**UNIT- III: INTRODUCTION TO REAL TIME OPERATING SYSTEMS**

Task and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment. (Chapter 6 and 7 from Text Book 3, Simon)

**Tasks and Task States**

1. **What is the primary state of a task when it is not currently eligible to run?**  
   a) Running  
   b) Ready  
   c) Blocked  
   d) Terminated

**Answer:** c) Blocked

1. **Which task state is associated with a task waiting for a specific event or resource?**  
   a) Suspended  
   b) Blocked  
   c) Running  
   d) Ready

**Answer:** b) Blocked

1. **What happens to a running task when it is preempted by a higher-priority task?**  
   a) It enters the terminated state  
   b) It goes to the ready state  
   c) It remains in the running state  
   d) It enters the suspended state

**Answer:** b) It goes to the ready state

**Tasks and Data**

1. **Which of the following ensures safe access to shared data between multiple tasks?**  
   a) Task priority  
   b) Data synchronization mechanisms  
   c) Context switching  
   d) Task preemption

**Answer:** b) Data synchronization mechanisms

1. **In a multitasking system, what is a critical section?**  
   a) A part of code that needs to execute without interruption  
   b) A section that always executes last in a task  
   c) The highest-priority section in a program  
   d) A debug section of the program

**Answer:** a) A part of code that needs to execute without interruption

**Semaphores**

1. **What is the primary purpose of a semaphore in an operating system?**  
   a) To assign tasks dynamically  
   b) To signal and control access to shared resources  
   c) To calculate task priorities  
   d) To handle interrupts

**Answer:** b) To signal and control access to shared resources

1. **What type of semaphore allows multiple tasks to access a shared resource simultaneously up to a limit?**  
   a) Binary semaphore  
   b) Counting semaphore  
   c) Mutex  
   d) Event semaphore

**Answer:** b) Counting semaphore

1. **Which semaphore type is commonly used to manage mutual exclusion?**  
   a) Mutex  
   b) Binary semaphore  
   c) Event semaphore  
   d) Counting semaphore

**Answer:** a) Mutex

**Shared Data**

1. **What is the main issue when tasks share data without synchronization?**  
   a) Memory allocation errors  
   b) Data inconsistency  
   c) Priority inversion  
   d) Deadlock

**Answer:** b) Data inconsistency

1. **Which of the following best describes a race condition?**  
   a) Tasks competing for CPU time  
   b) Two or more tasks accessing shared data simultaneously, leading to unpredictable results  
   c) A task being delayed indefinitely due to lower priority  
   d) A situation where a task cannot complete due to circular dependencies

**Answer:** b) Two or more tasks accessing shared data simultaneously, leading to unpredictable results.

**Message Queues**

1. **What is the primary purpose of a message queue in an operating system?**  
   a) To store data permanently  
   b) To facilitate inter-task communication  
   c) To manage task priorities  
   d) To synchronize semaphores

**Answer:** b) To facilitate inter-task communication

1. **Which of the following is a characteristic of a message queue?**  
   a) Messages are always processed in reverse order.  
   b) Messages are exchanged directly between tasks.  
   c) Messages are stored until the recipient retrieves them.  
   d) Messages cannot be prioritized.

**Answer:** c) Messages are stored until the recipient retrieves them.

1. **In a message queue, what determines the order in which messages are processed?**  
   a) Task priority  
   b) Time of arrival  
   c) Message priority  
   d) Both b and c

**Answer:** d) Both b and c

**Mailboxes**

1. **What is the primary difference between a mailbox and a message queue?**  
   a) A mailbox holds only one message at a time.  
   b) A mailbox can only be accessed by one task.  
   c) A mailbox allows for message prioritization.  
   d) A mailbox does not use any memory.

**Answer:** a) A mailbox holds only one message at a time.

1. **What happens if a task attempts to send a message to a full mailbox?**  
   a) The message is discarded.  
   b) The sending task is blocked until space becomes available.  
   c) The system generates an error.  
   d) The message overwrites the existing one.

**Answer:** b) The sending task is blocked until space becomes available.

1. **In which scenario is a mailbox more efficient than a message queue?**  
   a) When multiple messages need to be handled simultaneously.  
   b) When only one message needs to be stored at a time.  
   c) When message priority is critical.  
   d) When inter-task communication is not required.

**Answer:** b) When only one message needs to be stored at a time.

**Pipes**

1. **What is the main purpose of a pipe in inter-process communication?**  
   a) To send messages directly to hardware  
   b) To allow two or more processes to communicate by transferring data sequentially  
   c) To execute commands in parallel  
   d) To create multiple threads within a task

**Answer:** b) To allow two or more processes to communicate by transferring data sequentially

1. **What is a limitation of an unnamed pipe?**  
   a) It cannot transfer large amounts of data.  
   b) It only allows one-way communication.  
   c) It does not use memory buffers.  
   d) It requires disk storage for data transfer.

**Answer:** b) It only allows one-way communication.

1. **What type of pipe is commonly used to enable communication between unrelated processes?**  
   a) Named pipe  
   b) Unnamed pipe  
   c) Message pipe  
   d) Buffered pipe

**Answer:** a) Named pipe

**Timer Functions**

1. **What is the primary purpose of a timer function in an operating system?**  
   a) To execute tasks based on their priorities  
   b) To trigger actions at specific time intervals  
   c) To synchronize shared data  
   d) To manage task states

**Answer:** b) To trigger actions at specific time intervals

1. **Which of the following is an example of a one-shot timer?**  
   a) A timer that triggers an action repeatedly at fixed intervals  
   b) A timer that triggers an action only once after a delay  
   c) A timer that resets automatically  
   d) A timer that controls task switching

**Answer:** b) A timer that triggers an action only once after a delay

1. **What is a watchdog timer used for?**  
   a) To monitor system performance  
   b) To reset a system when it becomes unresponsive  
   c) To delay the execution of tasks  
   d) To synchronize interrupts

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**Events**

1. **What is the primary purpose of an event in an RTOS?**  
   a) To allocate memory dynamically  
   b) To enable communication between tasks  
   c) To synchronize tasks and interrupts  
   d) To store task states

**Answer:** c) To synchronize tasks and interrupts

1. **Which of the following mechanisms is used to notify tasks of an event occurrence?**  
   a) Semaphores  
   b) Event flags  
   c) Message queues  
   d) All of the above

**Answer:** d) All of the above

1. **What is an event group in an RTOS?**  
   a) A collection of semaphores  
   b) A set of binary flags used for task synchronization  
   c) A group of tasks sharing the same priority  
   d) A memory pool for events

**Answer:** b) A set of binary flags used for task synchronization

1. **Which of the following is true about event flags in an RTOS?**  
   a) They can only signal one task at a time.  
   b) They allow multiple tasks to wait for a single event.  
   c) They cannot be reset once set.  
   d) They are used exclusively for inter-task communication.

**Answer:** b) They allow multiple tasks to wait for a single event.

**Memory Management**

1. **What is the primary goal of memory management in an RTOS?**  
   a) To allocate the largest possible memory block  
   b) To ensure efficient and predictable memory allocation  
   c) To maximize the use of virtual memory  
   d) To dynamically change task priorities

**Answer:** b) To ensure efficient and predictable memory allocation

1. **Which of the following is a common memory allocation strategy in RTOS?**  
   a) Paging  
   b) Best fit  
   c) First fit  
   d) Both b and c

**Answer:** d) Both b and c

1. **What is fragmentation in the context of memory management?**  
   a) Dividing memory into equal-sized blocks  
   b) Inefficient memory usage due to unused gaps  
   c) A method for memory compaction  
   d) A technique to increase memory access speed

**Answer:** b) Inefficient memory usage due to unused gaps

1. **What is a memory pool in RTOS?**  
   a) A shared buffer for message queues  
   b) A predefined collection of fixed-size memory blocks  
   c) A virtual memory area used by tasks  
   d) A system cache for temporary data storage

**Answer:** b) A predefined collection of fixed-size memory blocks

**Interrupt Routines in an RTOS Environment**

1. **What is the purpose of an interrupt routine in an RTOS?**  
   a) To manage task switching  
   b) To handle real-time events with minimal delay  
   c) To allocate system resources dynamically  
   d) To synchronize memory access

**Answer:** b) To handle real-time events with minimal delay

1. **Which of the following is a characteristic of interrupt service routines (ISRs)?**  
   a) They can call any RTOS API function.  
   b) They must execute quickly to avoid blocking the system.  
   c) They always execute at the lowest priority.  
   d) They manage long-running tasks.

**Answer:** b) They must execute quickly to avoid blocking the system.

1. **Why is disabling interrupts considered a critical operation in an RTOS?**  
   a) It stops task scheduling.  
   b) It ensures atomic access to shared resources.  
   c) It increases task execution speed.  
   d) It reduces the overhead of context switching.

**Answer:** b) It ensures atomic access to shared resources.

1. **What is a nested interrupt?**  
   a) An interrupt that handles multiple tasks simultaneously  
   b) An interrupt that cannot be preempted  
   c) An interrupt that occurs while another interrupt is being processed  
   d) An interrupt triggered by hardware failure

**Answer:** c) An interrupt that occurs while another interrupt is being processed

1. **How does an RTOS handle interrupt latency?**  
   a) By increasing task priorities  
   b) By minimizing the time spent in the critical section  
   c) By using round-robin scheduling  
   d) By disabling all interrupts

**Answer:** b) By minimizing the time spent in the critical section