INDUSTRIAL NETWORKING
(AEI3133)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) In simplex transmission mode, data flows:
(a) In both directions simultaneously (b) In one direction only
(c) Alternately in both directions (d) None of the above

(ii) Which organization is responsible for defining industrial communication standards like Ethernet and wireless protocols?
(a) IEEE (b) ISO (c) IEC (d) All of the above

(iii) Which standard is used for unbalanced serial communication?
(a) RS-232 (b) RS-422 (c) RS-485 (d) IEEE 488

(iv) In RS-485, the communication is:
(a) Point-to-point (b) Multi-drop
(c) Parallel (d) None

(v) MODBUS protocol is mainly used in:
(a) Office LANs (b) Industrial automation
(c) Wireless phones (d) Satellites

(vi) Which of the following is a common use case for HART communication?
(a) Monitoring the temperature of a process vessel
(b) Controlling the flow rate of a pump
(c) Measuring the pressure in a pipeline
(d) All of the above

(vii) What is the function of a HART handheld communicator?
(a) To configure and calibrate HART-enabled field instruments
(b) To transmit process variables to a control system
(c) To modulate and demodulate HART signals
(d) None of the above

(viii) Foundation Fieldbus is primarily used for:
(a) Office automation (b) Industrial process automation
(c) Mobile communications (d) Internet browsing

(ix) PROFIBUS uses which access method for bus communication?
(a) CSMA/CD (b) Token Passing
(c) Master-Slave (d) Frequency Division

(x) The main role of an HMI system is to:
(a) Control sensors
(b) Provide user interface for monitoring and controlling industrial processes
(c) Replace PLCs
(d) Store data only

Fill in the blanks with the correct word

(xi) The device used to convert digital signals into analog signals for transmission over telephone lines is called a _____.

(xii) In synchronous communication, both sender and receiver are synchronized by a common _____.

(xiii) DeviceNet protocol is built on top of _____ protocol.

(xiv) The _____ model in PROFIBUS allows masters to take turns accessing the network

(xv) MODBUS TCP/IP encapsulates MODBUS protocol within _____ packets for Ethernet communication.

Group - B

2. (a) Differentiate between digital and analog communication with suitable examples. Mention two real-life applications where analog communication is still preferred. *[(CO1)(Remember/LOCQ)]*

(b) A noiseless channel has a bandwidth of 5 kHz. If it is required to transmit binary signals, calculate the maximum data rate achievable. *[(CO3)(Analyse/IOCQ)]*

(c) What is Manchester encoding? Draw and explain its waveform for a bit sequence 00100. *[(CO2)(Analyse/IOCQ)]*

(3 + 2) + 3 + (1 + 3) = 12

3. (a) Define network topology and draw the star, bus, and mesh topologies. *[(CO2)(Understand/LOCQ)]*

(b) Compare OSI and TCP/IP protocol models with respect to structure and use. *[(CO2)(Analyse/IOCQ)]*

(c) A binary signal is transmitted over a noiseless channel of bandwidth 6 kHz. Calculate the maximum data rate possible. *[(CO3)(Analyse/IOCQ)]*

(2 + 3) + 5 + 2 = 12

Group - C

4. (a) Name two international standardization bodies responsible for communication standards and two serial data communication interface standards. *[(CO2)(Remember/LOCQ)]*

(b) Why is RS-485 considered more robust than RS-232? *[(CO2)(Analyse/IOCQ)]*

(c) Construct the query and the response message frame in MODBUS PDU to read discrete inputs 197 – 218. *[(CO2)(Create/HOCQ)]*

(2 + 2) + 3 + 5 = 12

5. (a) State three features of proprietary protocols. Name two such protocols. *[(CO2)(Remember/LOCQ)]*

(b) Explain CSMA/CD channel arbitration scheme. *[(CO1)(Analyse/IOCQ)]*

(c) Name two sensor-level protocols. What the purpose of this protocol? *[(CO2)(Understand/LOCQ)]*

(3 + 2) + 3 + (2 + 2) = 12

Group - D

6. (a) What are the main features of a smart transmitter? *[(CO4)(Remember/LOCQ)]*

(b) Differentiate between open source and closed source with their pros and cons. *[(CO4)(Understand/LOCQ)]*

(c) Show the wired connection diagram of a HART communicator in a process control loop. *[(CO4)(Understand/LOCQ)]*

(d) A HART communicator shows a reading of 12 mA when connected in a pressure loop. The maximum and minimum pressures in the system are 20 kg/cm^2 and 0 kg/cm^2. Calculate the pressure corresponding to 12 mA. *[(CO4)(Analyse/IOCQ)]*

2 + 4 + 3 + 3 = 12

7. (a) What is Bell 202, and how is it used in frequency modulation? *[(CO4)(Understand/LOCQ)]*

(b) Illustrate a Master-Slave HART network, showing the interaction between the primary master, secondary master, and slave devices. *[(CO4)(Understand/LOCQ)]*

(c) How is the Burst mode of communication different from the Master-Slave mode of communication? *[(CO4)(Understand/LOCQ)]*

4 + 5 + 3 = 12

Group - E

8. (a) State 4 features of Manchester encoded bus powered (MBP) Characteristics. *[(CO1)(Understand/LOCQ)]*

(b) Explain PROFIBUS-DP slave-to-slave communication. *[(CO5)(Analyse/IOCQ)]*

(c) Explain unscheduled data transfer technique used in foundation fieldbus (FF). Name the types of virtual communication relationship (VCR) used in FF. *[(CO5)(Analyse/IOCQ)]*

4 + 3 + (3 + 2) = 12

9. (a) Name the blocks used in layer 8, the user layer of foundation fieldbus (FF). State the properties of H1 FF physical layer network. *[(CO3)(Remember/LOCQ)]*

(b) Describe function block of Foundation Fieldbus. *[(CO3)(Understand/LOCQ)]*

(c) Explain various types of HMI interfaces with examples. *[(CO2)(Understand/LOCQ)]*

(3 + 2) + 3 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	60.42	34.37	5.21