UNIT – V: INTRODUCTION TO ADVANCED ARCHITECTURES ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus; Internet-Enabled Systems, Design Example-Elevator Controller.

**ARM Processor MCQs**

1. What does ARM stand for?  
   a) Advanced RISC Machines  
   b) Asynchronous RISC Microprocessor  
   c) Applied RISC Microcontroller  
   d) Automated RISC Module  
   Answer: a) Advanced RISC Machines
2. Which instruction set is supported by ARM processors?  
   a) CISC  
   b) RISC  
   c) VLIW  
   d) SIMD  
   Answer: b) RISC
3. What is the main feature of the ARM Cortex-M series?  
   a) High power consumption  
   b) DSP support  
   c) Low power and energy efficiency  
   d) Complex instruction set  
   Answer: c) Low power and energy efficiency
4. Which of the following features is not a characteristic of ARM processors?  
   a) Pipelining  
   b) Harvard architecture  
   c) SIMD instruction set  
   d) Dual instruction pipelines  
   Answer: b) Harvard architecture
5. What is the purpose of the Thumb instruction set in ARM?  
   a) To improve processing speed  
   b) To reduce code size  
   c) To enable floating-point operations  
   d) To support multi-core systems  
   Answer: b) To reduce code size

**SHARC Processor MCQs**

1. What does SHARC stand for?  
   a) Scalable High-Performance Advanced RISC Controller  
   b) Super Harvard Architecture Computer  
   c) Signal Handling and Arithmetic Resource Controller  
   d) Synchronous High-Accuracy Register Compiler  
   Answer: b) Super Harvard Architecture Computer
2. SHARC processors are primarily designed for which application?  
   a) Web servers  
   b) Signal processing  
   c) Database management  
   d) Robotics control  
   Answer: b) Signal processing
3. Which architecture does SHARC processors use?  
   a) Von Neumann  
   b) Harvard  
   c) Modified Harvard  
   d) RISC-V  
   Answer: c) Modified Harvard
4. What is the primary memory used in SHARC processors for fast data access?  
   a) Cache memory  
   b) DRAM  
   c) Dual-port SRAM  
   d) Flash memory  
   Answer: c) Dual-port SRAM
5. Which company manufactures SHARC processors?  
   a) ARM  
   b) Texas Instruments  
   c) Analog Devices  
   d) Intel  
   Answer: c) Analog Devices

**Processor and Memory Organization MCQs**

1. What is the primary purpose of memory hierarchy in processors?  
   a) To increase the processor's clock speed  
   b) To reduce memory access time  
   c) To save cost on memory  
   d) To improve instruction set compatibility  
   Answer: b) To reduce memory access time
2. Which type of memory is typically closest to the processor in the memory hierarchy?  
   a) Cache memory  
   b) Main memory  
   c) Secondary storage  
   d) Virtual memory  
   Answer: a) Cache memory
3. What is the primary difference between SRAM and DRAM?  
   a) SRAM is faster and requires less power than DRAM  
   b) DRAM is faster and more expensive than SRAM  
   c) SRAM is faster but more expensive than DRAM  
   d) DRAM does not require refreshing, unlike SRAM  
   Answer: c) SRAM is faster but more expensive than DRAM
4. In embedded systems, which memory is most often used for program storage?  
   a) RAM  
   b) ROM/Flash memory  
   c) Cache memory  
   d) Virtual memory  
   Answer: b) ROM/Flash memory
5. Which of the following best describes the Harvard architecture?  
   a) Separate data and instruction memory  
   b) Unified memory for data and instructions  
   c) Memory hierarchy with virtual memory support  
   d) A multicore processor design  
   Answer: a) Separate data and instruction memory

**Instruction-Level Parallelism (ILP) MCQs**

1. What is Instruction-Level Parallelism (ILP)?  
   a) Executing multiple instructions sequentially  
   b) Executing multiple instructions simultaneously  
   c) Dividing a program into multiple threads  
   d) Processing instructions at a higher clock speed  
   Answer: b) Executing multiple instructions simultaneously
2. Which of the following hardware techniques is used to exploit ILP?  
   a) Multithreading  
   b) Pipelining  
   c) Dynamic voltage scaling  
   d) Cache coherency  
   Answer: b) Pipelining
3. Superscalar processors achieve ILP by:  
   a) Increasing clock frequency  
   b) Fetching and executing multiple instructions per cycle  
   c) Using deeper pipelines  
   d) Improving virtual memory management  
   Answer: b) Fetching and executing multiple instructions per cycle
4. What is the primary limitation of ILP in a program?  
   a) Limited processor resources  
   b) Data dependencies between instructions  
   c) Lack of compiler optimization  
   d) Limited instruction memory  
   Answer: b) Data dependencies between instructions
5. In embedded systems, ILP is often constrained by:  
   a) The size of the cache memory  
   b) Power and energy consumption  
   c) Availability of DRAM  
   d) Limited instruction set complexity  
   Answer: b) Power and energy consumption
6. Which technique allows overlapping instruction execution stages to increase ILP?  
   a) Speculative execution  
   b) Branch prediction  
   c) Pipelining  
   d) Out-of-order execution  
   Answer: c) Pipelining
7. What is the purpose of a branch predictor in exploiting ILP?  
   a) To reduce the memory access latency  
   b) To avoid stalls caused by control dependencies  
   c) To fetch multiple instructions in parallel  
   d) To optimize register allocation  
   Answer: b) To avoid stalls caused by control dependencies

**Networked Embedded Systems MCQs**

1. What is a networked embedded system?  
   a) An embedded system without any communication capability  
   b) An embedded system connected to a network for data exchange  
   c) A standalone embedded system for real-time applications  
   d) An embedded system using only wireless communication  
   Answer: b) An embedded system connected to a network for data exchange
2. Which of the following is a commonly used protocol in networked embedded systems?  
   a) TCP/IP  
   b) HDMI  
   c) USB  
   d) PCIe  
   Answer: a) TCP/IP
3. Which communication protocol is best suited for real-time communication in networked embedded systems?  
   a) HTTP  
   b) CAN (Controller Area Network)  
   c) FTP  
   d) SMTP  
   Answer: b) CAN (Controller Area Network)
4. In a networked embedded system, which type of network topology is typically used in automotive applications?  
   a) Star  
   b) Ring  
   c) Bus  
   d) Mesh  
   Answer: c) Bus
5. What is the primary purpose of the MQTT protocol in networked embedded systems?  
   a) File transfer  
   b) Message queuing and lightweight communication  
   c) High-speed video streaming  
   d) Hardware debugging  
   Answer: b) Message queuing and lightweight communication
6. Which wireless communication technology is commonly used in networked embedded systems for IoT applications?  
   a) Bluetooth Low Energy (BLE)  
   b) PCIe  
   c) SATA  
   d) HDMI  
   Answer: a) Bluetooth Low Energy (BLE)
7. What is a key characteristic of Zigbee in networked embedded systems?  
   a) High bandwidth  
   b) Low power consumption  
   c) Long-range communication  
   d) High-speed data transfer  
   Answer: b) Low power consumption
8. Which protocol is specifically designed for industrial networked embedded systems?  
   a) Ethernet/IP  
   b) SMTP  
   c) HTTP  
   d) FTP  
   Answer: a) Ethernet/IP
9. In networked embedded systems, what does the term "gateway" refer to?  
   a) A memory device for data storage  
   b) A device that connects different networks and protocols  
   c) A sensor used to capture environmental data  
   d) A microcontroller with high processing power  
   Answer: b) A device that connects different networks and protocols
10. What is the main advantage of using real-time Ethernet in networked embedded systems?  
    a) High data throughput for streaming  
    b) Guaranteed time-deterministic data delivery  
    c) Cost-effectiveness for large-scale networks  
    d) Support for multimedia applications  
    Answer: b) Guaranteed time-deterministic data delivery
11. Which type of addressing is used in Internet Protocol (IP) for networked embedded systems?  
    a) Logical addressing  
    b) Physical addressing  
    c) Symbolic addressing  
    d) Direct addressing  
    Answer: a) Logical addressing
12. In networked embedded systems, what is the role of a "sensor node"?  
    a) To manage the network topology  
    b) To process and forward sensor data  
    c) To monitor and sense environmental conditions  
    d) To provide user interface functionality  
    Answer: c) To monitor and sense environmental conditions
13. What is the primary challenge in designing networked embedded systems?  
    a) Ensuring compatibility with all types of microprocessors  
    b) Managing power consumption and real-time performance  
    c) Adding features like GUI and multimedia support  
    d) Designing for complex mathematical operations  
    Answer: b) Managing power consumption and real-time performance
14. Which type of communication is typically used in Wireless Sensor Networks (WSNs)?  
    a) Peer-to-peer  
    b) Multi-hop communication  
    c) Ring communication  
    d) Point-to-point communication  
    Answer: b) Multi-hop communication
15. What is a critical consideration when implementing security in networked embedded systems?  
    a) Minimizing hardware cost  
    b) Achieving high clock speeds  
    c) Ensuring low-latency encryption/decryption  
    d) Eliminating the need for firmware updates  
    Answer: c) Ensuring low-latency encryption/decryption

**Bus Protocols in Embedded Systems MCQs**

1. What is a bus in embedded systems?  
   a) A vehicle for transporting data  
   b) A communication pathway for data transfer  
   c) A type of microcontroller  
   d) A storage device in embedded systems  
   Answer: b) A communication pathway for data transfer
2. Which bus protocol is commonly used in automotive applications?  
   a) I²C  
   b) SPI  
   c) CAN  
   d) USB  
   Answer: c) CAN
3. What does I²C stand for?  
   a) Inter-integrated Circuit  
   b) Internal Integrated Communication  
   c) Intelligent Input Circuit  
   d) Interconnected Integrated Communication  
   Answer: a) Inter-integrated Circuit
4. Which of the following is a characteristic of the SPI (Serial Peripheral Interface) protocol?  
   a) Multi-master capability  
   b) Half-duplex communication  
   c) Full-duplex communication  
   d) Long-distance communication  
   Answer: c) Full-duplex communication
5. Which of the following is an example of a parallel communication bus?  
   a) PCI  
   b) I²C  
   c) SPI  
   d) CAN  
   Answer: a) PCI
6. In the CAN protocol, what is the primary purpose of the arbitration mechanism?  
   a) To provide error detection  
   b) To ensure the highest priority message is transmitted first  
   c) To establish synchronization between nodes  
   d) To encrypt transmitted data  
   Answer: b) To ensure the highest priority message is transmitted first
7. What type of communication does the I²C protocol use?  
   a) Synchronous, serial communication  
   b) Asynchronous, parallel communication  
   c) Synchronous, parallel communication  
   d) Asynchronous, serial communication  
   Answer: a) Synchronous, serial communication
8. Which bus protocol is designed for high-speed data transfer and is commonly used in video applications?  
   a) UART  
   b) HDMI  
   c) SPI  
   d) USB  
   Answer: b) HDMI
9. What is the maximum number of devices that can be connected to an I²C bus?  
   a) 64  
   b) 127  
   c) 255  
   d) Unlimited  
   Answer: b) 127
10. Which of the following best describes the USB protocol?  
    a) Multi-master, synchronous  
    b) Single-master, asynchronous  
    c) Multi-master, asynchronous  
    d) Single-master, synchronous  
    Answer: d) Single-master, synchronous
11. What is the function of the handshaking mechanism in a bus protocol?  
    a) To manage power consumption  
    b) To synchronize communication between devices  
    c) To encrypt data during transmission  
    d) To identify connected peripherals  
    Answer: b) To synchronize communication between devices
12. Which of the following is a key feature of the AMBA (Advanced Microcontroller Bus Architecture) protocol?  
    a) High-speed Ethernet communication  
    b) Standardization of on-chip interconnects  
    c) Support for wireless communication  
    d) External device compatibility  
    Answer: b) Standardization of on-chip interconnects
13. What is a primary advantage of using a CAN bus in embedded systems?  
    a) High bandwidth for multimedia applications  
    b) Real-time performance and fault tolerance  
    c) Full-duplex communication support  
    d) Simplified protocol structure  
    Answer: b) Real-time performance and fault tolerance
14. Which bus protocol is most suitable for low-power communication in IoT devices?  
    a) SPI  
    b) UART  
    c) I²C  
    d) CAN  
    Answer: c) I²C
15. What is the main difference between a synchronous and asynchronous bus?  
    a) Synchronous buses use a clock signal, while asynchronous buses do not  
    b) Asynchronous buses are faster than synchronous buses  
    c) Synchronous buses do not require handshaking, while asynchronous buses do  
    d) Asynchronous buses are only used for serial communication  
    Answer: a) Synchronous buses use a clock signal, while asynchronous buses do not

**I²C Bus MCQs**

1. What does I²C stand for?  
   a) Internal Integrated Communication  
   b) Inter-Integrated Circuit  
   c) Intelligent Intercommunication Circuit  
   d) Integrated Interconnection Controller  
   Answer: b) Inter-Integrated Circuit
2. How many wires are used in the I²C protocol for communication?  
   a) 1  
   b) 2  
   c) 3  
   d) 4  
   Answer: b) 2
3. Which lines are part of the I²C protocol?  
   a) TX and RX  
   b) SDA and SCL  
   c) MISO and MOSI  
   d) CLK and DATA  
   Answer: b) SDA and SCL
4. What is the role of the SCL line in the I²C protocol?  
   a) Data transmission  
   b) Clock synchronization  
   c) Error checking  
   d) Power supply  
   Answer: b) Clock synchronization
5. What is the maximum number of devices that can be connected on an I²C bus?  
   a) 64  
   b) 127  
   c) 255  
   d) Unlimited  
   Answer: b) 127
6. What is the data transfer rate of I²C in the "Fast Mode"?  
   a) 100 kbps  
   b) 400 kbps  
   c) 1 Mbps  
   d) 3.4 Mbps  
   Answer: b) 400 kbps
7. Which type of communication does I²C use?  
   a) Full-duplex  
   b) Half-duplex  
   c) Bidirectional, serial communication  
   d) Parallel communication  
   Answer: c) Bidirectional, serial communication
8. In I²C, how is a slave device identified?  
   a) By its physical position on the bus  
   b) By a unique address assigned to each slave  
   c) By its data transmission rate  
   d) By the master device configuration  
   Answer: b) By a unique address assigned to each slave
9. Which I²C feature helps manage multiple devices communicating simultaneously?  
   a) Arbitration  
   b) Parity bits  
   c) Clock stretching  
   d) Bit stuffing  
   Answer: a) Arbitration
10. What is the function of clock stretching in I²C?  
    a) Synchronizing multiple masters  
    b) Allowing a slave to hold the clock line low until it's ready  
    c) Increasing the data rate  
    d) Managing power consumption  
    Answer: b) Allowing a slave to hold the clock line low until it's ready

**CAN Bus MCQs**

1. What does CAN stand for?  
   a) Controller Area Network  
   b) Communication Access Network  
   c) Centralized Autonomous Network  
   d) Control Algorithm Network  
   Answer: a) Controller Area Network
2. Which feature makes CAN suitable for real-time applications?  
   a) High data rates  
   b) Deterministic message arbitration  
   c) Simple protocol stack  
   d) Large payload size  
   Answer: b) Deterministic message arbitration
3. What is the maximum data rate of a standard CAN bus?  
   a) 100 kbps  
   b) 125 kbps  
   c) 1 Mbps  
   d) 10 Mbps  
   Answer: c) 1 Mbps
4. How are devices identified on a CAN bus?  
   a) By unique node IDs  
   b) By message identifiers  
   c) By MAC addresses  
   d) By physical position on the bus  
   Answer: b) By message identifiers
5. Which of the following is true about CAN bus error handling?  
   a) Errors are ignored to maintain speed  
   b) Error frames are transmitted to identify issues  
   c) Errors cause the bus to shut down  
   d) Only the master handles errors  
   Answer: b) Error frames are transmitted to identify issues
6. What is the typical maximum number of nodes supported on a CAN bus?  
   a) 64  
   b) 128  
   c) 255  
   d) 32  
   Answer: b) 128
7. Which type of CAN frame contains the actual data being transmitted?  
   a) Error frame  
   b) Data frame  
   c) Remote frame  
   d) Arbitration frame  
   Answer: b) Data frame
8. What mechanism ensures that the highest-priority message is transmitted first on a CAN bus?  
   a) Time division multiplexing  
   b) Message prioritization based on IDs  
   c) Token passing  
   d) Data checksum  
   Answer: b) Message prioritization based on IDs
9. In CAN, what does the "ACK" field in the message frame indicate?  
   a) The message was successfully received  
   b) An error occurred during transmission  
   c) The bus is idle  
   d) The clock is synchronized  
   Answer: a) The message was successfully received
10. What is the main purpose of bit stuffing in CAN?  
    a) To increase data payload size  
    b) To ensure synchronization by limiting consecutive bits of the same level  
    c) To prioritize messages  
    d) To encrypt the data for security  
    Answer: b) To ensure synchronization by limiting consecutive bits of the same level

**Internet-Enabled Systems in Embedded Systems MCQs**

1. What is an Internet-Enabled Embedded System?  
   a) A system that uses the internet for storage only  
   b) An embedded system capable of connecting to and communicating over the internet  
   c) A standalone embedded system without networking capability  
   d) A system that only processes data locally  
   Answer: b) An embedded system capable of connecting to and communicating over the internet
2. Which protocol is commonly used by Internet-Enabled Embedded Systems for secure communication?  
   a) FTP  
   b) HTTP  
   c) HTTPS  
   d) SMTP  
   Answer: c) HTTPS
3. What is the main purpose of MQTT in Internet-Enabled Embedded Systems?  
   a) High-speed video transmission  
   b) Lightweight messaging for IoT devices  
   c) File storage and retrieval  
   d) Real-time data analytics  
   Answer: b) Lightweight messaging for IoT devices
4. Which layer of the OSI model does the TCP protocol belong to?  
   a) Physical layer  
   b) Data link layer  
   c) Transport layer  
   d) Application layer  
   Answer: c) Transport layer
5. What is the primary role of a gateway in an Internet-Enabled Embedded System?  
   a) To control power consumption of the system  
   b) To connect and translate between different network protocols  
   c) To encrypt transmitted data  
   d) To store and process data locally  
   Answer: b) To connect and translate between different network protocols
6. Which of the following technologies is widely used for short-range wireless communication in Internet-Enabled Embedded Systems?  
   a) LoRa  
   b) Zigbee  
   c) Ethernet  
   d) RS-232  
   Answer: b) Zigbee
7. What does IoT stand for in the context of Internet-Enabled Embedded Systems?  
   a) Internet of Technology  
   b) Internet of Things  
   c) Intelligent Operational Techniques  
   d) Integrated Online Transmission  
   Answer: b) Internet of Things
8. What is the primary benefit of using IPv6 in Internet-Enabled Embedded Systems?  
   a) Faster data rates  
   b) Reduced energy consumption  
   c) Larger address space for device connectivity  
   d) Improved security through encryption  
   Answer: c) Larger address space for device connectivity
9. Which protocol is used to assign dynamic IP addresses to devices in Internet-Enabled Embedded Systems?  
   a) HTTP  
   b) DNS  
   c) DHCP  
   d) ARP  
   Answer: c) DHCP
10. What is the role of the RESTful API in Internet-Enabled Embedded Systems?  
    a) To process sensor data  
    b) To provide an interface for web-based communication  
    c) To control hardware peripherals directly  
    d) To manage device power consumption  
    Answer: b) To provide an interface for web-based communication
11. Which of the following is a popular IoT communication protocol designed for constrained devices?  
    a) HTTP  
    b) MQTT  
    c) PCIe  
    d) FTP  
    Answer: b) MQTT
12. What is the function of a "cloud" in an Internet-Enabled Embedded System?  
    a) It provides hardware acceleration for real-time tasks  
    b) It stores, processes, and manages data remotely  
    c) It replaces the local processing unit entirely  
    d) It is used for device-to-device communication only  
    Answer: b) It stores, processes, and manages data remotely
13. Which of these wireless communication technologies is best for long-range communication in IoT applications?  
    a) Wi-Fi  
    b) Bluetooth  
    c) LoRa  
    d) Zigbee  
    Answer: c) LoRa
14. What is the main advantage of edge computing in Internet-Enabled Embedded Systems?  
    a) Centralized processing  
    b) Reduced latency by processing data closer to the source  
    c) Increased cloud dependency  
    d) Improved battery life for devices  
    Answer: b) Reduced latency by processing data closer to the source
15. Which of the following is a key challenge in designing Internet-Enabled Embedded Systems?  
    a) Limited processor compatibility  
    b) Ensuring low latency and secure communication  
    c) Lack of sensors for data collection  
    d) Difficulty in programming embedded processors  
    Answer: b) Ensuring low latency and secure communication

**Elevator Controller Design in Embedded Systems MCQs**

1. What is the primary function of an elevator controller in embedded systems?  
   a) Monitor power consumption  
   b) Manage the movement of the elevator and handle user inputs  
   c) Provide network connectivity for the elevator  
   d) Control lighting inside the elevator  
   Answer: b) Manage the movement of the elevator and handle user inputs
2. Which of the following components is critical for detecting the position of the elevator car?  
   a) Motor driver  
   b) Position sensor (e.g., encoder)  
   c) Display panel  
   d) Keypad  
   Answer: b) Position sensor (e.g., encoder)
3. What type of embedded system is an elevator controller?  
   a) Real-time system  
   b) General-purpose system  
   c) Batch processing system  
   d) Time-sharing system  
   Answer: a) Real-time system
4. Which type of scheduling is typically used in an elevator controller to handle multiple requests?  
   a) Round-robin scheduling  
   b) Priority-based scheduling  
   c) Time-slice scheduling  
   d) Cooperative multitasking  
   Answer: b) Priority-based scheduling
5. What is the purpose of a limit switch in an elevator system?  
   a) To detect overload conditions  
   b) To stop the elevator at its maximum or minimum position  
   c) To monitor the speed of the elevator  
   d) To communicate with the control panel  
   Answer: b) To stop the elevator at its maximum or minimum position
6. In an elevator controller, which component is responsible for driving the elevator motor?  
   a) Microcontroller  
   b) Motor driver  
   c) Sensor interface  
   d) Display unit  
   Answer: b) Motor driver
7. Which of the following is a common communication protocol used between floors and the elevator controller?  
   a) SPI  
   b) UART  
   c) CAN bus  
   d) I²C  
   Answer: c) CAN bus
8. What is the main role of the debounce circuit in an elevator button panel?  
   a) To filter noise from the elevator motor  
   b) To ensure reliable detection of button presses  
   c) To increase the speed of data transfer  
   d) To handle power interruptions  
   Answer: b) To ensure reliable detection of button presses
9. Which safety feature prevents the elevator from moving with its doors open?  
   a) Overload sensor  
   b) Door interlock mechanism  
   c) Speed limiter  
   d) Position encoder  
   Answer: b) Door interlock mechanism
10. In an elevator control algorithm, what is the purpose of the "call queue"?  
    a) To store user destinations  
    b) To prioritize requests from multiple floors  
    c) To log maintenance activities  
    d) To manage power allocation  
    Answer: b) To prioritize requests from multiple floors
11. What kind of feedback system is commonly used to maintain the elevator at the correct floor level?  
    a) Open-loop control  
    b) Closed-loop control  
    c) Time-based control  
    d) Manual control  
    Answer: b) Closed-loop control
12. Which of the following is an example of a real-time constraint in an elevator system?  
    a) Responding to a floor request within a specific time  
    b) Generating a daily maintenance report  
    c) Calculating energy consumption trends  
    d) Updating software remotely  
    Answer: a) Responding to a floor request within a specific time
13. What happens if the elevator is overloaded?  
    a) The elevator continues to operate normally  
    b) The elevator remains stationary, and an alert is triggered  
    c) The elevator moves at reduced speed  
    d) The system powers off to prevent damage  
    Answer: b) The elevator remains stationary, and an alert is triggered
14. What is the primary role of the embedded microcontroller in an elevator system?  
    a) To provide power to the motor  
    b) To control and coordinate all elevator operations  
    c) To handle external network communications  
    d) To process sensor data only  
    Answer: b) To control and coordinate all elevator operations
15. Which feature in an elevator controller improves user experience during peak times?  
    a) Intelligent scheduling algorithms (e.g., grouping requests by direction)  
    b) Reducing motor speed  
    c) Disabling certain buttons  
    d) Increasing debounce time for button presses  
    Answer: a) Intelligent scheduling algorithms (e.g., grouping requests by direction)