

**EI 2401 – INDUSTRIAL DATA NETWORKS****Unit I : Data Network Fundamentals PART A****1. Define networks?**

A network is a set of devices (referred to as nodes) connected by media links. A node can be a computer, printer, or any other device capable of sending or receiving data generated by other nodes on the network. The links connecting the devices are called as communication channels.

**2. Give some applications of networks?**

a) Marketing and sales, b) Financial services, c) Manufacturing, d) Electronic messaging, e) Directory services, f) Information services, g) Electronic data interchange, h) Teleconferencing, i) Cellular telephone, j) Cable television.

**3. Define line configuration?**

Line configuration refers to the way two or more communication devices attach to a link. A **link** is the physical communication pathway that transfers data from one device to another.

**4. Define topology? What are the different types of topology?**

Topology refers to the way a network is laid out, either physically or logically. Two or more devices connect to a link; two or more links form a topology. The different types of topology are, a) Mesh, b) Star, c) Tree, d) Bus, e) Ring

**5. Define peer-to-peer and primary-secondary transmissions?**

Peer-to-peer is one where the devices share the link equally. Primary-secondary is one where one device controls traffic and the others must transmit through it.

**6. What is the difference between active hub and passive hub?**

Active hub:- The central hub in the tree is an active hub. An active hub contains a repeater, which is a hardware device that regenerates the received bit patterns before sending them out.

Passive hub:- A passive hub provides a simple physical connection between the attached devices.

**7. Define transmission modes? What are the types of transmission modes?**

Transmission mode is used to define the direction of flow between two linked devices. There are three types of transmission modes;

a) Simplex :- The communication is unidirectional, as on a one-way street. Only one of the two stations on link can transmit; the other can only receive.

b) Half-duplex:- each station can transmit and receive but not at the same time. When one device is sending the other can only receive, and vice versa.

c) Full-Duplex:- both stations can transmit and receive simultaneously.

**8. What are the different categories of n/w?**

a) LAN (Local Area Network):- A LAN is usually privately owned and links the devices in a single office, building or campus. LANs are designed to allow resources to be shared between personal computers and workstations.

b) MAN (Metropolitan Area Network):- A MAN is designed to extend over an entire city. It may be a single n/w such as a cable tv n/w, or it may be means of connecting a number of LANs into a larger network so that resources may be shared LAN-to-LAN as well device-to-device.

c) WAN (Wide Area Network):- WAN provides long distance transmission of data, voice, image and video information over large geographical areas that may comprise a country, or even the whole world.

**9. What is an open system model?**

An open system model is a model that allows any two different systems to communicate regardless of their underlying architecture. It is a layered framework for the design of network systems that allows for communication across all types of computer systems. It is built of seven ordered layers. They are,

Layer1 – physical layer, Layer2 – data link layer, Layer3- network layer, Layer4 – transport layer, Layer5- session layer, Layer6 – presentation layer, Layer7 – application layer

**10. What is the mechanism of ENQ/ACK?**

The initiator first transmits a frame called an enquiry asking if the receiver is available to receive data. The receiver must answer either with an acknowledgement frame if it is ready to receive with negative acknowledgement.

**11. Define flow control?**

Flow control refers to a set of procedures used to restrict the amount of data the sender can send before waiting for acknowledgement

**12. What are the two methods that control the flow of data across communication links?**

- 1) stop and wait,
- 2) sliding window

**13. What is the mechanism of stop-and-wait flow control?**

In the stop and wait method of flow control sender sends one frame and waits for an acknowledgement before sending the next frame

**14. What is the mechanism of sliding window flow control?**

In the sliding window flow control; the sending of data is constrained by imaginary window that expands and contracts according to the acknowledgement received by the sender.

**15. What does the term error control mean in the data link layer?**

Error control in the data link layer is based on the automatic repeat request which means retransmission of data in three cases: damaged frame lost frame, lost acknowledgment.

**16. What is the mechanism of poll/select?**

A poll is sent to the secondary device by the primary to determine if the secondary has to send. The secondary can respond by sending a acknowledgement or a data frame.

A select frame is sent from the primary device to the secondary device to tell the secondary to prepare to receive data. The secondary responds with an ACK or a NAK

**17. Define protocol.**

A protocol in data communications is the set of rules used to implement one or more layers of the OSI model.

**18. What are the two types of data link protocol?**

1) Asynchronous protocol, 2) Synchronous protocol

**19. Distinguish X-modem and Y-modem?**

X-modem	Y-modem
1. the data is 128 bytes	1. the data unit is 1024 bytes
2. one CANS signal is used to abort a transmission	2. two CAN signals are used
3. CRC error checking is used	3. ITU-T CRC is used for error checking
4. It is a half-duplex stop and wait ARQ protocol	4. here multiple files can be sent simultaneously

**20. What are the disadvantages of asynchronous transmission?**

1) speed of transmission is less, 2) It leaves unpredictable gaps of time between each character. 3) addition of start, stop bits & insertion of gaps into the bit stream make asynchronous transmission slower.

**21. What are the two types of synchronous protocol and explain it?**

1) character oriented protocol, 2) bit-oriented protocol

**22. What is data transparency?**

Data transparency in data communication means we should be able to send any combination of bits as data. The combination of bits as data is not confused with the control information.

**23. Define BSC**

Binary synchronous communication is a well-known character oriented protocol. BSC operates in half-duplex mode using stop and wait ARQ in a point to –point or multipoint configuration.

**24. What is bit stuffing?**

Bit stuffing is the process of adding one extra '0' whenever there are five consecutive '1's in the data. So that the receiver doesn't mistake the data for a flag.

**25. What do you mean by HDLC?**

High-level data link control is a bit oriented data link designed to support both half-duplex and full-duplex communication over point-to point and multi point links.

**26. How do the three HDLC frame types differ from one another?**

a) I-frame – for data transmission and control, b) S-frame – control, c) U-frame – for control and management

**27. What are the types of modes in HDLC?**

a) normal response mode (NRM), b) asynchronous response mode (ARM), c) Asynchronous balanced mode (ABM)

**28. What is piggy bagging?**

Piggy backing means combining data to be sent and acknowledgement of the frame received in one single frame.

**29. Name the four types of s-frames?**

a) receive ready (RR), b) receive not ready (RNR), c) reject (REJ), d) selective reject (SREJ)

**30. Name the five categories of U-frame.**

1) Mode setting, 2) Unnumbered exchanging, 3) Disconnection, 4) Initiation, 5) Miscellaneous

**31. What are the types of sliding window ARQ error control?**

1) go-back-n, Selective –reject

**PART B**

1. Explain TCP/IP with its salient features?
2. Draw the OSI model and explain the functions performed by each layer of the Model? Explain how data is transmitted in this model
3. Explain HDLC protocol and compare with SDLC?
4. Describe the CSMA/CD MAC technique with necessary diagrams. Compare with ALOHA and slotted ALOHA?
5. Explain Media Access protocol? Explain token passing?
6. Compare the features of different switching technologies.
7. Explain the sliding window protocol.
8. Explain the BISYNC data transmission protocol.
9. Draw the IP header and explain each field.
10. Explain the Go-back N ARQ and selective reject ARQ selective error mechanism with flow diagram.
11. Write short notes on Token Ring.
12. Compare any four Media Access Protocol.
13. What is Framing? How is error control done by data link layer?
14. With suitable example explain the process of establishing a link, exchange the frames and terminating the link using high level data link protocol.
15. Explain the network hierarchy and compare the performances of Packet switching, Message switching and Circuit switching.

**Unit II : INTER NETWORKING PART A*****1. What is the function of repeaters?***

A repeater or regenerators is an electronic device that operates on only physical layer of the OSI model. A repeater installed on a link receives the signal before it becomes too weak or corrupted. Regenerates the original bit pattern and puts the refreshed copy back onto link.

***2. What is the function of bridges?***

It is operate on the physical layer and data link layers of the OSI model. Bridges can divide a large network into the small segments. They can also relay frames between two originally separate LANs. Bridges contain logic that filters traffic, thus making them useful for controlling congestion and isolating problem links.

***3. What is the function of routers?***

These have access to network layer address and contain software that enables them to determine which of several possible paths between those addresses in the best for a particular transmission. Routers operate in the physical , data link and network layers of the OSI model.

***4. What are gateways?***

A gateway is a protocol converter. A gateway can accept a packet formatted for one protocol and convert into a packet formatted for another protocol before forwarding it.

***5. What is the function of gateway?***

A gateway potentially operates in all seven layers of the OSI model. A gateway is a protocol converter. A gateway by itself can accept a packet formatted for one protocol & convert it to a packet formatted for another protocol before forwarding it.

***6. What is network?***

A network is a set of devices often referred to as nodes, connected by media link. A node can be a computer, printer or any device capable of sending and or receiving data generated by other nodes on the network. The links connecting the devices are often called communication channels.

***7. What is inter network?***

When two or more networks are connected they become an internetwork or internet. Individual networks are joined into internetworks by the use of internetworking devices. These include routers and gateways. The word internet means an interconnection of networks and is world wide network.

***8. What is adaptive routing?***

It involves a method in which router may select a new route for each packet in response to changes in condition and topology of the networks.

***9. What is nonadaptive routing?***

Once the path way towards a destination has been selected, the router sends all the packets to that destination along that one route. So the routing destinations are not made based on the condition or topology of the network.

***10. What is distance vector routing?***

Each router periodically shares its knowledge about the entire network with its neighbors. Periodically sends its knowledge about the network only to those routers to which it has direct links. Information sharing occurs.

**11. What is link routing?**

In link state routing each router shares its knowledge of its neighborhood with every other router in their internetwork. Each router sends out information about the neighbors when there is a change.

**12. What is flooding?**

Each router sends the information to every other router on the internetworking not just to its neighbors. It does so by a process called flooding. Flooding means that a router sends its information to all of its neighbors.

**13. What are the main elements of distance vector routing?**

shared information, routing table, updating data

**14. What are the types of bridges?**

simple bridge ; multipoint bridge ; transparent bridge

**15. What is spanning Tree Bridge?**

Two LANs may be connected by more than one bridge. In this case, if the bridges are transparent bridges, they may create a loop, which means a packet may be going round, from one LAN to another and back again to the first LAN. To avoid this situation bridges today use what is called the spanning tree algorithm.

**16. What is Fast Ethernet?**

It operates at 100 Mbps. With new applications such as computer aided design, image processing and real time audio and video being implemented on LANs.

**17. What is Gigabit Ethernet?**

It has a data rate of 1000Mbps. It is used in optical fiber, although the protocol does not eliminate the use of twisted pair cables.

**18. What are the types of Ethernet?**

10 BASE 5: Thick Ethernet.; 10 BASE 2: Thin Ethernet.; 10 BASE T: Twisted pair Ethernet  
Fast Ethernet, Gigabit Ethernet, Switched Ethernet.

**19. What are the types of base band Ethernet?**

10 BASE 5, 10 BASE 2, 10 BASE T, 1 BASE 5, 100 BASE T

**20. What are the types of Topology used in network?**

Mesh Topology ; Star Topology ; Bus Topology ; Ring Topology

**21. What are the advantages and disadvantages of Star topology?**

Advantages- less expensive, easy to install and configure

Disadvantages - Amount of cabling and number of I/O port required.

**22. What are the advantages and disadvantages of Mesh topology?**

Advantages- eliminating traffic problem, robust, privacy or security, fault identification and fault isolation

Disadvantages - hardware is required

**23. What are the advantages a of Tree topology?**

Advantages- Many devices to be attached to a single central hub, Allows the networks to isolate

**24. What is routing table?**

A routing table has columns for at least three types of information: the network ID and ID of the next router. The network ID is the final destination of the packet. The cost is the number of hops a packet must make packet to get there. And the next router is the router to which a packet must be delivered on its way to a particular destination.

**PARTB**

1. Explain in detail (i) Bridges (ii) Gateways
2. Explain the Ethernet Standards for Networks in detail.
3. What are Routers? What are the different types of routing?
4. Explain ARCNET configuration.
5. Explain i) Open system with bridge configuration, ii) Open system with gateway configuration
6. Describe the four types of Internetworking Devices.
7. What are the features of standard Ethernets and compare the same with ARCNET?
8. Explain the connectionless gateway configuration and describe the process of transmitting a datagram from network to network.
9. Explain the importance of Router in an internet.

10. What are the functions of Bridge? Define various strategies involved in designing Bridge from 802.X to 802.Y.
11. Explain the features of IEEE 802.3 Ethernet.
12. What are the functional difference between open system with bridge configuration and gateway configuration?
13. Explain the security aspect of internet working when it is used for control applications.
14. Explain the encoding method, frame format, network access protocol used by Ethernet standard.
15. What are various requirements for networks that are used for control? Elaborate.

### **UNIT – III : HART AND FIELDBUS      PART A**

#### **1. Define HART.**

HART is an acronym for "Highway Addressable Remote Transducer". The HART protocol makes use of the Bell 202 Frequency Shift Keying (FSK) standard to superimpose digital communication signals at a low level on top of the 4-20mA as shown in fig. This enables two-way field communication to take place and makes it possible for additional information(tag numbers, measured variables, range & span data) beyond just the normal process variable to be communicated to/from a smart field instrument. The HART protocol communicates at 1200 bps without interrupting the 4-20mA signal and allows a host application (master) to get two or more digital updates per second from a field device. As the digital FSK signal is phase continuous, there is no interference with the 4-20mA signal.

#### **2. Give the HART specifications?**

The HART specifications include a)Physical form of transmission, b)Transaction Procedures, c)Message structures, d)Data formats, e)set of commands to perform required operation.

#### **3. Write a brief note on HART signal Levels?**

HART protocol specifies that master device transmit a voltage signal whereas slave device transmits a current signal. The current signal is converted in to corresponding voltage by a loop load resistor, so all devices use voltage sensitive receiver circuits. The wave shape is sinusoidal, but trapezoidal waveform is acceptable. A square wave is not acceptable.

#### **4. Write a note on master slave operation?**

HART is a master-slave protocol. That is each message transaction is originated by the master station, the slave device only replies only when it receives a command message. The reply from the slave device acknowledges that the command has been received and may contain data requested by the master.

#### **5. Write a note on multimaster operation?**

HART protocol allows two active masters in a system, one is "primary master", another is "secondary master". Primary master would be the control system secondary master may be a hand-held communicator or a maintenance computer.

#### **6. What are the two modes of communication modes of HART?**

- i)Normal mode:- Maximum communication speed in normal mode is 2 message/sec. It performs a normal master-slave operation.
- ii)Burst mode:-To achieve a high data rate a burst mode is used. The communication speed is 3 message/sec. In burst mode a slave device repeatedly sends a data message as though it had received a specific command to do so.

#### **7. What are the two types of frame formats in HART protocol?**

- i)Short frame format:-Older HART instruments(Version4) used short frame format. In this the address of the slave device is '0'.
- ii)Long frame format:- HART version 5 introduced 'Long frame format'. In this the address of the slave device is world wide unique identifier. It is a 38 bit number derived from the manufacturer code. It contains the device code and device id no. Long frame format gives extra security against the possible reception and acceptance of command meant for another device, either due to external interference or due to excessive cross talk.

#### **8. What are the different groups of HART commands?**

- i)Universal:Provides functions which are implemented in all field devices. Eg. read primary variable and units
- ii)Common-Practice :-Provides functions common to many field devices but not all. If a device uses these functions, these commands should be used to perform them.
- iii)Device specific:-Provides functions which are more or less unique to a particular field device .

#### **9. What are the different HART networks?**

- i)Point-to-point: In point-to-point mode, the traditional 4–20 mA signal is used to communicate one process variable, while additional process variables, configuration parameters, and other device data are

transferred digitally using the HART protocol. The communication takes place between two devices.

ii) Multidrop:- The multidrop mode of operation requires only a single pair of wires and, if applicable, safety barriers and an auxiliary power supply for up to 15 field devices. All process values are transmitted digitally. In multidrop mode, all field device polling addresses are  $>0$ , and the current through each device is fixed to a minimum value (typically 4 mA).

#### **10. Write a note on HART compatible multiplexers?**

HART-compatible multiplexers are ideal for users who want to interface with a large number of HART devices. Multiplexers can be modular and are capable of supporting both point-to-point and all-digital (multidrop) HART communication modes. Communication between a multiplexer and a host application depends on the multiplexer capabilities (e.g., RS232C, RS485, Modbus, and TCP/IP Ethernet).

#### **11. What are the capabilities to be considered in selecting a HART multiplexer?**

HART multiplexer systems, the following capabilities should be considered: Number of HART channels supported, Number of HART channels that share a HART modem, Burst mode support, Multidrop support, Method of communication with the host computer or control system

#### **12. What is meant by pass-through feature?**

Some control systems are integrated with a configuration or instrument-management application. In these systems, the control system passes a HART command, issued by the management application, to the field device via its I/O interface. When the control system receives the reply from the field device, it sends the reply to the management application. This function is referred to as a *passthrough feature* of the control system.

#### **13. How is the HART protocol linked with OSI model?**

The HART protocol utilizes the OSI reference model. As is the case for most of the communication systems on the field level, the HART protocol implements only the layers 1, 2 and 7 of the OSI model. The layers 3 to 6 remain empty since their services are either not required or provided by the application layer 7.

#### **14. What are the features of HART protocol?**

The most important performance features of the HART protocol include: i) proven in practice, simple design, easy to maintain and operate, ii) interoperability, iii) compatible with conventional analog instrumentation, simultaneous analog and digital communication, iv) option of point-to-point or multidrop operation, v) flexible data access via up to two master devices, vi) supports multivariable field devices, vii) sufficient response time of approx. 500 ms, viii) open de-facto standard freely available to any manufacturer or user

#### **15. What is meant by Device Description (DD)?**

Some HART host applications use *device descriptions* (DD) to obtain information about the variables and functions contained in a HART field device. The DD includes all of the information needed by a host application to fully communicate with the field device. HART *Device Description Language* (DDL) is used to write the DD, that combines all of the information needed by the host application into a single structured file. The DD identifies which common practice commands are supported as well as the format and structure of all device-specific commands. A DD for a HART field device is roughly equivalent to a printer driver for a computer.

#### **16. What is meant by fieldbus?**

Fieldbus is an all digital, serial two way communication system that interconnects devices in the field such as sensors, actuators and controllers. Fieldbus replaces the 4-20mA standards. Fieldbus is a LAN for instruments with built in capability to distribute a control application across the network.

#### **17. What are the advantages of fieldbus?**

1) Give bidirectional digital communication, 2) Simple cabling and cross wiring, 3) Higher safety through self monitoring and maintenance, 4) Device interoperability, 5) Advanced functions added to field instrumentation, 6) Quick on-line diagnostics, 7) Fieldbus allows many pairs of wires to be connected to a single pair of wire. 8) Powerful Performance Software applications helps to configure a fieldbus quickly, 9) Provides more reliable data for control.

#### **18. Define interoperability?**

Interoperability is defined as :- "The ability to operate multiple devices, independent of manufacturer, in the same system, without loss of minimum functionality". Interoperability allows mixing devices from different manufacturers on the same fieldbus and allows replacing a defective device with a device from a different vendor.

#### **19. What are the main two components of interoperability?**

The two major components are, i) Functional Block, ii) Device Description.

**20. What is meant by function blocks?**

Function blocks provide common structure for defining inputs, outputs, control algorithms, events, alarms & block control diagrams. The common function block ensures system integrity. Function blocks allow timing and synchronization of control strategies so that system schedules can be built.

**21. What is meant by device description?**

A device description is a driver for the device. The DD includes the operating procedures, variable descriptions and other information required by the host. DD's are written using Device Description Language.

**22. Define interchangeability?**

In digital oriented systems, each company product follows their own standards. If in a system with two different operations, one fails and device with slight change can do the other device's operation it is known as interchangeability.

**23. What are the different fieldbus topologies?**

i) Point-to-point topology, ii) Bus with spurs topology, iii) Tree topology, iv) Daisy chain topology.

**24. What is meant by Bus with spur topology?**

With this topology, the fieldbus devices are connected to the bus segment through a length of cable called a spur. A spur can vary in length from 1m to 120 m. If spur is less than 1 m it is called splice.

**25. What is meant by daisy chain topology?**

With this topology the fieldbus cable is routed from device to device on the segment and is interconnected at the terminals of each fieldbus devices.

**26. What is meant by communication stack?**

The communication stack is comprised of layers 2 & 7 in the OSI model (Data Link & Application layer).

**27. What are the two types of fieldbus?**

i) H1 fieldbus: low speed (31.25 kbps), error proof transmission, used for control applications such as temp, level and flow control.

ii) H2 fieldbus: High speed (1 mbps or 2.5 mbps), used in advance process control, remote input/output and high speed factory automation applications.

**28. What is meant by report distribution type VCR?**

The report distribution VCR type is used for queued, unscheduled or user initiated one-to-many communication. It is used by fieldbus devices to send alarm notifications to the operator consoles.

**29. What is meant by publisher/subscriber VCR type?**

It is used for buffered (scheduled), one-to-many communication. Publisher/subscriber VCR type is used by the field devices for cyclic, scheduled publishing of user application function block input and output such as process variable and primary output on the fieldbus.

**30. What is meant by Fieldbus Message Specification (FMS)?**

FMS services allow user applications to send messages to each other across the fieldbus using a standard set of message formats. FMS describes the communication services, message formats and protocol behavior.

**31. What is meant by object description?**

Data that is communicated over the fieldbus is described by an object description. Object descriptions are collected together in a structure called an *object dictionary*.

**32. What are the operations of a LAS?**

i) CD schedule, ii) Live List maintenance, iii) Data Link Time Synchronization, iv) Token Passing, v) LAS redundancy.

**33. What is meant by Live List?**

The list of all devices that are responding properly to the Pass Token (PT) are called the Live List.

**34. What is meant by Virtual Field Device?**

A VFD is used to remotely view local device data described in the object dictionary. A typical device will have at least two VFDs.

**PART B**

1. Discuss the salient features of HART communication protocol?
2. Explain in general the field bus architecture. Draw the topologies and discuss.
3. (i) List the features of HART protocol? (ii) Sketch and explain HART frame and message formats
4. (i) Explain field controller implementation of HART protocol (ii) Compare field bus with HART protocol
5. Explain HART and the OSI model.
6. Give physical layer specification of Field bus.

7. Describe the HART message structure.
8. Explain the various types of HART commands and their functions.
9. Explain the implementation of HART field controller with relevant diagrams.
10. Discuss in detail the general architecture of Field bus in a DCS environment of your own choice.
11. With neat sketch, explain the different ways in which devices are connected to the Field bus.
12. Discuss about the field bus message specification services.
13. Explain the relevance of the terms interoperability and interchangeability in a DCS.
14. Compare Field bus with HART protocol.

#### UNIT IV MODBUS and PROFIBUS PA/DP/FMS AND FF PART A

##### 1. Give the modbus message frame format with size of each field.

Address field	Function field	Data field	Error check field
1 byte	1 byte	Variable	2 bytes

##### 2. What are the functions codes?

Read digital output status-01, read digital input status-02, Read holding register-03  
Read input register-04, Force single coil-05, Preset single register-06, Read exception status-07

##### 3. What are the common problems in MODBUS?

Hardware-mis wired communication cabling, faulty communication interfaces  
Software-access non-existent nodes (or) invalid function codes (or) illegal data format

##### 4. Mention the limitations of Modbus

Limitations are: Serial lines are relatively slow- 0.01 to 0.115Mbps. Complex hierarchy of masters and slaves -never simple or easy to maintain

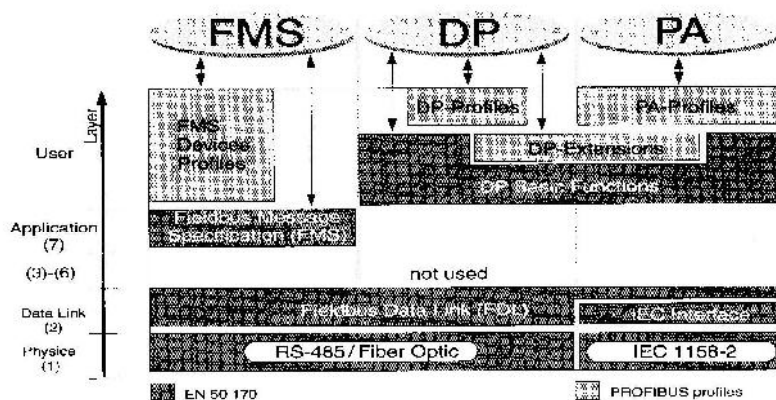
##### 5. What are the advantages of Modbus?

Modbus is a simple, flexible, publicly published protocol, which allows device to exchange discrete and analog data. Wide acceptance among instrument manufacturers and users with many systems in operation.

##### 6. What are the 2 transmission modes in Modbus?

Two modes are (i) ASCII, (ii) RTU-hexadecimal

##### 7. Draw the profibus protocol stack



**Figure 13.1**  
Profibus protocol stack

##### 8. What is a Profibus?

Profibus – PROcess FIEld BUS is widely accepted international networking standard

##### 9. What are the devices supported by Profibus?

It supports single-cable wiring of multi-input sensor blocks, pneumatic valves, complex intelligent devices and operator interfaces.

##### 10. What are the versions of Profibus available?

Profibus DP(master/slave), Profibus FMS (multi-master/peer-to-peer) and Profibus PA (intrinsically safe)

##### 11. How Profibus PA version is different from others?

All versions use same data link layer protocol, DP and PA use same physical layer implementation, EIA 485, while PA uses variation in order to accommodate safety requirements.

##### 12. What are the data transmission services defined in profibus?

Send-data-with-acknowledge(SDA)-acyclic, Send-data-with-no-acknowledge(SDN)-acyclic  
Send-data-request-data-with-reply(SRD)-acyclic, Cyclic send-and-request-data-with-reply-cyclic(CSRD)



**13. Mention the groups in fieldbus management layer**

Three groups are context management, configuration management and fault management.

**14. What are constituents of object dictionary(OD)?**

OD contains a header, a static list of types, a static object dictionary and a dynamic list of variables

**15. What are the diagnostic tools available for troubleshooting in profibus?**

Handheld testing devices – to check copper infrastructure before connecting any devices to the cable, D-type connectors with built-in terminators- to locate cable breaks and bus monitors- to perform packet content and timing verification.

**16. What is communication object?**

All objects of a real device that can be communicated with are called communication object

**PART B**

1. Give the Modbus protocol structure.
2. Explain in detail, function codes for input registers, holding registers and loop-back test.
3. Explain the troubleshooting of Modbus.
4. Describe in detail about the layers in Profibus.
5. Describe in detail about physical layer in Profibus
6. Describe in detail about datalink layer in Profibus
7. Describe in detail about application layer in Profibus
8. Write short notes on fieldbus management layer.
9. Write in detail about the relationship between application process and communication
10. Explain in detail about system operation of Profibus
11. Give detail specifications about troubleshooting tools.

**Unit-V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION****PART A****1. What are the components of a radio link?**

Antennas, Transmitter, Receivers, Antenna support structure, Cabling, Interface equipment.

**2. Name the different support structures of antenna.**

1. Mast, 2. Tower.

**3. Give the types of cables used in communication system**

1. Co-axial for all radio frequency 2. Twisted pair for voice, data 3. Power cables.

**4. Name the modes of Radio modems**

1. point to point, 2. point to multipoint

**5. Mention the features of radio modem**

a) Transmit/receive radio channel frequency, b) host data rate and format, c) Radio channel data rate

**6. What are the steps for implementing radio link?**

(i) Carry out radio path profile (ii) calculate RF losses (iii) calculate affects of transmitter power (iv) Decide on requirement (v) Choose cable and antenna (vi) purchase equipment (vii) Install equipment.

**7. What is the magnitude of signal in Ethernet?**

Voltages swing between 0 and -2.05 volts on coaxial cables or between -2.5 V to +2.5 V on twisted pair.

**8. What are the states that node in Ethernet using CSMA/CD access control?**

(i) Idle, or listen (ii) Transmit (iii) Contention

**9. What is 5-4-3-2 rule in Ethernet?**

It is a rule to find the maximum transmission path in a network. It stands for 5 segments-4 repeaters-3 coax segments-2 link segments

**10. What are the delays in 100 base T network?**

Repeater delay, cable delay, NIC delays and safety factor. The sum of these delays must be less than 2.56 microseconds for healthy transmission.

**11. What is need for partitioning an industrial network?**

Industrial network require fast response and real-time operation, while Ethernet doesnot require same response. Security is another concern where industrial network is split off from commercial networks. Industrial network are also partitioned into sub-networks for these reasons.

**12. Name some connectors used for indutrial Ethernet.**

Screw type N connectors and D type connectors, RJ -45, DB- type connectors, M12 connectors

**13. Mention some of the problems and faults in Industrial Ethernet.**

Problems attributed to either cabling, the LAN devices, the NIC or the protocol stack configuration on the hosts.

**14. Mention the different bands of radio spectrum.**

Ultra-high frequency (mid and low); Very high frequency (high, mid, low); High frequency

**15. What is intermodulation?**

Intermodulation is a interference, occurs where two or more frequencies interact in a non-linear device such as a transmitter or receiver or rusty bolted joints acting as RF diode to produce one or more additional frequencies that potentially cause interference to other users.

**16. What factors cause attenuation of RF signal?**

(i) Free space attenuation, (ii) Diffraction losses, (iii) Rain attenuation, (iv) Reflection losses.

**17. What is Fresnel zone?**

There is an area around the radio path that appears as a cone that should be kept as clearance for the radio path. This is referred to as the 'Fresnel zone'

**PART B**

1. Explain how industrial Ethernet vary from commercial Ethernet.
2. In detail, describe the common problems experienced in Industrial Ethernet.
3. List the components of a radio link and explain each.
4. Explain the steps for implementing a radio link.
5. Explain the troubleshooting of Radio link
6. Describe briefly about Industrial Ethernet.
7. Describe briefly about commercial Ethernet.
8. Write short notes on : i) Diffraction losses ii) Connectors used in industrial ethernet