Student Name	
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Question 1: (60 Marks

Choose the most suitable and correct answer for each of the following questions:

1) An embedded system can be defined as a control system designed to perform a _____ purpose.
(A) generic (B) specific (C) customized (D) Both B and C

2) Each of the following hardware components can be found in an embedded system except for:
(A) microcontroller (B) firmware (C) sensors (D) actuators

(3) The following is a system whose correctness depends on the response time.
(A) Embedded System (B) Realtime System (C) Batch Processing System (D) Both A and B

(4) _____ represents the signal that is sent by a device to request an interrupt in an embedded system.
(A) An Interrupt Service Request (B) An Interrupt Service Priority
(C) An Interrupt Service Routine (D) An Interrupt Service Response

(5) Which of the following is correct about a synchronous event in an embedded system?
(A) Occurs **regularly** within a time window and within a **predictable** period
(B) Occurs **irregularly** within a time window and within a **predictable** period
(C) Occurs **regularly** within a time window and within an **unpredictable** period
(D) Occurs **irregularly** within a time window and within an **unpredictable** period

(6) Which of the following are valid use cases of a design pattern for an embedded system?
(A) Pattern Mining and Pattern Matching (B) Pattern Instantiation and Pattern Mining
(C) Pattern Matching and Pattern Design (D) Pattern Instantiation and Pattern Generation

(7) Which of the following represents a valid design use case that is used to apply an existing patt embedded system under development?
(A) Pattern Mining (B) Pattern Matching
(C) Pattern Instantiation (D) Pattern Generation

(8) Another popular name for an Observer design pattern is _____ pattern
(A) Publish-Observe (B) Publish-Subscribe (C) Publish-Listen-In (D) None of the mentioned

(9) All of the following statements are valid about a real time trigger except for
(A) It must be related to a timer (B) It can be or cannot be related to an event
(C) It must be implemented with an ISR (D) Only A and B are correct

(10) An embedded system design involves a HW/SW co-design methodology which means that
(A) HW design, SW design and interface design are all performed in parallel with no interaction between them the HW/SW system integration phase.
(B) HW design and SW design are performed in parallel with continuous interaction between them starting fr in the design process.
(C) HW design, SW design and interface design are performed in parallel with continuous interaction be starting from day one in the design process.
(D) SW design and interface design are performed in parallel with continuous interaction between them startin one in the design process.

(11) A design trade-off spreadsheet compares between different design alternatives in terms of different
(A) design optimization criteria (B) design patterns (C) design trade-offs (D) design weights

(12) A design trade-off spreadsheet compares between different design alternatives with different desig
(A) weights (B) scores (C) weighted scores (D) metrics

(13) The following represents a valid non-functional design optimization criterion except for
(A) performance (B) reliability (C) correct functionality (D) complexity

(14) Consider an embedded system that is responsible for sending emergency messages to save lives of worke construction location. This system is considered as a _____ system.
(A) critical hard-realtime (B) non-critical hard-realtime (C) critical-soft-realtime (D) non-critical soft-realtime
(15) Consider an embedded system that is responsible for controlling stream of videos over the Internet. system is considered as a _____ system.
(A) critical hard-realtime (B) non-critical hard-realtime (C) critical-soft-realtime (D) non-critical soft-realtime
(16) When designing an embedded system, system synthesis is the stage where the system is _____
(A) specified using behavioural specifications
(B) specified using architectural specifications
(C) verified using a high-level performance simulation tool
(D) verified using a low-level C/HDL simulation tool
(17) The HW/SW Co-design methodology _____
(A) resembles (~~is~~) the waterfall software design methodology
(B) resembles the agile software design methodology
(C) resembles the agile and the waterfall software design methodologies
(D) None of the above
(18) The following is considered a characteristic of both a realtime and a non-realtime operating system.
(A) Determinism (B) Failure handling (C) Fail-soft operation (D) User Control
(19) Earliest deadline first is considered a _____ realtime scheduling algorithm
(A) static table driven (B) static priority driven (C) dynamic planning-based (D) dynamic best effort
(20) RMS is considered a _____ realtime scheduling algorithm
(A) static table driven (B) static priority driven (C) dynamic planning-based (D) dynamic best effort
(21) FCFS is considered a _____ scheduling algorithm
(A) static table driven (B) static priority driven (C) dynamic planning-based (D) dynamic best effort
(22) To meet the starting deadline and ending deadline of an aperiodic realtime task, the task should _____
(A) start **on or after** the starting deadline and finish **on or before** the ending deadline
(B) start **on or before** the starting deadline and finish **on or before** the ending deadline
(C) start **on or before** the starting deadline and finish **on or after** the ending deadline
(D) start **on or after** the starting deadline and finish **on or after** the ending deadline
(23) To meet the starting deadline and ending deadline of a periodic realtime task, the task execution time should be _____ the ending deadline minus the starting deadline
(A) equal to (B) less than or equal (C) less than (D) more than or equal
(24) In real time operating systems, _____
(A) realtime kernel is not required
(B) task scheduling aims to schedule tasks to finish in the lowest possible time
(C) tasks must be serviced by their deadlines
(D) all tasks should have the same priority
(25) The interrupt latency should be _____ for real time operating systems.
(A) maximum (B) minimal (C) dependent on the scheduling (D) zero
(26) When the System processes data instructions without any delay is called as
(A) online system (B) real-time system (C) embedded system (D) offline system
(27) Which of the following guarantee correct realtime scheduling?
(A) non-preemptive kernels (B) preemptive kernels
(C) neither preemptive nor non-preemptive kernels (D) preemptive kernels or non preemptive kernels
Suppose that we have a periodic task, T1, with an execution time 50 ms and a period 100 ms. Suppose that we have another periodic task, T2, with an execution time 25 ms and a period 100 ms. Answer the questions 28 and 29.
(28) The total processor utilization by the tasks T1 and T2 is _____.
(A) 25% (B) 50% (C) 75% (D) 100%
(29) The tasks, T1 and T2, can be scheduled correctly to meet their deadlines using _____
(A) perfect scheduling only (B) RMS only (C) both perfect scheduling and RMS (D) None of the above
(30) In the case of RMS, a task with the shortest period is assigned which of the following priority?
(A) the highest (B) the lowest (C) cannot decide due to insufficient information (D) None of the above

(31) Which of the following is NOT an example of an event in an embedded system?
(A) A button is pressed (B) A notification message is received (C) A sensor provides a certain value (D) None of above

(32) When designing an event-driven embedded system for an AC system, it is required to update the temperatu value. Which of the following design options guarantees that the AC system performs better?
(A) Include, inside an ISR, all logic required to set any new temperature value and update the LCD
(B) Using an ISR to set a bit in an event array (C) Using a key poll to set a bit in an event array
(D) Both B and C

(33) When designing an event-driven embedded system for an AC system, the number of events in the system should be _____
(A) dynamic (B) discrete (C) static (D) continuous

(34) An event-driven embedded system for an AC system stores an event array which holds only one event of ea supported type at the same time. This characteristic is called _____
(A) Single-type support (B) Singularity (C) Singleton (D) None of the above

(35) An ISR for an embedded system should be designed according to the following design rules.
(A) Write interrupt handling code to be as small and as fast as possible
(B) Only perform the essential tasks that cannot be done outside the ISR
(C) Try as much as possible not to call any other outside functions in the ISR.
(D) All of the above

(36) A good design for an embedded system should follow the following non-functional design principles.
(A) The design should perform all required system functionalities
(B) The design should be built from one or more design patterns
(C) The design should favor one optimization criteria over the others
(D) All of the above

(37) For any design pattern the pattern consequences describe
(A) the patterns' main problem (B) the structure of the pattern (C) pattern name (D) None of the above

(38) Which of the following design patterns is considered a pattern for accessing hardware?
(A) Observer (B) Mediator (C) All of the above (D) None of the above

(39) In the Observer design pattern, the class which contains the actual source code required to serve requests f specific datum is _____
(A) AbstractClient (B) ConcreteClient (C) AbstractSubject (D) ConcreteSubject

(40) In the Observer design pattern, the class which contains the interface required to request a specific datu _____
(A) AbstractClient (B) ConcreteClient (C) AbstractSubject (D) ConcreteSubject

(41) Suppose you have a set of motors that should work in a synchronized fashion to accomplish a certain ta Which of the following design patterns is more suitable to be used in the design of this system?
(A) Observer (B) Mediator (C) Hardware Adapter (D) Hardware Proxy

(42) The Cyclic Executive design pattern guarantees the following two conflicting objectives.
(A) **Fair** scheduling among all realtime tasks while all tasks **should meet** their deadlines.
(B) **Unfair** scheduling among all realtime tasks while all tasks **should meet** their deadlines.
(C) **Fair** scheduling among all realtime tasks while **Not** all tasks **should meet** their deadlines.
(A) **Unfair** scheduling among all realtime tasks while **Not** all tasks **should meet** their deadlines.

(43) The Cyclic Executive design pattern guarantees _____
(A) fast response to urgent events (B) immediate response to urgent events
(C) slow response to urgent events (D) undetermined response to urgent events

(44) Suppose you want to design an embedded system that should irregularly poll a set of devices. Which of the following design patterns is more suitable to be used in the design of this system?
(A) Interrupt Polling (B) Periodic Polling (C) Opportunistic Polling (D) Both B and C

(45) The Hardware Proxy pattern provides a marshaling process as follows.
(A) The marshaling process converts data from high level format to low level format
(B) The marshaling process converts data from low level format to high level format
(C) The marshaling process depends on the implementation of the pattern
(D) None of the above

(46) Which of the following design patterns is considered a pattern that addresses concurrency?
(A) Semaphore (B) Synchronization (C) Polling (D) None of the above
(47) Which of the following design patterns is considered a pattern that addresses resource management?
(A) Mediator (B) Cyclic Executive (C) Resource Sharing (D) Critical Region
(48) Which of the following design patterns is considered a pattern that addresses safety and reliability?
(A) Cyclic Executive (B) Critical Region (C) All of the above (D) None of the above
Consider the following inequality used by the Cyclic Executive pattern to schedule *n* tasks.

$$D_i \geq \sum_{j=1}^{n} C_j + K$$

(49) The parameter C_j in the above inequality represents the _____ case execution time for task *j*
(A) best (B) average (C) worst (D) burst
(50) The parameter *K* in the above inequality represents the cyclic executive loop overhead including ___
(A) task invocation overhead (B) task processing overhead
(C) task return overhead (D) Both A and C
(51) The parameter D_i in the above inequality represents the _____
(A) starting deadline for task *i* (B) ending deadline for task *i* (C) Any of the above (D) None of the above
(52) The unbounded priority inversion problem is completely avoided when using the _____ design pattern
(A) Mediator (B) Observer (C) Cyclic Executive (D) Critical Region
(53) The unbounded blocking problem is completely avoided when using the _____ design pattern
(A) Polling (B) Interrupt (C) Cyclic Executive (D) Critical Region
(54) The Cyclic Executive pattern applies the _____ scheduling algorithm
(A) Earliest deadline first (B) RMS (C) Round-Robin (D) None of the above
(55) The Cyclic Executive pattern has a timer that controls the _____
(A) time allocated to the whole cycle in which all tasks are executed
(B) time slot allocated to each task in the whole cycle of tasks
(C) time required to context switch from one task to another
(D) time required to process each task executed in the cycle
(56) Suppose you have three periodic tasks, T1, T2 and T3. T1 has an instance that occurs every 1 ms. T2 h instance that occurs every 2 ms. T3 has an instance that occurs every 3 ms. Which task has a higher rate?
(A) T1 (B) T2 (C) T3 (D) All tasks have same rate
(57) Suppose you have three periodic tasks, T1, T2 and T3. T1 has an instance that occurs every 1 ms. T2 ha instances each of them occurs every 1 ms. T3 has three instances each of them occurs every 1 ms. Which task higher rate?
(A) T1 (B) T2 (C) T3 (D) All tasks have same rate
(58) Suppose you have three periodic tasks, T1, T2 and T3. T1 has an instance that executes in 1 ms. T2 h instance that executes in 2 ms. T3 has an instance that executes in 3 ms. Which task has a higher rate?
(A) T1 (B) T2 (C) T3 (D) cannot decide due to insufficient information
(59) Which of the following is NOT an example of a trigger in an embedded system?
(A) A LED blinks every 1 ms (B) A notification message is received 2 ms after a button is pressed
(C) A motor arm rotates after a button is pressed (D) None of the above
(60) The Hardware Adapter pattern converts solves the following problem.
(A) It converts between two hardware interfaces
(B) It adapts an existing hardware interface to work well with an existing application
(C) It converts between a hardware interface and a software interface
(D) Both A and B