MAHARAJA RANJIT SINGH PUNJAB TECHNICAL UNIVERSITY, BATHINDA
Ph.D. Entrance Examination of COMPUTER SCIENCE AND ENGINEERING

Key:

Q.No.	Answer
1	B
2	D
3	B
4	D
5	C
6	C
7	B
8	B
9	D
10	C
11	B
12	A
13	C
14	B
15	A

Q.No.	Answer
16	B
17	C
18	C
19	A
20	A
21	B
22	B
23	B
24	B
25	A
26	D
27	B
28	D
29	B
30	B

Q.No.	Answer
31	A
32	D
33	C
34	B
35	C
36	D
37	B
38	A
39	D
40	B

14/1/25

Controller of Examinations
MRSPTU, Bathinda

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Q1. Which of the following is a tautology?

(A) P∧Q
(B) P∨¬P
(C) P∨Q
(D) ¬P∧¬Q

Q2. In a graph G, if the chromatic number is 4, which of the following must be true?

(A) G is bipartite
(B) G contains a cycle of odd length
(C) G is not planar
(D) G requires at least four colors to properly color its vertices

Q3. If A is a 2×2 matrix with eigenvalues 3 and 5, then the trace of A is?

(A) 15
(B) 8
(C) 2
(D) 5

Q4. Which of the following statements about context-free grammars is true?

(A) Every context-free language is regular
(B) Context-free grammars can describe all languages recognized by finite automata
(C) Context-free grammars can generate languages that cannot be recognized by Turing machines
(D) Every regular language is context-free

[Q5 What is the power set of {1, 2}?

(A) {∅}
(B) {∅, {1}, {2}}
(C) {∅, {1}, {2}, {1,2}}
(D){1,2}

Q6 How many flip-flops are required for a mod-16 counter?

(A) 2
(B) 3
(C) 4
(D) 5

Q7 Which of the following is a characteristic of combinational circuits?

(A) Memory-dependent
(B) No memory element
(C) Sequential operation
(D) Asynchronous

Q8 What is the main advantage of using indexed addressing mode?

(A) Simplifies instruction format
(B) Allows easy array access
(C) Reduces instruction size
(D) Improves execution speed

Q9 Which addressing mode is used in the instruction MOV AX, [BX+SI+10H]?

(A) Direct addressing
(B) Indirect addressing
(C) Indexed addressing
(D) Base plus index addressing

Q10 In RAID (Redundant Array of Independent Disks), which level provides the best balance of performance and fault tolerance?

(A) RAID 0
(B) RAID 1
(C) RAID 5
(D) RAID 6

Q11 Which of the following is a characteristic of a hardwired control unit?

(A) Easy to modify
(B) Uses a fixed set of logic circuits
(C) Uses software routines
(D) Slower than microprogrammed control

Q12 What is a memory hierarchy?

(A) A structure where data is stored in multiple levels based on speed and size
(B) A method to organize the operating system files
(C) A technique to store large programs
(D) A model for processing data faster

Q13 What is the time complexity of binary search in a sorted array?

(A) O(1)
(B) O(n)
(C) O(log n)
(D) $O(n^2)$

Q14 What is the function of an interrupt vector?

(A) Store the interrupt request
(B) Point to the ISR (Interrupt Service Routine)
(C) Prioritize multiple interrupts
(D) Mask low-priority interrupts

Q15 Which of the following data structures can be used to efficiently implement a priority queue?

(A) Binary Heap
(B) AVL Tree
(C) Hash Table
(D) Doubly Linked List

Q16 What is a binary search tree (BST)?

(A) A tree where each node has at most two children
(B) A tree where values on the left are smaller and on the right are larger for every node
(C) A tree used for organizing data in a linear sequence
(D) A tree where data is stored randomly

Q17 What is the time complexity of accessing an element in an array by index?

(A) O(n)
(B) O(log n)
(C) O(1)
(D) $O(n^2)$

Q18 Which algorithm is used to find the minimum spanning tree in a graph?

(A) Dijkstra's Algorithm
(B) Bellman-Ford Algorithm
(C) Prim's Algorithm
(D) Floyd-Warshall Algorithm

Q19 Consider an ER diagram that models a university system with entities like "Student", "Course", and "Instructor". Which of the following relationships would be best modeled as a many-to-many (M:N) relationship?

(A) A student can enroll in multiple courses, and each course can have multiple students.
(B) A student can enroll in multiple courses, but each course can have only one student.
(C) An instructor can teach multiple courses, but each course can only be taught by one instructor.
(D) An instructor can teach multiple courses, but each course can have only one student.

Q20 Which of the following is popular for applications such as storage of log files in a database management system since it offers the best write performance?

(A) RAID level 0
(B) RAID level 1
(C) RAID level 2
(D) RAID level 3

Q21 Which of the following techniques is used for deadlock recovery in DBMS?

(A) Rollback all transactions
(B) Abort one or more transactions
(C) Increase system resources
(D) Reassign system resources

Q22 Which of the following is the most suitable data structure for representing a sparse graph?

(A) Adjacency matrix
(B) Adjacency list
(C) Queue
(D) Stack

Q23 Which of the following is a regular language?

(A) $\{a^n b^n \mid n \geq 0\}$
(B) $\{a^* b^*\}$
(C) $\{a^n b^n \mid n \geq 1\}$
(D) $\{a^n b^m \mid n \neq m\}$

Q24 Which of the following languages is accepted by a pushdown automaton?

(A) Regular languages
(B) Context-free languages
(C) Recursive languages
(D) Context-sensitive languages

Q25 Which of the following does NOT affect the balance factor in an AVL tree?

(A) Changes in the structure of the tree that do not affect height
(B) Insertion of a new node
(C) Deletion of a node
(D) Rotations (left or right) to rebalance the tree

Q26 Which of the following statements about Turing machines is true?

(A) Turing machines can solve all problems that can be solved by finite automata
(B) Turing machines can recognize all context-free languages
(C) Turing machines are limited to recognizing regular languages
(D) Turing machines can simulate any algorithm that can be expressed as a computer program

Q27 What is the pumping lemma for regular languages used for?

(A) To prove a language is context-free
(B) To prove that a language is not regular
(C) To define regular expressions
(D) To find an optimal DFA

Q28 Which of the following is not a typical intermediate representation used in compilers?

(A) Abstract syntax tree (AST)
(B) Three-address code
(C) Register transfer language (RTL)
(D) Machine code

Q29 Which of the following is true about intermediate code generation?

(A) It is the final output of the compilation process
(B) It is platform-independent code
(C) It is written in the target machine language
(D) It is used only for debugging

Q30 Consider the following sequence of instructions:

t1 = a + b
t2 = a + b

Which optimization can be applied here to reduce redundant computation?

(A) Constant folding
(B) Common sub-expression elimination
(C) Loop optimization
(D) Instruction reordering

Q31 What does the process of constant propagation involve?

(A) Substituting the values of constants at compile time into expressions
(B) Converting variables into constants at runtime
(C) Avoiding the use of constants in programs
(D) Changing constant values during code execution

Q32 Consider a certain program X consisting of two source modules A1 and A2 that are contained in two separate files. In case A1 consists of a reference to the function that is defined in A2, then the reference will be resolved at what time?

(A) Compile-time
(B) Edit-time
(C) Load-time
(D) Link-time

Q33 How many tokens are present in following C statement?
printf("i=%d, &i=%x", i&i);

(A) 6
(B) 10
(C) 9
(D) 13

Q34 What is deadlock in an operating system?

(A) A situation where processes do not terminate
(B) A state where processes are stuck waiting for resources held by each other
(C) A process running indefinitely without completion
(D) A method for ensuring system stability

Q35 You are implementing a system where threads need to access a shared resource. If one thread is modifying the resource, and you want to prevent other threads from reading or writing the resource at the same time, which synchronization primitive should you use?

(A) Read-Write Lock
(B) Semaphore
(C) Mutex
(D) Condition Variable

Q36 A deadlock avoidance algorithm dynamically examines the which of the following to ensure that a circular wait condition can never exist?

(A) Operating system
(B) Resources
(C) System storage state
(D) Resource allocation state

Q37 What is a relational algebra operation?

(A) A type of indexing used for query optimization
(B) A set of operations used to query and manipulate relational databases
(C) A technique to store large amounts of data
(D) A method for database design

Q38 You are designing a system that requires a file system with high-speed access and minimal disk fragmentation. Which file allocation method would you choose?

(A) Contiguous Allocation
(B) Linked Allocation
(C) Indexed Allocation
(D) B+ Tree Allocation

Q39 In distance vector routing, how often do routers share their routing tables?

(A) When there is a link state change
(B) On demand
(C) Only during initialization
(D) Periodically

Q40 In a system with a 4 KB page size, how many bits are required for the page offset in a virtual address?

(A) 10 bits
(B) 12 bits
(C) 14 bits
(D) 16 bits