

MIZORAM PUBLIC SERVICE COMMISSION

**TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF
INSPECTOR OF LEGAL METROLOGY
UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS, GOVT. OF MIZORAM
NOVEMBER, 2023**

**COMPUTER SCIENCE & ENGINEERING
PAPER-I**

Time Allowed : 2 hours

Full Marks : 200

All questions carry equal marks of 2 each.

Attempt all questions.

1. Which of the following notations is commonly used to represent a mapping from set A to set B?
(a) $A \rightarrow B$ (b) $A \subseteq B$
(c) $A \cup B$ (d) $A \cap B$
2. What does it mean for a mapping to be surjective?
(a) Every element in the codomain has a pre-image in the domain.
(b) Every element in the domain has a pre-image in the codomain.
(c) No two different elements in the domain map to the same element in the codomain.
(d) All elements in the domain map to the same element in the codomain.
3. What is a partially ordered set (poset)?
(a) A set of positive integers
(b) A set of elements with no order or relationship
(c) A set with a binary relation that is reflexive, antisymmetric, and transitive
(d) A set of prime numbers
4. What is a lattice in the context of posets?
(a) A set of elements with no order
(b) A set of prime numbers
(c) A poset in which every pair of elements has both a least upper bound (supremum) and a greatest lower bound (infimum)
(d) A poset with no upper bounds
5. In mathematical induction, what must be proven in the base case?
(a) The hypothesis holds for all values (b) The hypothesis holds for at least one value
(c) The hypothesis is false for all values (d) The hypothesis is irrelevant in the base case
6. What is mathematical induction used to prove?
(a) Geometric theorems (b) Algebraic equations
(c) Analytical calculus problems (d) Logical propositions

7. What is the truth value of the proposition " $\neg(P \wedge Q)$ " if both P and Q are true?
 - (a) True
 - (b) False
 - (c) Unknown
 - (d) Undefined
8. What does it mean for two logical expressions to be logically equivalent?
 - (a) They have the same truth value for all possible combinations of input values.
 - (b) They have the same number of variables.
 - (c) They both represent tautologies.
 - (d) They have the same truth value for some input values.
9. What is the formula for finding the number of combinations of n objects taken r at a time?
 - (a) $n! / (n - r)!$
 - (b) $n! / r!$
 - (c) $n! * r!$
 - (d) $n! - r!$
10. How many combinations are there for choosing 3 items from a set of 7 items?
 - (a) 27
 - (b) 31
 - (c) 35
 - (d) 43
11. What is a recurrence relation in mathematics?
 - (a) A relation between two variables that cannot be determined
 - (b) A relation between a sequence and its previous terms
 - (c) A relation between two unrelated sequences
 - (d) A relation between an equation and its solutions
12. In the Fibonacci sequence, what is the recurrence relation that defines each term?
 - (a) $F(n) = F(n - 1) + F(n - 2)$
 - (b) $F(n) = F(n - 1) * F(n - 2)$
 - (c) $F(n) = F(n + 1) - F(n - 1)$
 - (d) $F(n) = F(n - 1) / F(n - 2)$
13. What is the chromatic number of a graph?
 - (a) The number of edges in the graph
 - (b) The minimum number of colors needed to color the nodes so that no two adjacent nodes have the same color
 - (c) The number of nodes in the graph
 - (d) The number of cycles in the graph
14. Which famous problem in graph theory involves finding a path that visits every edge exactly once and returns to the starting node?
 - (a) The Traveling Salesman Problem
 - (b) The Four-Color Theorem
 - (c) The Bipartite Graph Problem
 - (d) The Chromatic Number Problem
15. What is the minimum number of edges required for a connected graph to have a spanning tree having n vertices?
 - (a) n
 - (b) n - 1
 - (c) n + 1
 - (d) 2n
16. Which algorithm is commonly used to find the minimum spanning tree of a weighted graph?
 - (a) Breadth-First Search (BFS)
 - (b) Depth-First Search (DFS)
 - (c) Kruskal's algorithm
 - (d) Dijkstra's algorithm
17. Graph isomorphism is primarily concerned with preserving which aspect of the graphs?
 - (a) The number of vertices
 - (b) The number of edges
 - (c) The degree of vertices
 - (d) The colors of vertices

18. In an NFA, if there exists at least one path from the start state to a final state that accepts the input string, what is the overall acceptance status of the input string?
- (a) Accepted (b) Rejected
(c) Ambiguous (d) Undefined
19. What is the maximum number of next states a DFA transition can have for a given input symbol?
- (a) 0 (b) 1
(c) 2 (d) Unlimited
20. Which type of finite automaton is typically used for state minimization?
- (a) Non-deterministic Finite Automaton (NFA) (b) Deterministic Finite Automaton (DFA)
(c) Pushdown Automaton (PDA) (d) Turing Machine (TM)
21. How are outputs associated with states in a Moore machine?
- (a) Each state has a fixed output, independent of inputs.
(b) Outputs are defined for each state and input combination.
(c) Outputs are defined only for the initial state.
(d) Outputs are defined only for the final state.
22. Which of the following statements is true about Type 1 grammars?
- (a) They are also known as context-free grammars. (b) They can be parsed using a finite automaton.
(c) They can generate context-free languages. (d) They can generate context-sensitive languages.
23. Which of the following statements is true about Type 3 grammars?
- (a) They can generate context-free languages. (b) They can be recognized by a Turing machine.
(c) They are the most powerful type of grammar. (d) They can generate regular languages.
24. What is the range of membership values in a fuzzy set?
- (a) 0 to 1 (b) -1 to 1
(c) 1 to ∞ (d) $-\infty$ to ∞
25. Which fuzzy logic operation corresponds to the logical OR operation in classical logic?
- (a) Fuzzy intersection (b) Fuzzy union
(c) Fuzzy complement (d) Fuzzy implication
26. Which type of transistor is commonly used for high-power switching applications due to its ability to handle large current flows?
- (a) NPN transistor (b) PNP transistor
(c) Field-Effect Transistor (FET) (d) Metal-Oxide-Semiconductor FET (MOSFET)
27. What is the key factor that determines the switching speed of a transistor when used as a switch?
- (a) The collector current (b) The base current
(c) The emitter voltage (d) The transition capacitance
28. Which law of Boolean algebra states that the order of operations does not affect the final result when using AND and OR operations?
- (a) Commutative Law (b) Associative Law
(c) Distributive Law (d) Identity Law
29. Boolean function $y(x'z + xz') + x(yz + yz')$ can be simplified as
- (a) $x + y$ (b) x'
(c) y (d) z

30. Which method of Boolean function simplification involves creating a truth table and grouping adjacent terms with the same output value?
- (a) Karnaugh Map (K-map) (b) Quine-McCluskey method
(c) Algebraic manipulation (d) De Morgan's theorem
31. Simplification of $f(a,b,c,d) = \sum(0,1,2,3,4,5,6,7,8,10,13)$ is
- (a) $a'b + b'c'd' + b'cd' + b'c'd$ (b) $a' + b'c'd' + b'cd' + bc'd$
(c) $a' + b'd' + bc'd$ (d) $a'd' + a'c + b'd' + bc'd$
32. In the context of digital circuit design, what is the benefit of a simplified Boolean function obtained using a K-map?
- (a) Reduced power consumption
(b) Increased clock speed
(c) Smaller and more efficient circuits
(d) Enhanced resistance to electromagnetic interference
33. What is the output of an XOR gate if both of its inputs are set to logic level 1?
- (a) Logic level 0 (b) Logic level 1
(c) Logic level X (undefined) (d) Logic level Z (high impedance)
34. In DTL (Diode-Transistor Logic), what is the role of diodes?
- (a) To amplify the input signals (b) To perform logical AND operations
(c) To switch between different logic levels (d) To provide power to the circuit
35. What is the typical threshold voltage polarity for a PMOS transistor?
- (a) Positive threshold voltage (b) Negative threshold voltage
(c) Zero threshold voltage (d) Variable threshold voltage
36. Which logic gate is NOT a basic building block of CMOS circuits?
- (a) NAND gate (b) NOR gate
(c) XOR gate (d) XNOR gate
37. In CMOS circuits, what is the purpose of using complementary NMOS and PMOS transistors?
- (a) To increase power consumption
(b) To reduce speed
(c) To lower noise immunity
(d) To achieve low power consumption and high noise immunity
38. What is the primary characteristic of combinational logic circuits?
- (a) They have memory elements.
(b) They are synchronous circuits.
(c) They have feedback loops.
(d) They have no memory elements; their output depends solely on the current inputs.
39. In a full adder, what is the result if you add $1 + 1 + 1$?
- (a) Sum = 0, Carry-out = 0 (b) Sum = 1, Carry-out = 0
(c) Sum = 0, Carry-out = 1 (d) Sum = 1, Carry-out = 1

40. What is the primary function of a digital comparator circuit?
- (a) To perform arithmetic operations
 - (b) To compare two binary numbers and determine their relationship
 - (c) To convert analog signals to digital signals
 - (d) To store binary data temporarily
41. What is the primary function of a multiplexer (MUX) in digital circuits?
- (a) To perform addition operations
 - (b) To select single signal from multiple signals
 - (c) To decode binary numbers
 - (d) To invert binary signals
42. In telecommunications, what is the purpose of a demultiplexer in a digital subscriber line (DSL) modem?
- (a) To encrypt data for secure transmission
 - (b) To combine multiple data streams into one
 - (c) To separate voice and data signals
 - (d) To increase the bandwidth of the DSL line
43. Which type of flip-flop is commonly used for storing a single bit of data and has two stable states, "0" and "1"?
- (a) D flip-flop
 - (b) T flip-flop
 - (c) JK flip-flop
 - (d) SR flip-flop
44. In digital logic, what is the clock signal used for in flip-flops?
- (a) To perform logical operations
 - (b) To reset the flip-flop
 - (c) To synchronize data storage or transfer
 - (d) To invert the input signals
45. Which flip-flop type has an "indeterminate" or "forbidden" state when both of its inputs (S and R) are set to logic level 1?
- (a) D flip-flop
 - (b) T flip-flop
 - (c) JK flip-flop
 - (d) SR flip-flop
46. Which type of flip-flop is often used for synchronizing signals in digital systems and does not have a clock input?
- (a) D flip-flop
 - (b) T flip-flop
 - (c) JK flip-flop
 - (d) SR flip-flop
47. Which type of register is commonly used to store the address of the next instruction to be executed in a CPU?
- (a) Data register
 - (b) Program counter (PC)
 - (c) Accumulator
 - (d) Memory buffer register (MBR)
48. In audio applications, which type of waveform is commonly associated with musical instrument sounds?
- (a) Sine wave
 - (b) Square wave
 - (c) Triangular wave
 - (d) Sawtooth wave
49. What does the term "quantization" refer to in A/D conversion?
- (a) The process of converting digital signals to analog signals
 - (b) The process of mapping continuous analog values to discrete digital values
 - (c) The process of filtering out high-frequency noise
 - (d) The process of measuring the signal frequency
50. What is the primary storage technology used in Solid-State Drives (SSDs)?
- (a) Magnetic disks
 - (b) Optical disks
 - (c) NAND flash memory
 - (d) RAM (Random Access Memory)

51. What does VLIW stands for?
(a) Very Long Instruction Word (b) Very Long Instruction Width
(c) Very Large Instruction Word (d) Very Large Instruction Width
52. What is the fullform of CISC?
(a) Complex Instruction Sequential Compiler (b) Complex Integrated Set Computer
(c) Complete Instruction Sequential Compilation (d) Complex Instruction Set Computer
53. When a CPU accesses data stored in cache memory, it checks the _____ to determine if the data has been modified.
(a) Flag bit (b) Reference bit
(c) Update bit (d) Dirty Bit
54. In zero-address instruction format, the operands are stored in _____.
(a) Registers (b) Stack
(c) Accumulator (d) Cache
55. The length of word in a 64-bit machine is _____.
(a) 4 bytes (b) 8 bytes
(c) 12 bytes (d) 16 bytes
56. Which if the following memory device store the BOOT sector files of the system?
(a) Cache (b) RAM
(c) ROM (d) SSD
57. _____ is a program that directly executes the instruction in a high-level language without converting into machine code.
(a) Compiler (b) Interpreter
(c) Assembler (d) Decoder
58. In a microprocessor, what does the control unit use to generate control signals for different CPU operations?
(a) Instruction format (b) Opcode
(c) Microinstructions (d) Memory address
59. What is the role of the clock signal in a computer system?
(a) It carries data between the CPU and memory. (b) It generates control signals.
(c) It synchronizes the timing of various operations. (d) It performs arithmetic calculations.
60. What is a linker in the context of assembly programming?
(a) A program that converts assembly code to machine code
(b) A program that translates high-level code to assembly code
(c) A program that resolves references between separately assembled modules
(d) A program that optimizes the execution speed of assembly code
61. What is the primary purpose of micro-operations in a CPU?
(a) Execute high-level programming code
(b) Manage input/output devices
(c) Control the operation of the CPU's internal components
(d) Perform complex mathematical calculations

62. Which register is often used as an intermediary in data transfer operations?
(a) Program Counter (PC) (b) Accumulator (ACC)
(c) Memory Buffer Register (MBR) (d) Instruction Register (IR)
63. Which of the following statements is true regarding register transfer operations?
(a) Register transfer operations are performed using high-level programming languages.
(b) Register transfer operations can only involve one register at a time.
(c) Register transfer operations are used to move data between registers and perform arithmetic/logic operations.
(d) Register transfer operations do not require a control unit.
64. Which of the following provides fastest data access?
(a) Caches (b) DRAMs
(c) SRAMs (d) Registers
65. Which phase of the assembly process generates the actual machine code?
(a) Lexical analysis (b) Parsing
(c) Pass 1 (d) Pass 2
66. What is the primary advantage of using BCD representation for decimal numbers?
(a) Compact storage (b) High precision
(c) Efficient arithmetic operations (d) Easy conversion
67. What is the advantage of microprogrammed control over hardwired control?
(a) Faster execution (b) Greater flexibility and easier modification
(c) Lower cost (d) Simplicity in design
68. Which of the following is true about microprogrammed control?
(a) It is a form of hardwired control.
(b) It uses only high-level programming languages.
(c) It does not require control memory.
(d) It relies on microinstructions to control the CPU's operations.
69. What is the purpose of using the mantissa in floating-point representation?
(a) To store the sign of the number
(b) To determine the order of magnitude of the number
(c) To represent the actual digits of the number's fractional part
(d) To indicate the precision of the exponent
70. In a stack, which operation retrieves the top element without removing it?
(a) Pop (b) Push
(c) Peek (d) Delete
71. Which of the following is a common application of a stack in computer science?
(a) Sorting algorithms (b) Database management
(c) Recursive function calls (d) Disk storage
72. What is the advantage of using a fixed-length instruction format?
(a) It allows for variable-length instructions. (b) It simplifies instruction decoding.
(c) It increases memory efficiency. (d) It enables the use of complex data types.

73. What is the purpose of an opcode in an instruction format?
- (a) To specify the source and destination registers
 - (b) To specify the type of operation to be performed
 - (c) To store the result of an operation
 - (d) To indicate the memory address of the instruction
74. The situation that occurs in pipelining when the execution of an instruction depends on the result of previous instruction which has not been computed is called
- (a) Data deathtrap
 - (b) Data hazard
 - (c) Pipeline structure hazard
 - (d) Deadlock
75. Which of the following is the proper sequence of decomposition of instruction in pipelining?
- (a) Fetch -> Decode -> Memory Access -> Execute -> Write
 - (b) Fetch -> Memory Access -> Decode -> Execute -> Write
 - (c) Fetch -> Decode -> Execute -> Memory access -> Write
 - (d) Fetch -> Memory Access -> Execute -> Decode -> Write
76. In most programming languages, how are elements in an array typically accessed?
- (a) By their names
 - (b) By their memory addresses
 - (c) By their indices or positions
 - (d) By using a hash table
77. In many programming languages, how can you concatenate two strings?
- (a) Using the '+' operator
 - (b) Using the '&' operator
 - (c) Using the '^' operator
 - (d) Using the '%' operator
78. Which of the following is not a common operation performed on strings?
- (a) Concatenation
 - (b) Comparison
 - (c) Bitwise manipulation
 - (d) Substring extraction
79. What is a "bit field" in programming?
- (a) A data type that can hold only one bit of information
 - (b) A structure or variable that packs multiple data values into a single word or byte
 - (c) A technique for compressing large files into smaller sizes
 - (d) A data structure used to store bit-level data such as images
80. What does "packing" refer to in computer programming?
- (a) Arranging physical objects
 - (b) Compressing data to reduce its size
 - (c) Organizing files in a folder
 - (d) Allocating memory for variables
81. What is the primary goal of designing efficient algorithms?
- (a) To use the least amount of memory
 - (b) To minimize the number of steps
 - (c) To make the code shorter and easier to write
 - (d) To ensure 100% accuracy in the output
82. In algorithm analysis, what does "time complexity" refer to?
- (a) The actual execution time of the algorithm
 - (b) The number of steps required by the algorithm as a function of input size
 - (c) The memory space used by the algorithm
 - (d) The speed of the computer running the algorithm

83. What does "Big O notation" describe in algorithm analysis?
- (a) The largest number in a data set
 - (b) The upper bound on the growth rate of an algorithm's runtime
 - (c) The smallest number in a data set
 - (d) The average case of an algorithm's performance
84. Which sorting algorithm has the best average-case time complexity among the following?
- (a) Bubble Sort
 - (b) Insertion Sort
 - (c) Merge Sort
 - (d) Quick Sort
85. What is the time complexity of the Bubble Sort algorithm in the worst-case scenario?
- (a) $O(1)$
 - (b) $O(n)$
 - (c) $O(n^2)$
 - (d) $O(\log n)$
86. What is the time complexity of Binary Search on a sorted array?
- (a) $O(1)$
 - (b) $O(\log n)$
 - (c) $O(n)$
 - (d) $O(n^2)$
87. Which searching algorithm examines each element in the search space sequentially until a match is found?
- (a) Linear Search
 - (b) Binary Search
 - (c) Merge Sort
 - (d) Quick Sort
88. What is a potential issue with recursive functions that do not have a base case or have a base case that is never reached?
- (a) They run faster than iterative functions
 - (b) They always produce correct results
 - (c) They may cause a stack overflow error
 - (d) They do not use the call stack
89. What is the time complexity for the push and pop operations in a typical stack implementation?
- (a) $O(1)$ - Constant time
 - (b) $O(\log n)$ - Logarithmic time
 - (c) $O(n)$ - Linear time
 - (d) $O(n^2)$ - Quadratic time
90. In a queue, which operation adds an element to the back of the queue?
- (a) Push
 - (b) Pop
 - (c) Enqueue
 - (d) Dequeue
91. Which data structure is often used to implement a queue efficiently?
- (a) Linked list
 - (b) Array
 - (c) Hash table
 - (d) Tree
92. Which Abstract Data Type (ADT) is often used to represent a collection of elements with no specific order?
- (a) Stack
 - (b) Queue
 - (c) Set
 - (d) Dictionary
93. In a priority queue, what data structure is commonly used for efficient implementation?
- (a) Array
 - (b) Linked list
 - (c) Hash table
 - (d) Binary Search Tree
94. In which algorithm or problem-solving technique is Union-Find commonly used?
- (a) Depth-First Search (DFS)
 - (b) Binary Search
 - (c) Quick Sort
 - (d) Breadth-First Search (BFS)

95. In a binary tree, what is the maximum number of children a node can have?
- (a) 0 (b) 1
(c) 2 (d) Unlimited
96. In an in-order traversal of a binary search tree (BST), in what order are the nodes visited?
- (a) Left child, root, right child (b) Root, left child, right child
(c) Right child, root, left child (d) Left child, right child, root
97. What is the primary goal of balancing a binary search tree (BST)?
- (a) To make the tree taller
(d) To increase the number of leaf nodes
(c) To maintain a low height and ensure efficient operations
(d) To add more branches to the tree
98. Which self-balancing binary search tree (BST) data structure uses rotations to maintain balance?
- (a) AVL tree (b) Binary heap
(c) B-tree (d) Trie
99. What is the maximum number of keys a non-root internal node in a B-tree of order "m" can have?
- (a) 0 (b) 1
(c) m-1 (d) m
100. In which domain or application is B-tree often used?
- (a) Game development (b) Image processing
(c) File systems and databases (d) Social media networks

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