

# MIZORAM PUBLIC SERVICE COMMISSION

## TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE, P&E CADRE (ELECTRICAL WING) UNDER POWER & ELECTRICITY DEPARTMENT, GOVERNMENT OF MIZORAM, JULY-2023

### COMPUTER SCIENCE AND ENGINEERING PAPER-I

Time Allowed : 3 hours

FM : 200

#### **SECTION - A (Multiple Choice questions) (100 Marks)**

*All questions carry equal mark of 2 each. Attempt all questions.*

*This Section should be answered only on the **OMR Response Sheet** provided.*

- How many injections are defined from set A to set B if set A has 4 elements and set B has 5 elements?  
(a) 144 (b) 24  
(c) 64 (d) 120
- Which of the following function is also referred to as an injective function?  
(a) One-to-One (b) Many-to-one  
(c) Onto (d) None of the above
- If  $x \in \mathbb{N}$  and  $x$  is prime, then  $x$  is \_\_\_\_\_ set.  
(a) Finite set (b) Empty set  
(c) Not a set (d) Infinite set
- Which one of the following is NOT necessarily a property of a Group?  
(a) Commutativity (b) Associativity  
(c) Existence of inverse for every element (d) Existence of identity
- Consider the binary relation  $R = \{(x, y), (x, z), (z, x), (z, y)\}$  on the set  $\{x, y, z\}$ . Which one of the following is TRUE?  
(a)  $R$  is symmetric but NOT antisymmetric (b)  $R$  is NOT symmetric but antisymmetric  
(c)  $R$  is both symmetric and antisymmetric (d)  $R$  is neither symmetric nor antisymmetric
- How many different non-isomorphic Abelian groups of order 4 are there?  
(a) 2 (b) 3  
(c) 4 (d) 5
- Power set of empty or Null set has exactly \_\_\_\_\_ subset.  
(a) One (b) Three  
(c) Two (d) Zero
- A graph  $G$  is called a \_\_\_\_\_ if it is a connected acyclic graph.  
(a) Cyclic graph (b) Regular graph  
(c) Tree (d) Not a graph

9. Let  $S$  be a set of  $n$  elements. The number of ordered pairs in the largest and the smallest equivalence relations on  $S$  is
- (a)  $n$  and  $n$  (b)  $n^2$  and  $n$   
(c)  $n^2$  and  $0$  (d)  $n$  and  $1$
10. If two finite state machine  $M$  and  $N$  are isomorphic, then
- (a)  $M$  can be transformed to  $N$ , merely re-labelling its states  
(b)  $M$  can be transformed to  $N$ , merely re-labelling its edges  
(c) Both (a) & (b)  
(d) None of these
11. Correct hierarchical relationship among context-free, right-linear, and context-sensitive language is
- (a) context-free  $\subset$  right-linear  $\subset$  context-sensitive  
(b) context-free  $\subset$  context-sensitive  $\subset$  right-linear  
(c) context-sensitive  $\subset$  right-linear  $\subset$  context-free  
(d) right-linear  $\subset$  context-free  $\subset$  context-sensitive
12. In the method of defuzzification, MeOM stands for
- (a) Mean of Minima (b) Method of Minima  
(c) Method of Maxima (d) Mean of Maxima
13. \_\_\_\_\_ is suitable for testing the odd parity of word.
- (a) AND gate (b) OR gate  
(c) NOR gate (d) XOR gate
14. Select the combinational logic circuit which produces a specific binary word or number is
- (a) Encoder (b) Multiplexer  
(c) Decoder (d) Demultiplexer
15. Why we use demultiplexer?
- (a) Route the data from a single input to one of many outputs  
(b) Select data from several inputs and route it to a single output  
(c) Perform serial to parallel conversion  
(d) Both (a) & (b)
16. PAL circuit consists of
- (a) Fixed OR & programmable AND logic  
(b) Programmable OR & Fixed AND Logic  
(c) Fixed OR & fixed AND logic  
(d) Programmable OR & programmable AND logic
17. Which of the following input overrides other?
- (a) Asynchronous override synchronous (b) Synchronous override asynchronous  
(c) Clear input override Present input (d) Present input override Clear input
18. Where is the logic set when the transmission line is idle in the asynchronous transmission?
- (a) Remains in the previous state  
(b) It is set to logic low  
(c) It is set to logic high  
(d) State of the transmission line is not used to start transmission

19. If the clock input applied to a cascaded Mod-6 & Mod-4 counter is 48KHz. Then the output of the cascaded arrangement shall be of
- (a) 8 KHz (b) 12 KHz  
(c) 2 KHz (d) 18 KHz
20. Which of the following digital logic circuits can be used to add more than 1 – bit simultaneously?
- (a) Full – adder (b) Ripple – carry adder  
(c) Half – adder (d) Serial adder
21. Digital data can be applied to gate by maximum frequency which is called
- (a) Charging time (b) Propagation speed  
(c) Binary level transaction period (d) Operating speed
22. How many rows are needed in the primitive flow table for the gated latch?
- (a) 1 row (b) 3 rows  
(c) 5 rows (d) 7 rows
23. Select the Number of ripple counter in IC \_\_\_\_\_ are
- (a) 7492 (b) 7865  
(c) 7493 (d) 7654
24. If there are four ROM ICs of 8K and two RAM ICs of 4K words, than the address range of Ist RAM is (Assume initial addresses correspond to ROMs)
- (a) (8000)H to (9FFF)H (b) (6000)H to (7FFF)H  
(c) (8000)H to (8FFF)H (d) (9000)H to (9FFF)H
25. What is computer organization?
- (a) structure and behaviour of a computer system as observed by the user  
(b) structure of a computer system as observed by the developer  
(c) structure and behaviour of a computer system as observed by the developer  
(d) All of the mentioned
26. Which of the following is a type of architecture used in the computers nowadays?
- (a) Microarchitecture (b) Harvard Architecture  
(c) Von-Neumann Architecture (d) System Design
27. Which of the architecture is power efficient?
- (a) RISC (b) ISA  
(c) IANA (d) CISC
28. In order to read multiple bytes of a row at the same time, we make use of
- (a) Memory extension (b) Cache  
(c) Shift register (d) Latch
29. The number successful accesses to memory stated as a fraction is called as
- (a) Access rate (b) Success rate  
(c) Hit rate (d) Miss rate
30. \_\_\_\_\_ is the 8-bit encoding format used to store data in a computer.
- (a) ANCI (b) USCII  
(c) ASCII (d) EBCDIC

31. What is a stack pointer?
- (a) The first memory location where a subroutine address is stored
  - (b) A register in which flag bits are stored
  - (c) 16-bit register in the microprocessor that indicates the beginning of the stack memory
  - (d) A register that decodes and executes the 16-bit arithmetic expression
32. 8080 Microprocessor is an \_\_\_\_\_ machine with \_\_\_\_\_ data path to memory.
- (a) 8 Bit , 16 Bit.
  - (b) 16 Bit, 8 Bit
  - (c) 16 Bit, 16 Bit
  - (d) 8 Bit, 8 Bit
33. The “natural” unit of organization of memory. The size of a word is typically equal to the number of bits used to represent an \_\_\_\_\_ and to the instruction length.
- (a) integer
  - (b) float
  - (c) char
  - (d) double
34. When virtual addresses are used, the system designer may choose to place the cache between the processor and the MMU is called
- (a) physical cache
  - (b) logical cache
  - (c) mid line cache
  - (d) main line cache
35. RAID 3 is also called
- (a) Bit Interleaved parity.
  - (b) Mirror Disk
  - (c) Dual Redundancy
  - (d) Block Level Distributed Parity
36. Each process is represented in the OS by a
- (a) system task control block
  - (b) operating system control block
  - (c) system control block.
  - (d) process control block
37. An adjacency matrix representation of a graph cannot contain information of
- (a) Edges
  - (b) Direction of Edges
  - (c) Nodes
  - (d) Parallel Edges
38. The best average behaviour is shown by
- (a) Merge Sort
  - (b) Insertion Sort
  - (c) Quick Sort
  - (d) Heap Sort
39. Two main measures of the efficiency of an algorithm are
- (a) Time and Space
  - (b) Complexity and Capacity
  - (c) Processor and Memory
  - (d) Data and Space
40. Consider a max heap represented by the array: 40, 30, 20, 10, 15, 16, 17, 8, and 4. Now consider that a value of 35 is inserted into this heap. After insertion, the new heap is
- (a) 40, 30, 20, 10, 15, 16, 17, 8, 4, 35
  - (b) 40, 35, 20, 10, 30, 16, 17, 8, 4, 15
  - (c) 40, 30, 20, 10, 35, 16, 17, 8, 4, 15
  - (d) 40, 35, 20, 10, 15, 16, 17, 8, 4, 30
41. The best data structure to check and evaluate arithmetic expressions is
- (a) Queue
  - (b) Stack
  - (c) Tree
  - (d) List

42. Given the following input (3422, 3134, 1741, 7699, 9819, 1671, 7163, 9149) and the hash function  $x \bmod 10$ , which of the following statements are true?
- i) 7699, 9819, 9149 hash to the same value
  - ii) 1741, 1671 has to the same value
  - iii) All elements hash to the same value
  - iv) Each element hashes to a different value
- (a) i only (b) ii only  
(c) i and ii only (d) iii or iv
43. The post order traversal of a binary tree is DEBFCA. Find out the pre-order traversal.
- (a) ABFCDE (b) ADBFEC  
(c) ABDECF (d) ABDCEF
44. The worst-case occur in linear search algorithm when
- (a) Item is not in the array at all
  - (b) Item is the last element in the array or item is not there at all.
  - (c) Item is the last element in the array
  - (d) Item is somewhere in the middle of the array
45. If the location of element is same before sorting and after sorting, then it is called
- (a) Sort Selection (b) Sorting  
(c) Sort Stability (d) None of the above
46. Recursive algorithms are based on
- (a) Divide and conquer approach (b) Top-down approach  
(c) Bottom-up approach (d) Hierarchical approach
47. Assume a binary search tree is constructed using the integer values and searched for the number 55. Identify the INCORRECT sequence from the list given. Justify your answer.
- (a) 10, 75, 64, 43, 60, 57, 55 (b) 90, 12, 68, 34, 62, 45, 55  
(c) 9, 85, 47, 68, 43, 57, 55 (d) 79, 14, 72, 56, 16, 53, 55
48. Calculate the complexity of Radix sort algorithm, to sort the following elements 18, 12, 101, 132, 154, 168, 175, 9999, 166, 177, 252, 3656, 242 using 10 buckets.
- (a) 69 (b) 92  
(c) 115 (d) 140
49. How many stacks are needed to implement a queue? Consider the situation where no other data structure like arrays, linked list is available to you.
- (a) 1 (b) 2  
(c) 3 (d) 4
50. List the complexity of sorting algorithms in worst case from lower to higher order.
- (a) Merge sort == Heap Sport < Quick sort == Selection Sort == Bubble Sort == Insertion Sort  
(b) Merge Sort < Heap Sort < Quick Sort < Selection sort < Bubble Sort < Insertion Sort  
(c) Merge Sort <= Heap Sort <= Quick Sort < Selection Sort < Bubble Sort < Insertion Sort  
(d) Merge Sort > Heap Sort < Quick Sort < Selection Sort < Bubble Sort < Insertion Sort

**SECTION - B (Short answer type question) (100 Marks)**

All questions carry equal marks of 5 each.

This Section should be answered only on the Answer Sheet provided.

1. How many words can be formed from the letters of the word, 'SIGNATURE' to that the vowels always come together?
2. In a basketball match, all ten players shake hands with each other once after the match. How many handshakes will be there?
3. Prove the following by principle of "Induction Method" for all  $n \geq 0$ ,  $\sum_{i=0}^n i^3 = \left[\frac{n(n+1)}{2}\right]^2$
4. Design DFA which accepts the strings 1010 only.
5. Consider the following NFA with a given below:

**TRANSITION TABLE**

STATES	INPUTS			
	$\emptyset$	a	b	c
$\Rightarrow p$	F	{p}	{q}	{r}
q	{p}	{q}	{r}	F
*r	{q}	{r}	F	{p}

Convert the automation to DFA

6. Draw a logic diagram using only two-input NOR gates to implement the following function:  
 $F(A, B, C, D) = (A \oplus B)' (C \oplus D)$
7. Construction of half adder without using AND and OR Gate?
8. Implement a full adder with two 4X1 multiplexers.
9. How will you define the present state and next state of sequential circuit?
10. Why look ahead carry adder is faster than ripple adder?
11. Explain clock speed related to computer performance.
12. What is two level memory access in multilevel memory hierarchy?
13. Briefly explain the technique of pipelining. What is the use of Control Register.
14. If a system designer wants to exchange the data directly between main memory and I/O module without processor involvement, which technique they need to be chosen by system designer and why?
15. Most of the machines provide a variety of shifting and rotating functions. List out the possible shift and rotate functions with suitable diagrams.
16. Explain the concept of Recursion.
17. Explain the steps to check whether a given expression is balanced or unbalanced.
18. Analyze the time complexity of Prim's Algorithm.
19. Sort the array {14, 23, 43, 56, 34, 65, 34, 76, 87, 98, 45, 23, 45, 12, 34, 56} using Merge Sort.
20. Identify the heap from the following sequences and determine it is min or max binary heap
  - (a) 1, 3, 2, 4, 6, 5
  - (b) 6,5,3,4,2,1
  - (c) 30,12,90,8,15
  - (d) Jack, Queen, King, Rahul, Frick, Laxman
  - (e) Queen, laxman, king, Frick, Eigen, Hive