MCQs: Introduction to Embedded Systems, Characteristics, and Applications

Section 1: Introduction to Embedded Systems

1. **What is an embedded system?**
   - A. A combination of hardware and software designed for general-purpose tasks
   - B. A system embedded into a device to perform specific tasks
   - C. A large-scale system managing multiple tasks simultaneously
   - D. A system with minimal reliability and stability
     Answer: B
2. **Which of the following is NOT a characteristic of embedded systems?**
   - A. Task-specific
   - B. High cost
   - C. Low power consumption
   - D. Highly reliable
     Answer: B
3. **Embedded systems are commonly found in which of the following industries?**
   - A. Automotive
   - B. Consumer electronics
   - C. Medical devices
   - D. All of the above
     Answer: D
4. **What is a common feature of embedded processors?**
   - A. High power consumption
   - B. Small size and low power
   - C. Complex user interfaces
   - D. Lack of stability
     Answer: B

Section 2: Von Neumann and Harvard Architectures

5. **In the Von Neumann architecture, the data and instructions share the same:**
   - A. Memory
   - B. CPU
   - C. Input/Output devices
   - D. Power source
     Answer: A

6. **What differentiates Harvard architecture from Von Neumann architecture?**
   - A. Single memory for data and instructions
   - B. Separate memory for data and instructions
   - C. Lower efficiency
   - D. No use of microprocessors
     Answer: B
7. **Which of the following is an advantage of Harvard architecture?**
   - A. Simplified hardware
   - B. Simultaneous access to data and instructions
   - C. Low power consumption
   - D. Reduced processing speed
     Answer: B

Section 3: Application-Specific Integrated Circuits (ASICs)

8. **What does ASIC stand for?**
   - A. Advanced Software Integration Circuit
   - B. Application Specific Integrated Circuit
   - C. Automated Signal Integration Circuit
   - D. All System Integration Chip
     Answer: B
9. **Which of the following is NOT a type of ASIC?**
   - A. Full Custom ASIC
   - B. Semi-Custom ASIC
   - C. Standard Cell ASIC
   - D. Random Access ASIC
     Answer: D
10. **What is a major application of ASICs in modern technology?**
    - A. Bitcoin mining
    - B. Word processing software
    - C. Basic arithmetic calculations
    - D. None of the above
      Answer: A

Section 4: Embedded Networking and Standards

11. **Which communication interface is used for short-distance communication within an embedded system?**
    - A. I2C
    - B. Ethernet
    - C. Bluetooth
    - D. Zigbee
      Answer: A
12. **Which protocol is widely used for connecting USB devices to computers?**
    - A. RS232
    - B. I2C
    - C. SPI
    - D. USB
      Answer: D
13. **What is the maximum theoretical data transfer speed of USB 3.2 Generation 2x2?**
    - A. 480 Mbps
    - B. 5 Gbps
    - C. 20 Gbps
    - D. 40 Gbps
      Answer: C

Section 5: Real-Time Embedded Systems

14. **Which of the following is a key characteristic of real-time embedded systems?**
    - A. High latency
    - B. Constant response
    - C. Variable accuracy
    - D. Minimal reliability
      Answer: B
15. **Hard real-time systems are used in applications where:**
    - A. Occasional delays are acceptable
    - B. Deadlines must always be met
    - C. Cost is the primary concern
    - D. Timing is irrelevant
      Answer: B

16. **Which of these is an example of a hard real-time system?**
    - A. Music streaming app
    - B. Airbag deployment system
    - C. Online shopping cart
    - D. Photo editing software
      Answer: B
17. **Which scheduling algorithm assigns priorities based on task periods?**
    - A. Earliest Deadline First (EDF)
    - B. Least Laxity First (LLF)
    - C. Rate Monotonic Scheduling (RMS)
    - D. Priority-based Scheduling
      Answer: C

Section 6: Embedded System Communication Protocols

18. **What is the maximum data transfer speed of Zigbee?**
    - A. 250 kbps
    - B. 1 Mbps
    - C. 3 Mbps
    - D. 20 Mbps
      Answer: A
19. **What topology does Zigbee primarily support?**
    - A. Star
    - B. Ring
    - C. Mesh
    - D. Both A and C
      Answer: D
20. **Bluetooth networks are commonly referred to as:**
    - A. Zigbee clusters
    - B. Piconets
    - C. Star networks
    - D. Grid systems
      Answer: B

Section 7: Characteristics of Embedded Systems

21. **Which of the following is NOT a characteristic of an embedded system?**
    - A. High efficiency
    - B. Minimal user interface
    - C. Designed for multitasking general-purpose operations
    - D. Low power consumption
      Answer: C
22. **Embedded systems typically operate on:**
    - A. Unlimited power sources
    - B. High-capacity batteries
    - C. Low power consumption for energy efficiency
    - D. Renewable energy only
      Answer: C
23. **The stability of an embedded system is critical for:**
    - A. Enhanced multitasking abilities
    - B. Reliable long-term operations
    - C. Ensuring the system can handle user interfaces
    - D. Allowing power-intensive features
      Answer: B
24. **Embedded systems with high reliability are commonly used in:**
    - A. Basic household appliances
    - B. Critical medical devices like pacemakers
    - C. Entertainment systems
    - D. Educational software
      Answer: B
25. **A unique feature of embedded systems compared to general-purpose computers is:**
    - A. Their ability to operate autonomously without complex user interfaces
    - B. Their low production cost
    - C. Unlimited power usage
    - D. Compatibility with all external hardware
      Answer: A

Section 8: Von Neumann and Harvard Architectures

26. **Which architecture uses a single bus for both data and instructions?**
    - A. Harvard
    - B. Von Neumann
    - C. Modified Harvard
    - D. Multi-core architecture
      Answer: B
27. **What is the main disadvantage of Von Neumann architecture?**
    - A. High cost
    - B. Slow processing due to shared data and instruction bus
    - C. Incompatibility with embedded systems
    - D. Complex hardware requirements
      Answer: B
28. **The Harvard architecture allows:**
    - A. Data and instructions to be fetched simultaneously
    - B. A single memory for both instructions and data
    - C. Slower execution of programs
    - D. Time sharing between data and instruction access
      Answer: A
29. **In which type of architecture is memory divided into two separate modules for data and instructions?**
    - A. Harvard architecture
    - B. RISC architecture
    - C. Von Neumann architecture
    - D. Parallel architecture
      Answer: A
30. **The main advantage of the Harvard architecture is its ability to:**
    - A. Execute complex tasks
    - B. Perform parallel computations
    - C. Fetch data and instructions simultaneously
    - D. Use a single memory module
      Answer: C

Section 9: ASICs and Their Applications

31. **Which type of ASIC is most customizable?**
    - A. Semi-Custom ASIC
    - B. Full Custom ASIC
    - C. Programmable ASIC
    - D. Standard Cell ASIC
      Answer: B
32. **Semi-Custom ASICs include:**
    - A. FPGA
    - B. Standard Cell and Gate Array ASICs
    - C. ROM-based chips
    - D. General-purpose processors
      Answer: B
33. **What is the main advantage of Full Custom ASICs?**
    - A. Low cost
    - B. High performance and low power consumption
    - C. Rapid development time
    - D. Flexibility for multiple uses
      Answer: B
34. **Which type of ASIC is reprogrammable and commonly used for various applications?**
    - A. Gate Array ASIC
    - B. FPGA
    - C. Full Custom ASIC
    - D. Standard Cell ASIC
      Answer: B
35. **Gate Array ASICs allow customization at which level?**
    - A. Transistor level
    - B. Interconnection level
    - C. Software level
    - D. Operating system level
      Answer: B

Section 10: Communication Protocols and Standards

36. **Which communication protocol is synchronous and multi-master capable?**
    - A. SPI
    - B. I2C
    - C. RS232
    - D. USB
      Answer: B
37. **Which of the following protocols is used for point-to-point communication?**
    - A. I2C
    - B. SPI
    - C. RS232
    - D. Zigbee
      Answer: C
38. **What is the main advantage of SPI over I2C?**
    - A. Higher speed and simplicity
    - B. Reduced wiring complexity
    - C. Longer communication range
    - D. Better error handling
      Answer: A
39. **The maximum length for USB without a hub is:**
    - A. 3 meters
    - B. 5 meters
    - C. 40 meters
    - D. 100 meters
      Answer: B
40. **Which protocol uses a piconet topology?**
    - A. Zigbee
    - B. Bluetooth
    - C. USB
    - D. RS485
      Answer: B

Section 11: Real-Time Embedded Systems

41. **A soft real-time system allows:**
    - A. No deadline misses
    - B. Occasional deadline misses
    - C. No task prioritization
    - D. Constant hardware updates
      Answer: B

42. **Which type of scheduling is optimal for preemptive task sets?**
    - A. Rate Monotonic Scheduling
    - B. Earliest Deadline First
    - C. Priority-based Scheduling
    - D. Least Laxity First
      Answer: B

43. **What defines a firm real-time system?**
    - A. Strict deadlines with no flexibility
    - B. Flexible deadlines without impact
    - C. Deadlines where occasional misses degrade performance
    - D. No deadlines required for tasks
      Answer: C

44. **Which is an example of a hard real-time embedded system?**
    - A. Online gaming platform
    - B. Missile control system
    - C. Mobile messaging application
    - D. Digital photography
      Answer: B

45. **Which algorithm schedules tasks based on remaining execution time?**
    - A. Least Laxity First
    - B. Earliest Deadline First
    - C. Rate Monotonic Scheduling
    - D. Priority-based Scheduling
      Answer: A

Section 12: Real-Time Embedded Systems - Continued

46. **In a real-time system, what happens if a deadline is missed in a hard real-time system?**
    - A. It is acceptable as long as the next task meets its deadline
    - B. It leads to catastrophic consequences
    - C. The system adjusts the deadline dynamically
    - D. The task is ignored without any consequences
      Answer: B
47. **Which of the following real-time systems allows occasional deadline misses without catastrophic outcomes?**
    - A. Hard real-time systems
    - B. Soft real-time systems
    - C. Firm real-time systems
    - D. None of the above
      Answer: C
48. **What is a critical characteristic of an RTOS (Real-Time Operating System)?**
    - A. High computational overhead
    - B. Task scheduler to ensure deadline adherence
    - C. Extensive user interfaces
    - D. No support for real-time constraints
      Answer: B
49. **Examples of soft real-time systems include:**
    - A. Air traffic control systems
    - B. Multimedia streaming services
    - C. Pacemakers
    - D. Missile guidance systems
      Answer: B
50. **Which scheduling algorithm assigns the shortest periods to higher-priority tasks?**
    - A. Rate Monotonic Scheduling (RMS)
    - B. Earliest Deadline First (EDF)
    - C. Priority-based Scheduling
    - D. First Come First Serve (FCFS)
      Answer: A

Section 13: Embedded Networking

51. **What is the primary use of RS485 over RS232?**
    - A. Higher speed
    - B. Better noise immunity and longer distances
    - C. Simplicity in design
    - D. Lower power requirements
      Answer: B

52. **Which protocol supports multi-slave communication?**
    - A. SPI
    - B. I2C
    - C. RS232
    - D. Ethernet
      Answer: B

53. **What is a key feature of Zigbee networks?**
    - A. Long-range, high-speed data transfer
    - B. Low-power, short-range communication
    - C. Complex user management
    - D. Extensive wiring requirements
      Answer: B

54. **What is the main advantage of Bluetooth communication?**
    - A. Low cost and short-range wireless communication
    - B. High speed and reliability over long distances
    - C. Compatibility with Zigbee
    - D. Use of multiple antennas
      Answer: A

55. **Zigbee is most suitable for:**
    - A. Video streaming
    - B. Home automation
    - C. High-speed internet access
    - D. Industrial long-distance networking
      Answer: B

Section 14: Characteristics of Communication Protocols

56. **Which protocol is based on a master-slave configuration?**
    - A. USB
    - B. I2C
    - C. Bluetooth
    - D. RS485
      Answer: B
57. **The polling principle is used in which communication protocol?**
    - A. USB
    - B. RS232
    - C. SPI
    - D. Zigbee
      Answer: A
58. **The typical speed of RS232 is:**
    - A. 480 Mbps
    - B. 20 kbps
    - C. 1 Mbps
    - D. 250 kbps
      Answer: B
59. **The architecture unit of a Bluetooth network is called:**
    - A. Zigbee mesh
    - B. Piconet
    - C. Star topology
    - D. Scatternet
      Answer: B
60. **Which topology is used for Zigbee smart energy networks?**
    - A. Tree topology
    - B. Star topology
    - C. Ring topology
    - D. Mesh topology
      Answer: B

Section 15: Design Considerations for Embedded Systems

61. **Scalability in embedded systems ensures:**
    - A. Fixed functionality without updates
    - B. Easy future updates and enhancements
    - C. Limited memory usage
    - D. Reduced performance for multitasking
      Answer: B

62. **What is a major design consideration for embedded systems in mission-critical applications?**
    - A. Low cost
    - B. Reliability and fault tolerance
    - C. Complex user interfaces
    - D. Extensive hardware resources
      Answer: B

63. **Security in embedded systems is crucial for:**
    - A. Preventing unauthorized access and data breaches
    - B. Reducing system performance overhead
    - C. Managing user preferences
    - D. Eliminating hardware redundancy
      Answer: A

64. **Which power management technique is commonly used in embedded systems?**
    - A. Dynamic voltage scaling
    - B. Constant power supply
    - C. Overclocking processors
    - D. Disabling sleep modes
      Answer: A

65. **Testing in embedded systems is crucial to:**
    - A. Ensure system reliability under real-time conditions
    - B. Avoid hardware design validation
    - C. Reduce manufacturing costs
    - D. Eliminate user interface complexity
      Answer: A

Section 16: Embedded System Applications

66. **Which of these is NOT an application of embedded systems?**
    - A. Automotive airbag systems
    - B. Flight navigation systems
    - C. Desktop software applications
    - D. Home automation systems
    Answer: C

67. **In industrial automation, embedded systems are used for:**
    - A. Entertainment purposes
    - B. Process control and robotics
    - C. Graphic design applications
    - D. Social networking
    Answer: B

68. **Which embedded system application is critical in medical devices?**
    - A. Air conditioning units
    - B. Pacemakers
    - C. Home lighting systems
    - D. Video editing software
    Answer: B

69. **Smartphones are an example of:**
    - A. Standalone embedded systems
    - B. Networked embedded systems
    - C. Mobile embedded systems
    - D. Reactive embedded systems
    Answer: C

70. **Which of the following uses a real-time embedded system?**
    - A. Digital cameras
    - B. Heart rate monitors
    - C. Smart thermostats
    - D. All of the above
    Answer: D

RS232 Communication

71. **RS232 is primarily used for:**
    - A. High-speed wireless communication
    - B. Serial communication between devices
    - C. Ethernet-based networking
    - D. Multi-master communication
    Answer: B

72. **What type of communication does RS232 support?**
    - A. Half-duplex
    - B. Full-duplex
    - C. Broadcast
    - D. Multicast
    Answer: B

73. **The maximum standard speed of RS232 is:**
    - A. 20 kbps
    - B. 100 Mbps
    - C. 250 kbps
    - D. 480 Mbps
    Answer: A

74. **Which pins are used for data transmission in RS232?**
    - A. RTS and CTS
    - B. RX and TX
    - C. GND and VCC
    - D. SCL and SDA
    Answer: B

75. **What is a limitation of RS232 communication?**
    - A. Limited to two devices
    - B. Low noise immunity
    - C. Short communication distance
    - D. All of the above
    Answer: D

SPI (Serial Peripheral Interface)

76. **SPI communication is based on a:**
    - A. Master-slave architecture
    - B. Peer-to-peer architecture
    - C. Broadcast network
    - D. Multi-master bus
      Answer: A
77. **How many wires does a basic SPI connection require?**
    - A. 2
    - B. 4
    - C. 6
    - D. 8
      Answer: B
78. **Which line in SPI is used for synchronization between master and slave devices?**
    - A. MOSI
    - B. MISO
    - C. SCK
    - D. CS
      Answer: C
79. **In SPI, the role of the CS (Chip Select) line is to:**
    - A. Control data speed
    - B. Indicate the end of communication
    - C. Select the active slave device
    - D. Initiate power management
      Answer: C
80. **What is the primary advantage of SPI over I2C?**
    - A. Longer communication range
    - B. Higher speed and full-duplex communication
    - C. Simpler wiring
    - D. Multi-master support
      Answer: B

I2C (Inter-Integrated Circuit)

81. **I2C supports:**
    - A. Single master only
    - B. Multi-master and multi-slave communication
    - C. Broadcast only
    - D. Full-duplex communication
      Answer: B
82. **How many lines are required for I2C communication?**
    - A. 1
    - B. 2
    - C. 4
    - D. 6
      Answer: B
83. **The lines used in I2C communication are:**
    - A. SDA and SCL
    - B. MOSI and MISO
    - C. RX and TX
    - D. D+ and D-
      Answer: A
84. **Which device generates the clock signal in I2C communication?**
    - A. Slave device
    - B. Master device
    - C. Intermediate device
    - D. Both master and slave
      Answer: B
85. **I2C is most suitable for:**
    - A. Long-distance communication
    - B. High-speed data transfer
    - C. Onboard communication in embedded systems
    - D. Wireless communication
      Answer: C

USB (Universal Serial Bus)

86. **Which of the following is a feature of USB communication?**
    - A. High speed and plug-and-play support
    - B. Point-to-point communication only
    - C. Multi-master configuration
    - D. High latency
    Answer: A

87. **What is the data transfer speed of USB 2.0?**
    - A. 1.5 Mbps
    - B. 12 Mbps
    - C. 480 Mbps
    - D. 5 Gbps
    Answer: C

88. **The differential pair in USB is responsible for:**
    - A. Power delivery
    - B. Data transfer
    - C. Clock synchronization
    - D. Signal amplification
    Answer: B

89. **Which type of USB supports 20 Gbps data transfer speed?**
    - A. USB 3.2 Generation 2x2
    - B. USB 2.0
    - C. USB 1.1
    - D. USB 3.0
    Answer: A

90. **What is the primary drawback of USB?**
    - A. Limited broadcast capability
    - B. High cost
    - C. Lack of compatibility with embedded systems
    - D. No support for short-distance communication
    Answer: A

Bluetooth Communication

91. **Bluetooth operates in which frequency band?**
    - A. 1 GHz to 2 GHz
    - B. 2.4 GHz to 2.485 GHz
    - C. 3 GHz to 4 GHz
    - D. 868 MHz

    Answer: B

92. **The basic network unit in Bluetooth is called a:**
    - A. Mesh network
    - B. Piconet
    - C. Star topology
    - D. Cluster

    Answer: B

93. **Bluetooth is primarily designed for:**
    - A. Long-range high-speed communication
    - B. Short-range voice and data communication
    - C. Industrial automation
    - D. Satellite communication

    Answer: B

94. **What is the transmission capacity of Bluetooth?**
    - A. 720 kbps
    - B. 480 Mbps
    - C. 1 Mbps
    - D. 3 Mbps

    Answer: D

95. **A group of interconnected Bluetooth piconets is called a:**
    - A. Scatternet
    - B. Zigbee cluster
    - C. Point-to-point network
    - D. Star topology

    Answer: A

Zigbee Communication

96. **Zigbee is based on which IEEE standard?**
    - A. IEEE 802.15.4
    - B. IEEE 802.11
    - C. IEEE 802.3
    - D. IEEE 802.16
    Answer: A

97. **Zigbee is most suitable for:**
    - A. High-speed data transfer
    - B. Long-distance networking
    - C. Low-power, low-data rate applications
    - D. Multi-master communication
    Answer: C

98. **Which topology is NOT supported by Zigbee?**
    - A. Star topology
    - B. Ring topology
    - C. Mesh topology
    - D. Tree topology
    Answer: B

99. **The range of Zigbee communication is typically:**
    - A. 10 meters
    - B. 75-100 meters
    - C. 1 km
    - D. 5 km
    Answer: B

100. **What is a major application of Zigbee?**
- A. Medical imaging systems
- B. Home automation systems
- C. Real-time video streaming
- D. High-speed computing clusters

Answer: B

Mixed MCQs on Embedded Communication Protocols

101. **Which protocol uses clock pulses for synchronization in data transfer?**
- A. RS232
- B. I2C
- C. Zigbee
- D. USB

Answer: B

102. **In SPI communication, which pin is NOT used?**
- A. MOSI
- B. MISO
- C. SCL
- D. SCK

Answer: C

103. **RS232 can be classified as a type of:**
- A. Parallel communication
- B. Serial communication
- C. Wireless communication
- D. Synchronous communication

Answer: B

104. **What is the typical range of Bluetooth communication?**
- A. 10-100 meters
- B. 1-10 kilometers
- C. 75-100 meters
- D. 1-2 meters

Answer: A

105. **Which communication protocol is widely used in battery-powered IoT devices for low power consumption?**
- A. USB
- B. SPI
- C. Zigbee
- D. RS232

Answer: C

106. What is the main purpose of the Start and Stop bits in RS232 communication?
- A. To identify data type
- B. To enable error correction
- C. To frame the data bytes for transmission
- D. To control data flow speed

Answer: C

107. **Which of the following uses the polling mechanism for communication?**
- A. Zigbee
- B. USB
- C. I2C
- D. Bluetooth

Answer: B

108. **In I2C communication, the role of the master device is to:**
- A. Respond to commands
- B. Generate clock pulses and initiate data transfer
- C. Act only as a transmitter
- D. Generate power supply for the bus

Answer: B

109. **Which protocol operates at the highest speed among these?**
- A. USB 3.2
- B. RS232
- C. Zigbee
- D. I2C

Answer: A

110. **In Zigbee networks, which device coordinates the entire network?**
- A. End device
- B. Router
- C. Coordinator
- D. Gateway

Answer: C

Scenario-Based MCQs

111. **If you are designing a system to communicate with sensors on a short-range, low-power network, which protocol would you choose?**
- A. USB
- B. Zigbee
- C. RS232
- D. SPI

Answer: B

112. A device needs to exchange data with multiple peripherals at high speed. Which protocol is most suitable?
- A. SPI
- B. RS232
- C. Zigbee
- D. Bluetooth

Answer: A

113. **In a project requiring communication between multiple microcontrollers, which protocol would you recommend for simplicity and flexibility?**
- A. RS232
- B. I2C
- C. Bluetooth
- D. USB

Answer: B

114. **You need to transmit data over long distances with high noise immunity. Which protocol fits this requirement?**
- A. SPI
- B. RS485 (based on RS232)
- C. USB 2.0
- D. Bluetooth

Answer: B

115. **An IoT application requires short-range wireless communication for multiple devices. Which protocol is the best choice?**
- A. RS232
- B. Zigbee
- C. I2C
- D. USB

Answer: B

Conceptual MCQs

116. **Which protocol enables simultaneous bidirectional communication?**
- A. USB
- B. I2C
- C. SPI
- D. RS232

Answer: C

117. **In SPI communication, what does full-duplex mean?**
- A. Data can be transmitted and received simultaneously
- B. Only one device communicates at a time
- C. Communication is half-duplex by default
- D. Multiple masters control the communication

Answer: A

118. **What is the primary role of the SCL line in I2C communication?**
- A. Sending data
- B. Receiving data
- C. Generating clock pulses
- D. Powering the bus

Answer: C

119. **Which protocol is commonly used for real-time video or multimedia transmission?**
- A. RS232
- B. USB
- C. Zigbee
- D. I2C

Answer: B

120. **Which feature makes Bluetooth suitable for wearable devices?**
- A. High-speed communication
- B. Short-range and low power consumption
- C. Complex configuration
- D. Multi-hop networking

Answer: B

Comparison-Based MCQs

121. **What differentiates I2C from SPI?**
- A. I2C is faster than SPI
- B. I2C requires fewer lines than SPI
- C. SPI supports longer distances than I2C
- D. SPI operates in multi-master mode by default

Answer: B

122. **Zigbee is preferred over Bluetooth for:**
- A. Long-distance and low-power communication
- B. High-speed file transfer
- C. Real-time gaming applications
- D. Video streaming

Answer: A

123. **USB is a better choice than RS232 for:**
- A. Long-distance communication
- B. High-speed data transfer and plug-and-play compatibility
- C. Low-cost applications
- D. Communication between microcontrollers

Answer: B

124. **Bluetooth is more suitable than Zigbee when:**
- A. High data transfer speeds are required
- B. Long-range communication is needed
- C. Energy consumption is critical
- D. Multi-device communication is required

Answer: A

125. **I2C communication is limited in speed compared to SPI because:**

- A. It uses only two lines
- B. It supports multiple masters
- C. It is half-duplex
- D. The clock line synchronization limits its speed

Answer: D