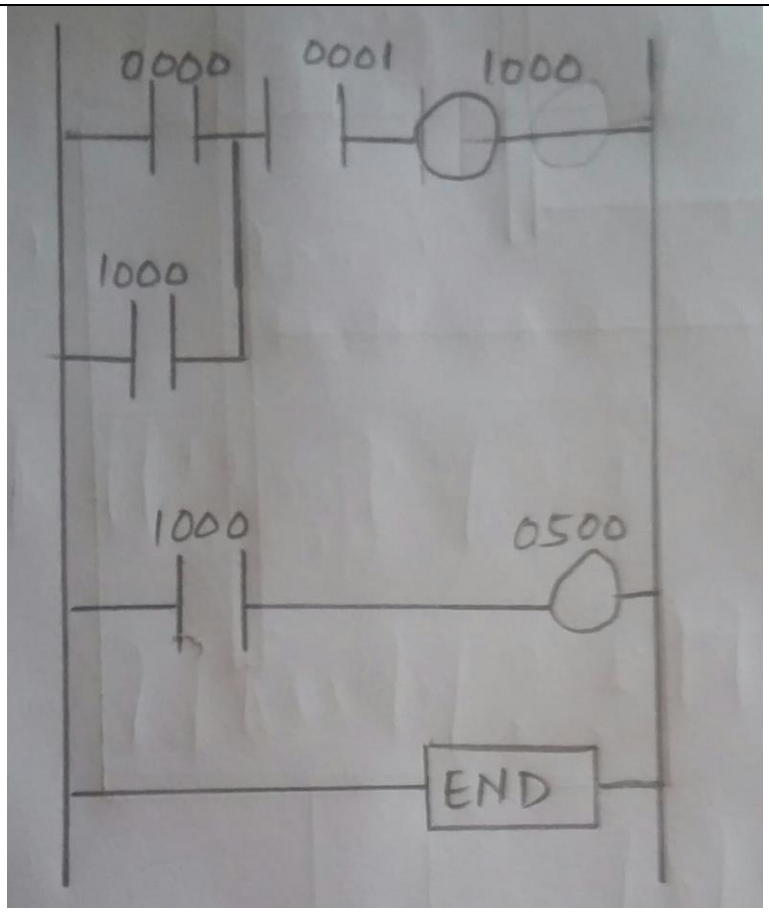
Both of our inputs will be NC (normally closed) fibber-optic level sensors. When they are NOT immersed in liquid they will be ON. When they are immersed in liquid they will be OFF.

We will give each input and output device an address. This lets the plc know where they are physically connected. The addresses are shown in the following tables:



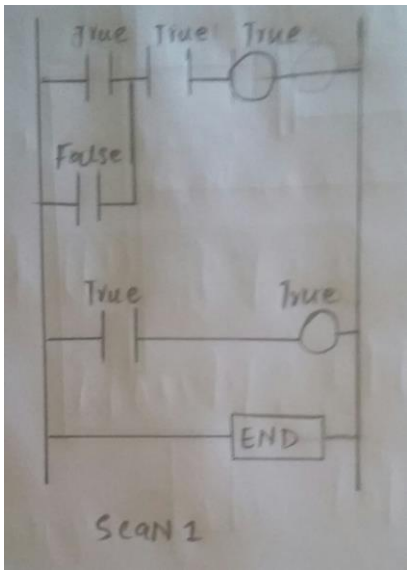
Input	ADDress	output	ADDress	Internal utility RELAY
low	0000	Motor	0500	1000
High	0001			

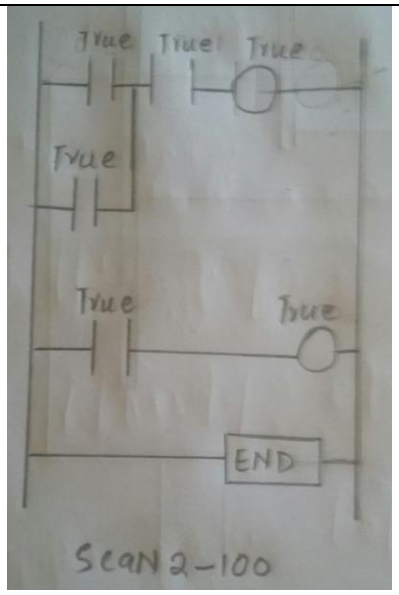
Here is what the ladder diagram will actually look like. Notice that we are using an internal utility relay in this example. You can use the contacts of these relays as many times as required. Here they are used twice to simulate a relay with 2 sets of contacts. Remember, these relays DO NOT physically exist in the plc but rather they are bits in a register that you can use to SIMULATE a relay.



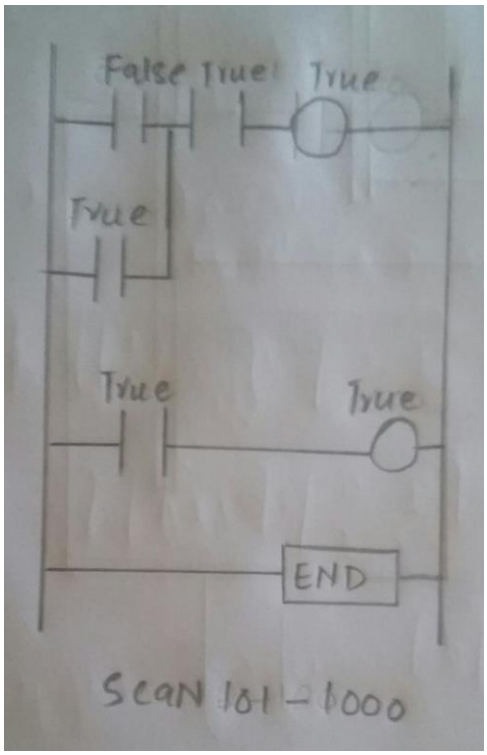
How a Ladder is Scanned

Let's watch what happens in this program scan by scan. Initially the tank is empty. Therefore, input 0000 is TRUE and input 0001 is also TRUE.



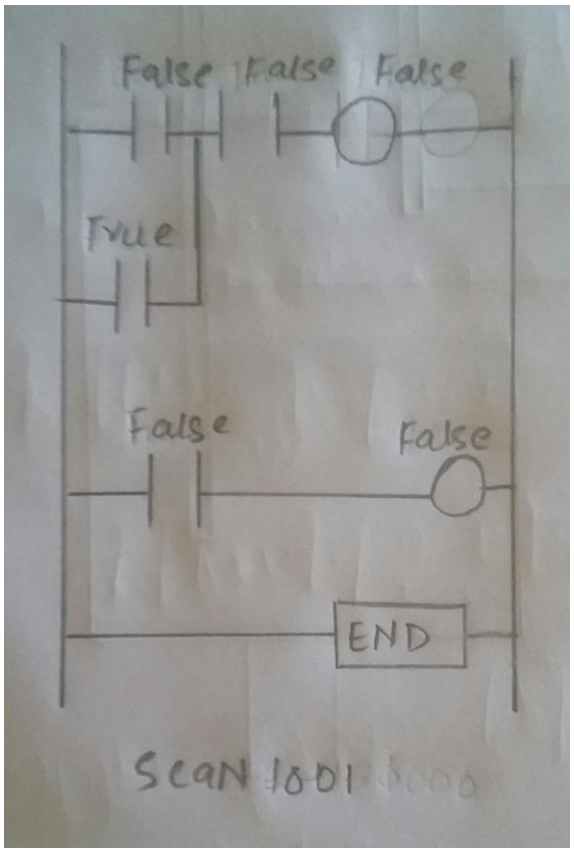


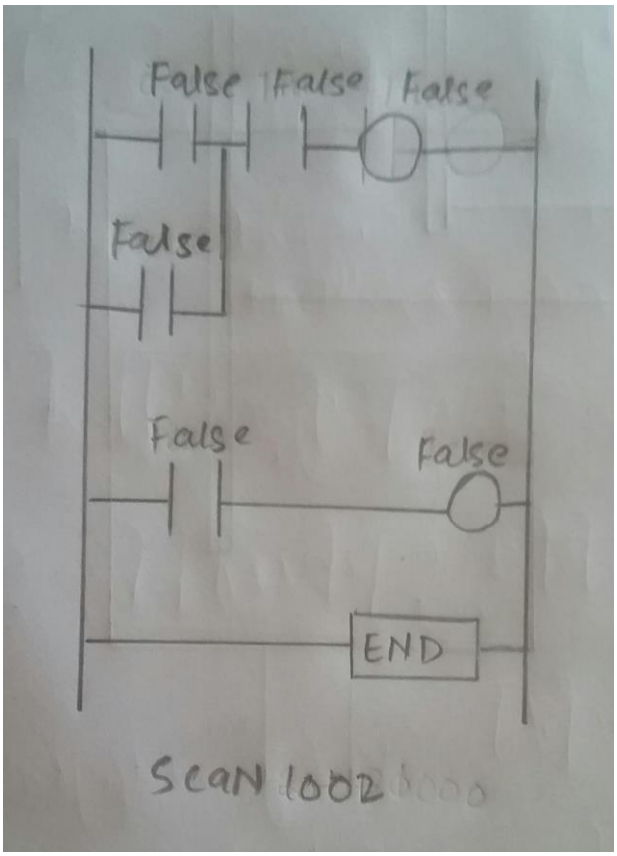
Gradually the tank fills because 500 (fill motor) is on. After 100 scans the oil level rises above the low level sensor and it becomes open. (i.e. FALSE).



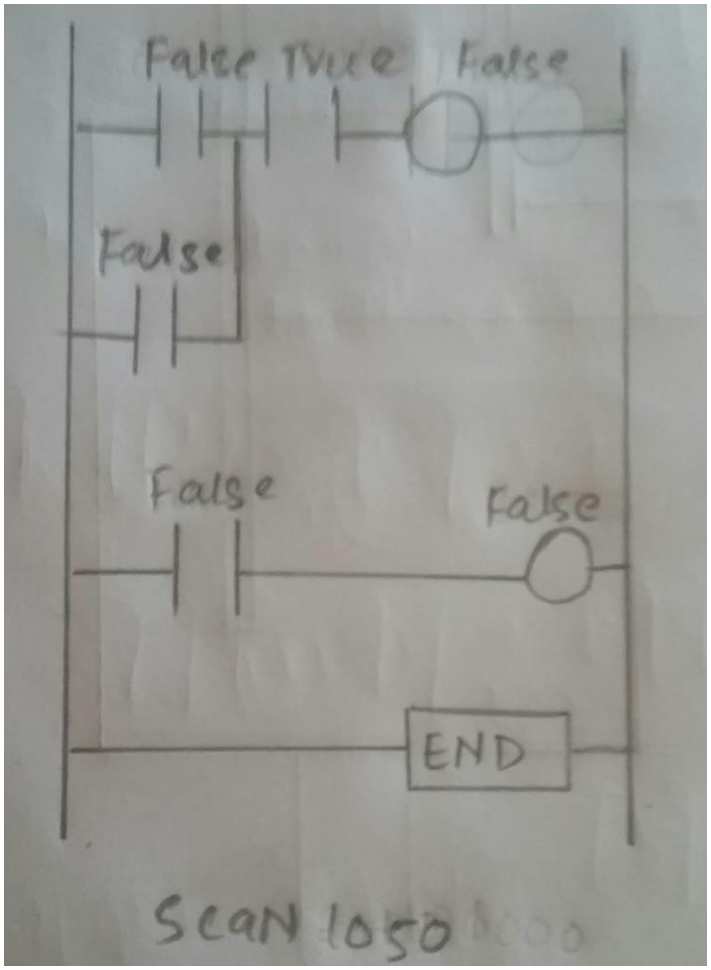
Notice that even when the low level sensor is false there is still a path of true logic from left to right. This is why we used an internal relay. Relay 1000 is latching the output (500) on. It will stay this way until there is no true logic path from left to right. (i.e. when 0001 becomes false).

After 1000 scans the oil level rises above the high level sensor at it also becomes open (i.e. false).





Since there is no more true logic path, output 500 is no longer energized (true) and therefore the motor turns off. After 1050 scans the oil level falls below the high level sensor and it will become true again.



Notice that even though the high level sensor became true there still is NO continuous true logic path and therefore coil 1000 remains false!!! After 2000 scans the oil level falls below the low level sensor and it will also become true again. At this point the logic will appear the same as SCAN 1 above and the logic will repeat as illustrated above.

Question No 2.

(A)

Write some benefits of Industrial Automation .

Answer:

Industrial Automation:

Automation is basically the allocation of human control function to

technical equipment to automate the systems that produce their goods or services in the most efficient manner possible.

Or

Industrial automation systems are systems used to control and monitor a process, machine or device in a computerized manner that usually fulfills repetitive functions or tasks. They are intended to operate automatically in order to reduce and improve human work in the industry.

These systems replace the repetitive and mechanical tasks mainly performed by one person and the decisions he or she makes in the manufacturing process. This is done through the use of logical programming commands and powerful machinery.

Industrial automation systems bring various benefits to organizations.

Benefits of An Industrial Automation System:

According to different companies such as Sure Controls and Big Sky Engineering and the Encyclopedia Britannica (in its article Advantages and disadvantages of automation), organizations implement a system of these characteristics because of the following advantages they provide:

1. Productivity. These systems make automation possible for factories and industrial processes, allowing a continuous mass production 24/7. 24 hours a day, seven days a week, which improves productivity and reduces assembly times.

2. Quality. By means of adaptive control and monitoring in different stages and industrial processes, these systems are useful in eliminating human error and thus improve the quality and homogeneity of the products offered. The performance is not reduced after several hours of continuous work.

3. Greater consistency. Machines and computers work at a constant and continuous pace. Therefore, automated production processes have a longer duration, stability and solidity when managed with an automation system

4. Flexibility. Implementing a new task in a traditional production chain involves hours or days of user training. On the other hand, with an automated system, reprogramming a robot or machine is a simple and fast process that provides greater flexibility in the production process.

5. More precise information. Automation of data collection improves accuracy and reduces costs. Such increased accuracy enables company managers to make better decisions.

6. Safety. It is safer to use robots on production lines with dangerous working conditions for humans. In the United States, the Occupational Safety and Health Act was passed in 1970 with the aim of improving job safety and protecting employees. Since its passage, it has promoted automation and robotics in the country's factories and the use of automation systems.

7. Cost reduction. Although the initial investment in industrial automation systems might be rather high, implementing this technology will translate into a reduction of data analytics costs. Furthermore, thanks to this automated data analysis, the risk of machine failure and service interruptions is reduced to a minimum.

8. Improved working conditions. Workers in a factory where an industrial automation system has been implemented work fewer hours and spend their time on high value-added tasks.

9. Increased added value. Automation systems free employees from having to perform tedious and routine functions. When the action of machines and computers frees employees from performing these functions, they can carry out more value-added tasks in other areas of the company that provide greater benefit.

TYPES OF AUTOMATION:

Building automation
Example: lifts, smoke detectors

Office automation
Example: printers, cctv cameras

Scientific automation
Example: rocket launching

Light automation
Example: street solar lightening

Industrial automation
Example: automated bottle filling stations , steel factories etc.

Part(B).

Briefly explain the components and functions of SCADA system.

Answer:

SCADA:

stands for supervisory control and data acquisition. It is a type of software application program for process control. SCADA is a central control system which consists of controllers network interfaces, input/output, communication equipment, and software. SCADA systems are used to monitor and control the equipment in the industrial process which includes manufacturing, production, development, and fabrication. The infrastructural processes include gas and oil distribution, electrical power, water distribution. Public utilities include bus traffic system, airport. The SCADA system takes the reading of the meters and checks the status of sensors in regular intervals so that it requires minimal interference of humans.

The four main functions of SCADA System:

1.Control Feature using Graphical Representation
2. Real-time/Historical Trend Feature
3.Alarm Handling
4.Report Generation
5.centrally monitor and control thousands of industrial equipment such as valves motor relay sensor etc.
6.display current state or remote process(visualization)

Basic Components of SCADA System:

A basic SCADA system consists of following components:

1.Human Machine Interface
2.Supervisory System
3.Remote Terminal Units
4.Programmable Logic Controllers (PLCs)
5.Communication Infrastructure

6.SCADA Programming

1. Human Machine Interface:

It is an I/O device that allows a human operator to control the process data. This is achieved by linking SCADA's databases and software programs for providing management information like detailed schematics, scheduled maintenance, data diagnostics and logistic information. The operating personnel can also see the graphical representation of data.

2. Supervisory System:

This system acts as a communication server between the HMI software in control room workstations and its equipment like PLCs, RTUs, sensors etc.

Smaller Supervisory Control and Data Acquisition systems have only a single PC that serves as a supervisory or master system. Larger Supervisory Control and Data Acquisition systems have multiple servers, sites for disaster recovery and distributed software applications. The servers are configured as dual-redundant or hot-standby formation for continuously monitoring server failure.

3. Remote Terminal Units:

This system contains physical objects that are interfaced with Remote Terminal Units (RTUs). These electronic devices are controlled by microprocessors and are used for transmitting recorded data to the supervisory systems. They also receive data from the master system in order to control the connected objects.

They are also called as Remote Telemetry Units.

4. Programmable Logic Controllers:

PLCs find their use in the Supervisory Control and Data Acquisition system through sensors. They are attached to the sensors in order to convert the sensor output signal into digital data.

They are preferred over RTUs because of their configuration, flexibility, affordability and versatility.

5. Communication Infrastructure:

Generally, a combination of direct wired connection and radio is used in Supervisory Control and Data Acquisition systems. However, SDH/ SONET can also be used for larger systems like railways and power stations.

Among the compact SCADA protocols, few recognized and standardized protocols deliver information only when the RTUs are polled by the supervisory station.

6. SCADA Programming:

SCADA programming in HMI or master station is used for creating diagrams and maps that provide vital information during process or event failure. Most of the commercial Supervisory Control and Data Acquisition systems use standardized interfaces in programming.

Types of SCADA System:

There are four different types of SCADA systems from four generations. They are:

1.Early or Monolithic SCADA Systems (First Generation)
2.Distributed SCADA Systems (Second Generation)
3.Networked SCADA Systems (Third Generation)
4.IoT SCADA Systems (Fourth Generation)

Applications of SCADA System:

Power Generation & Distribution:
Used to monitor current flow, voltage, circuit breaker functions. Also used in remotely switching on/ off of power grids.

Water & Sewage System:
Used by municipal corporations for regulating and monitoring water flow, reservoir status, pressure in distribution pipes, etc.

Industries and Buildings:
Used to control HVAC, central air conditioning, lighting, entry/ exit gates, etc.

Oil and Gas Industries:
Used for regulating and monitoring flow, reservoir status, pressure in distribution pipes, etc.

Communication Networks:
Used for monitoring and controlling servers, networks and nodes.

Manufacturing:

Used for managing inventories for controlling over manufacturing/ stocking. Also used for monitoring and regulating instrumentation, process and product quality.

Public Transport:

Used for regulating subway electricity, automating traffic signals/ railway crossing and live tracking of flights/ trains/ buses.

Advantages of SCADA System:

The advantages of Supervisory Control and Data Acquisition system include:

1.Improvement in Service Quality
2.Improvement in Reliability
3.Reduction in operation and maintenance costs
4.Easy to monitor large system parameters
5.Real time information on demand
6.Reduction in Manpower
7.Value added services
8.Ease in Fault Detection and Fault Localization (FDFL)
9.Reduction in Repair Time (System Down Time)

Question(3)(a).

Differentiate between Hardwired control systems and PLC system.

Answer:

Hard-wired control systems:

In hard wired control systems, relays are used. For example: In Electrical-control, the wiring of control elements such as sensors, solenoids, counters etc. are through relays control. Such relay controlled systems are also called as hard-wired control system because any modification in control program involves rewiring of the circuit.

Therefore, hardwired controls are cumbersome and difficult to modify when production requirement changes regularly. Hard-wired control systems are difficult to maintain because any small problem in design could be a major problem in terms of tracing and rewiring.

Hard wired control systems consists of three division

1. Input section – Consists of push –buttons, switches and sensors. They transfer signals to the
processing section

2. Processing section – Consists of relay coils and contacts. They determined the relationship
between the inputs received and outputs required

3. Output section – Consists of solenoids, lamps, and contactor coils etc. The processed signals
are transferred to this section.

PLC Systems.

PLC systems offer number of advantages over hard wired electromechanical relay control systems. Unlike the electromechanical relays, PLCs are not hard-wired to perform specific functions. Thus, when system operation requirement change, a software program is readily changed instead of having to physically rewire relays.

In addition, PLCs are more reliable, faster in operation, smaller in size, and can be readily expanded.

PLC systems consists of three division

1. Input section – Consists of push –buttons, switches and sensors which are connected to specific input addresses in the program. They transfer address information to the processing section

2. Processing section – The microprocessor receives the input signals from input sections and
executes the information (called instructions) in the software program and sends the processed
signals to output section

3. Output section – Takes the signal from processing section and modify the signal from the
processor to operate output devices connected to specific output addresses.

Comparison between Hardwired and PLC system.

Hardwired control systems:

•The functions are determined by the physical wiring.

•Changing the function means changing the wiring.

•Can be contact-making type (relays, contactors) or electronic type (logic circuits)

PLC Systems:

•The functions are determined by a program stored in the memory.

•The control functions can be changed simply by changing the program.

•Consist of a control device, to which all the sensors and actuators are connected.

Question(3)B.

What are the function of SCADA.

Answer:

SCADA.

is the short abbreviation of Supervisory Control and Data Acquisition.

As the name suggests SCADA mainly does three operations:

Supervise real-time data in the form of graphical presentation
Control industrial processes locally or through Remote locations
Acquire real-time data as well as logs data.

SCADA system is an important factor of the industrial organization as they help to monitor process data as well as control the processes and easily detect any issue within the process thus reduce downtime.

THE FUNCTIONS OF SCADA SYSTEMS:

Supervisory control and data acquisition (SCADA) systems are centralized control systems that monitor, collect and process data from sensors placed throughout a factory or remote field location.

Identification:

SCADA systems are used in a variety of industries such as traffic systems, electric power utilities and mass transit systems where equipment functions must be closely monitored and controlled automatically. SCADA systems can collect data from sensors as well as send control signals back to the equipment being monitored.

Functions:

SCADA systems perform several functions. The three basic functions are the monitoring, control and user interface functions. The monitoring function collects data and sends it back to the central computer. The control function gathers data from monitoring sensors, processes it and send control signals back to the equipment according to a prescribed software program. The user interface is often a large control room where individuals can monitor SCADA input and output responses in real time.

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