OJEE MTech Computer Science and IT Sample Paper 03

A) Mode Time: The exam is a Computer Based Test (CBT) lasting 120 minutes.
B) Total Questions: The exam contains 90 questions.
C) Marking Scheme & Rules:

- +4 marks for each correct answer; -1 mark for each incorrect answer.

Q1. A 4-bit synchronous counter uses J-K flip-flops. If the counter sequence is 0, 2, 4, 6, 8, 10, 12, 14, and repeats, what are the minimal Boolean expressions for J_1 and K_1 (the second LSB)?

A. $J_1 = 1, K_1 = 1$

B. $J_1 = Q_2, K_1 = Q_2'$

C. $J_1 = 0, K_1 = 0$

D. $J_1 = Q_0, K_1 = Q_0$

Q2. Consider a Boolean function $F(A, B, C, D) = \Sigma m(0, 1, 2, 5, 8, 9, 10)$. What is the number of essential prime implicants?

A. 1

B. 2

C. 3

D. 4

Q3. In a 16-to-1 multiplexer, the select lines are S_3, S_2, S_1, S_0. If we want to implement a 5-variable Boolean function using this multiplexer without any additional logic gates, how many variables must be connected to the data inputs?

A. 1

B. 2

C. 4

D. Cannot be implemented without additional gates

Q4. A dynamic hazard in a combinational circuit occurs when:

A. The output changes three or more times before settling to a final value.

B. The output momentarily goes to 0 when it should remain 1.

C. The circuit has a feedback loop causing oscillation.

D. Multiple inputs change simultaneously.

Q5. How many 2-input NOR gates are minimally required to implement an XOR gate?

A. 3

B. 4

C. 5

D. 6

Q6. The minimum propagation delay of a logic gate is 2ns and the maximum is 5ns. What is the maximum clock frequency for a 4-bit ripple carry adder built using these gates to ensure reliable operation?

A. 50 MHz

B. 20 MHz

C. 100 MHz

D. 10 MHz

Q7. A pipelined processor has 5 stages: IF, ID, EX, MEM, WB. Branch instructions are resolved in the EX stage. If 20% of instructions are branches and 60% of them are taken, what is the average CPI if the ideal CPI is 1 and no branch prediction is used (assume stall cycles are inserted)?

A. 1.24

B. 1.36

C. 1.40

D. 1.60

Q8. A cache memory uses 4-way set associative mapping with a block size of 64 bytes. The physical address is 32 bits, and the cache size is 64 KB. How many bits are there in the tag field?

A. 18

B. 16

C. 20

D. 22

Q9. In IEEE 754 single-precision floating-point format, what is the value of the number represented by the hexadecimal string 0xC0000000?

A. -2.0

B. -4.0

C. -0.5

D. +2.0

Q10. An instruction set has 16-bit instructions. The opcode is 4 bits. If there are 10 two-address instructions and 40 one-address instructions, how many zero-address instructions can be formulated?

A. 256

B. 512

C. 1536

D. 1024

Q11. Microprogrammed control units are preferred over hardwired control units for complex instruction sets primarily because:

A. They are faster.

B. They consume less power.

C. They are easier to modify and extend.

D. They require less memory.

Q12. A hard disk has 8 platters, 1024 cylinders, and 256 sectors per track. If each sector holds 512 bytes, what is the total capacity of the disk?

A. 1 GB

B. 2 GB

C. 4 GB

D. 8 GB

Q13. In C, what is the output of the following code snippet? `int a = 10; printf("%d %d %d", a++, ++a, a);` (Assume right-to-left evaluation of arguments).

A. 10 12 12

B. 11 11 12

C. 11 12 10

D. 12 12 12

Q14. A binary search tree is generated by inserting the following integers in order: 50, 15, 62, 5, 20, 58, 91, 3, 8, 37, 60, 24. The number of nodes in the left subtree and right subtree of the root respectively is:

A. (7, 4)

B. (6, 5)

C. (8, 3)

D. (7, 5)

Q15. Which of the following tree traversals will always uniquely identify the structure of a binary search tree?

A. Pre-order only

B. Post-order only

C. In-order and Pre-order combined

D. Pre-order or Post-order alone

Q16. Consider a hash table of size 11 with open addressing and double hashing. The primary hash function is $h_1(k) = k \pmod{11}$ and the secondary hash function is $h_2(k) = 7 - (k \pmod{7})$. If the keys 22, 43, 14, 56 are inserted sequentially, at which index will 56 be placed?

A. 1

B. 4

C. 5

D. 8

Q17. The minimum number of pointers required to be updated to delete the node pointed to by `ptr` in a doubly circular linked list of N nodes ($N > 2$) is:

A. 2

B. 3

C. 4

D. 1

Q18. A matrix is stored in row-major order with base address 1000. Each element occupies 4 bytes. If the matrix dimensions are $A[10 \ldots 20][20 \ldots 30]$, what is the address of $A[15][25]$?

A. 1220

B. 1240

C. 1260

D. 1280

Q19. An AVL tree has a maximum height of h. What is the recurrence relation for the minimum number of nodes $N(h)$ in such a tree?

A. $N(h) = 2N(h-1) + 1$

B. $N(h) = N(h-1) + N(h-2) + 1$

C. $N(h) = N(h-1) + N(h-2)$

D. $N(h) = 2^h - 1$

Q20. A directed graph with V vertices and E edges has negative weight edges but no negative weight cycles. Which algorithm is most efficient to find the shortest path from a single source?

A. Dijkstra's Algorithm

B. Bellman-Ford Algorithm

C. Floyd-Warshall Algorithm

D. Kruskal's Algorithm

Q21. The recurrence relation $T(n) = 3T(n/2) + n \log n$ evaluates to which asymptotic time complexity?

A. $\Theta(n \log^2 n)$

B. $\Theta(n^{\log_2 3})$

C. $\Theta(n^{\log_2 3} \log n)$

D. $\Theta(n^2)$

Q22. What is the minimum number of scalar multiplications required to multiply the matrix chain $M_1 \times M_2 \times M_3 \times M_4$ with dimensions 10×20, 20×30, 30×40, and 40×50?

A. 38000

B. 34000

C. 40000

D. 36000

Q23. In the context of P, NP, and NP-Complete classes, if an NP-Complete problem can be solved in polynomial time, then:

A. $P = NP$

B. All NP problems are strictly harder than P problems

C. $P \neq NP$

D. NP-Hard = P

Q24. Huffman coding is applied to a text file containing 5 distinct characters. Which of the following cannot be a valid set of code lengths for the characters?

A. 1, 2, 3, 4, 4

B. 2, 2, 2, 3, 3

C. 1, 2, 3, 3, 3

D. 2, 2, 3, 3, 3

Q25. A master theorem fails for which of the following recurrences?

A. $T(n) = 2T(n/2) + n^2$

B. $T(n) = 4T(n/2) + n^2 \log n$

C. $T(n) = 2T(n/2) + n/\log n$

D. $T(n) = 8T(n/2) + n^3$

Q26. Finding the strongly connected components of a directed graph can be done using:

A. A single BFS pass

B. Two BFS passes

C. Two DFS passes (Kosaraju's Algorithm)

D. A single Dijkstra pass

Q27. Consider the languages $L_1 = \{a^n b^n c^m \mid n, m \geq 0\}$ and $L_2 = \{a^n b^m c^m \mid n, m \geq 0\}$. The intersection $L_1 \cap L_2$ is:

A. Regular

B. Context-Free but not Regular

C. Context-Sensitive but not Context-Free

D. Recursively Enumerable but not Context-Sensitive

Q28. Which of the following problems is undecidable?

A. Determining if a DFA accepts the empty string

B. Determining if a CFG generates all possible strings over its alphabet

C. Determining if an NFA accepts a finite language

D. Determining if a regular grammar is ambiguous

Q29. The minimum number of states in a DFA that accepts strings over $\{0, 1\}$ where the number of 0s is a multiple of 3 and the number of 1s is a multiple of 4 is:

A. 7

B. 12

C. 14

D. 24

Q30. Let R be a regular language and C be a context-free language. Which of the following is guaranteed to be context-free?

A. $C \setminus R$

B. $R \setminus C$

C. The complement of C

D. $C \cap C$

Q31. A Turing machine that can move its tape head left, right, or stay stationary on a step is:

A. Strictly more powerful than a standard Turing machine

B. Equivalent in power to a standard Turing machine

C. Equivalent to a Pushdown Automaton

D. Equivalent to a Linear Bounded Automaton

Q32. The pumping lemma for regular languages is primarily used to:

A. Prove a language is regular

B. Construct a DFA for a language

C. Prove a language is not regular

D. Minimize a DFA

Q33. Which of the following parsing techniques is strictly the most powerful?

A. SLR(1)

B. LALR(1)

C. LR(1)

D. LL(1)

Q34. Given the production rules $S \rightarrow aSb \mid \epsilon$, the FIRST and FOLLOW sets for S are:

A. FIRST(S) = $\{a\}$, FOLLOW(S) = $\{b, \$\}$

B. FIRST(S) = $\{a, \epsilon\}$, FOLLOW(S) = $\{b, \$\}$

C. FIRST(S) = $\{a\}$, FOLLOW(S) = $\{b\}$

D. FIRST(S) = $\{a, \epsilon\}$, FOLLOW(S) = $\{b\}$

Q35. Left factoring is a technique used to:

A. Eliminate left recursion from a grammar

B. Make a grammar suitable for top-down parsing

C. Resolve shift-reduce conflicts in bottom-up parsing

D. Optimize the intermediate code

Q36. A syntax-directed translation scheme uses only synthesized attributes. This type of attribute grammar is called:

A. L-attributed

B. S-attributed

C. Inherited

D. Y-attributed

Q37. In intermediate code generation, a three-address code uses at most how many operands?

A. 1

B. 2

C. 3

D. 4

Q38. Peephole optimization is applied to:

A. The source code

B. The syntax tree

C. The target code or intermediate code

D. The lexical analyzer

Q39. A system has 3 processes and 4 instances of a single resource type. Each process needs at most 2 instances. Is the system in a safe state?

A. Always safe and deadlock-free

B. May deadlock depending on the order of requests

C. Will definitely deadlock

D. Insufficient information to determine

Q40. In a demand paging system, the page fault rate is p. Memory access time is 100 ns, and page fault overhead is 10 ms. To keep the effective access time below 200 ns, what is the strict upper bound on p?

A. 10^{-5}

B. 10^{-4}

C. 10^{-6}

D. 10^{-7}

Q41. Which scheduling algorithm guarantees the minimum average waiting time for a given set of processes?

A. First-Come, First-Served (FCFS)

B. Shortest Job First (SJF)

C. Round Robin (RR)

D. Priority Scheduling

Q42. Belady's Anomaly is observed in which page replacement algorithm?

A. LRU

B. Optimal

C. FIFO

D. LFU

Q43. Two threads share a variable `count` initialized to 0. Thread A executes `count++` and Thread B executes `count--`. If they run concurrently without synchronization, the final value of `count` can be:

A. Only 0

B. Only 1 or -1

C. -1, 0, or 1

D. Any integer value

Q44. The bounded-buffer problem is an example of:

A. Deadlock avoidance

B. Inter-process communication and synchronization

C. Disk scheduling

D. Page replacement

Q45. A hard limit on the number of open files per process is maintained in the:

A. System-wide open-file table

B. Process-specific open-file table

C. Inode table

D. Directory structure

Q46. Let $R(A, B, C, D, E)$ be a relation schema with functional dependencies $A \rightarrow BC$, $CD \rightarrow E$, $B \rightarrow D$, and $E \rightarrow A$. What is the highest normal form of R?

A. 1NF

B. 2NF

C. 3NF

D. BCNF

Q47. In a B+ tree of order n, every non-root internal node must have at least how many children?

A. $\lceil n/2 \rceil$

B. $\lfloor n/2 \rfloor$

C. n

D. $n - 1$

Q48. Schedule S_1 contains transactions T_1 and T_2. T_1 reads X, T_2 reads X, T_1 writes X, T_2 writes X. This schedule is:

A. Conflict serializable

B. Recoverable

C. Not conflict serializable

D. Strict

Q49. Which of the following is true about a relation in Boyce-Codd Normal Form (BCNF)?

A. It may have partial dependencies.

B. Every determinant is a candidate key.

C. It is strictly less restrictive than 3NF.

D. Multi-valued dependencies are eliminated.

Q50. The ACID property "Isolation" is primarily implemented by the DBMS using:

A. Write-ahead logging

B. Concurrency control protocols

C. Shadow paging

D. Integrity constraints

Q51. In SQL, the `HAVING` clause is used to filter:

A. Rows before grouping

B. Rows after grouping

C. Columns from the result set

D. Joined tables

Q52. A subnet mask is 255.255.255.224. How many usable host IP addresses are available per subnet?

A. 32

B. 30

C. 64

D. 62

Q53. In TCP congestion control, when a timeout occurs, the congestion window (*cwnd*) size is:

A. Halved

B. Set to 1 MSS

C. Doubled

D. Left unchanged

Q54. The count-to-infinity problem is a classic issue associated with which routing protocol?

A. OSPF

B. BGP

C. RIP (Distance Vector)

D. IS-IS (Link State)

Q55. In an Ethernet network using CSMA/CD, what is the minimum frame size required for a 1 Gbps network with a maximum segment length of 1 km and signal speed of 2×10^8 m/s?

A. 512 bits

B. 1000 bits

C. 10000 bits

D. 64 bytes

Q56. Which layer of the OSI model is responsible for end-to-end encryption and data compression?

A. Application Layer

B. Presentation Layer

C. Session Layer

D. Transport Layer

Q57. In IPv6, the IP header size is fixed at:

A. 20 bytes

B. 32 bytes

C. 40 bytes

D. 60 bytes

Q58. ARP (Address Resolution Protocol) maps:

A. MAC address to IP address

B. IP address to MAC address

C. Domain name to IP address

D. IP address to Port number

Q59. If the parity bit is used for error detection, what is the Hamming distance of the code?

A. 1

B. 2

C. 3

D. 4

Q60. A Stop-and-Wait ARQ protocol operates over a link with a propagation delay of 10 ms and a bandwidth of 1 Mbps. To achieve 50% link utilization, the frame size should be approximately:

A. 10,000 bits

B. 20,000 bits

C. 5,000 bits

D. 1,000 bits

Q61. If a 3×3 real matrix A has eigenvalues 1, 2, and -1, what is the determinant of $A^2 + 2A$?

A. -3

B. 3

C. -24

D. 24

Q62. For a system of linear equations $AX = B$ where A is an $m \times n$ matrix, the system has infinitely many solutions if:

A. Rank(A) ¡ Rank([A—B])

B. Rank(A) = Rank([A—B]) = n

C. Rank(A) = Rank([A—B]) ¡ n

D. Rank(A) ¿ n

Q63. An orthogonal matrix Q satisfies which of the following conditions?

A. $Q^T = Q$

B. $Q^T Q = I$

C. $Q^2 = I$

D. $\det(Q) = 0$

Q64. Evaluate the definite integral $\int_0^{\pi/2} \frac{\sin x}{\sin x + \cos x} dx$.

A. $\pi/4$

B. $\pi/2$

C. 0

D. 1

Q65. The directional derivative of $f(x, y, z) = x^2yz^3$ at the point (1, 1, 1) in the direction of the vector $\mathbf{i} + \mathbf{j} + \mathbf{k}$ is:

A. 6

B. $6/\sqrt{3}$

C. $3/\sqrt{3}$

D. 3

Q66. Find the maxima of the function $f(x) = x^3 - 3x^2 + 4$.

A. $x = 0$

B. $x = 2$

C. $x = -1$

D. $x = 1$

Q67. The Fourier transform of a real, even function is always:

A. Real and even

B. Real and odd

C. Imaginary and even

D. Imaginary and odd

Q68. What is the Laplace transform of $e^{3t}\sin(4t)$?

A. $\frac{4}{(s-3)^2+16}$

B. $\frac{s-3}{(s-3)^2+16}$

C. $\frac{4}{(s+3)^2+16}$

D. $\frac{s}{(s-3)^2+16}$

Q69. The residue of $f(z) = \frac{1}{(z-1)(z-2)}$ at the pole $z = 1$ is:

A. 1

B. -1

C. 2

D. 0

Q70. According to Cauchy's Integral Theorem, if $f(z)$ is analytic inside and on a simple closed contour C, then $\oint_C f(z)dz$ evaluates to:

A. $2\pi i$

B. 0

C. πi

D. Infinity

Q71. What is the value of i^i where $i = \sqrt{-1}$?

A. $e^{-\pi/2}$

B. $e^{\pi/2}$

C. 1

D. -1

Q72. The convergence order of the Newton-Raphson method for finding a simple root of an equation is:

A. Linear

B. Quadratic

C. Cubic

D. Fractional

Q73. In Simpson's 1/3 rule for numerical integration, the interpolating polynomial used over each sub-interval is of degree:

A. 1

B. 2

C. 3

D. 4

Q74. If the Runge-Kutta 4th order method is used to solve a differential equation, the local truncation error is of the order:

A. $O(h^2)$

B. $O(h^3)$

C. $O(h^4)$

D. $O(h^5)$

Q75. A fair coin is tossed 10 times. What is the probability of getting exactly 5 heads?

A. 252 / 1024

B. 1 / 2

C. 120 / 1024

D. 126 / 1024

Q76. The lifetime of a lightbulb follows an exponential distribution with a mean of 1000 hours. Given that the bulb has survived for 500 hours, what is the expected additional lifetime of the bulb?

A. 500 hours

B. 1000 hours

C. 1500 hours

D. 2000 hours

Q77. In a Poisson distribution, if the variance is 4, what is the probability that $X = 0$?

A. e^{-2}

B. e^{-4}

C. $4e^{-4}$

D. 1

Q78. Matrix M is symmetric. The eigenvectors corresponding to distinct eigenvalues of M are guaranteed to be:

A. Linearly dependent

B. Orthogonal

C. Parallel

D. Zero vectors

Q79. If X and Y are independent random variables, the covariance between them, $Cov(X, Y)$, is:

A. 1

B. $E[X]E[Y]$

C. 0

D. $Var(X) + Var(Y)$

Q80. A box contains 3 red and 4 black balls. Two balls are drawn successively without replacement. What is the probability that both are red?

A. 1/7

B. 2/7

C. 3/7

D. 9/49

Q81. A tech company tracks bugs reported across 4 quarters. Q1: 150 bugs, Q2: 200 bugs, Q3: 120 bugs, Q4: 180 bugs. 60% of total bugs were resolved by year-end. How many bugs remained unresolved at the end of the year?

A. 240

B. 260

C. 390

D. 300

Q82. If the unresolved bugs from the previous question are carried over to the next year's Q1, and next year's Q1 produces 20% fewer new bugs than this year's Q1, what is the total bug backlog at the end of next year's Q1 (assuming no bugs resolved yet in the new year)?

A. 360

B. 380

C. 350

D. 400

Q83. Find the missing term in the series: 3, 7, 23, 95, ?

A. 479

B. 385

C. 412

D. 521

Q84. Look at the sequence: J14, L16, ____, P20, R22. What goes in the blank?

A. M18

B. N18

C. O18

D. N19

Q85. In a certain code language, "ALGORITHM" is coded as "KCHNTQGSL". How is "STRUCTURE" coded in that language?

A. RSTTBUTQD

B. RSSTBVTQD

C. QRSSTUTQD

D. VQRTSTBUD

Q86. If "BLACK" is coded as 11-3-1-12-2, then "WHITE" will be coded as:

A. 5-20-9-8-23

B. 23-8-9-20-5

C. 5-20-8-9-23

D. 23-9-8-20-5

Q87. Pointing to a photograph of a boy, Suresh said, "He is the son of the only son of my mother." How is Suresh related to that boy?

A. Brother

B. Uncle

C. Cousin

D. Father

Q88. A is B's sister. C is B's mother. D is C's father. E is D's mother. Then, how is A related to D?

A. Grandmother

B. Grandfather

C. Daughter

D. Granddaughter

Q89. Six people (P, Q, R, S, T, U) are sitting around a circular table facing the center. P is second to the left of Q. R is not an immediate neighbor of P or Q. T is immediately to the right of P. Who sits immediately to the left of Q?

A. S

B. U

C. T

D. Data inadequate

Q90. A cube is painted blue on all faces and then cut into 64 smaller equal-sized cubes. How many of these smaller cubes have exactly two faces painted?

A. 8

B. 16

C. 24

D. 32

Solutions

1. Answer: A
Explanation: J-K flip-flops toggle their state when both inputs are 1. Since the counter strictly counts even numbers, the second least significant bit (Q_1) alternates every single clock cycle (0,1,0,1), hence $J_1 = K_1 = 1$.

2. Answer: C
Explanation: K-map minimization gives essential prime implicants $B'C'$, $B'D'$, and $A'C'D$, each uniquely covering at least one minterm.

3. Answer: A
Explanation: A 16:1 MUX has 4 select lines. By Shannon expansion, any 5-variable Boolean function can be implemented using 4 variables as selects and the remaining variable or constants as data inputs.

4. Answer: A
Explanation: A dynamic hazard is when the output changes more than twice before settling due to unequal propagation delays along multiple paths in a multi-level circuit.

5. Answer: C
Explanation: The XOR function requires 5 NOR gates when implemented minimally using De Morgan's theorem and double inversion.

6. Answer: A
Explanation: Ripple carry adder delay $= 4 \times 5$ ns $= 20$ ns. Maximum clock frequency is $1/20$ ns $= 50$ MHz.

7. Answer: A
Explanation: Average stall penalty $= 0.2 \times 0.6 \times 2 = 0.24$. Hence CPI $= 1 + 0.24 = 1.24$.

8. Answer: A
Explanation: Cache has 256 sets (8 bits index) and 64-byte blocks (6 bits offset). Tag $= 32 - (8 + 6) = 18$ bits.

9. Answer: A
Explanation: 0xC0000000 corresponds to sign=1, exponent=128, mantissa=0, giving value -2.0.

10. Answer: C
Explanation: Expanding opcode technique reallocates unused opcodes to zero-address format, yielding 1536 instructions.

11. Answer: C
Explanation: Microprogrammed control units use microcode, making modification and debugging easier than hardwired control.

12. Answer: A
Explanation: Disk capacity $= 8 \times 1024 \times 256 \times 512 = 2^{30}$ bytes $= 1$ GB.

13. Answer: D
Explanation: Using multiple increments on the same variable within one sequence point causes undefined behavior in C.

14. Answer: A
Explanation: 7 nodes are in the left subtree and 4 nodes are in the right subtree.

15. Answer: D
Explanation: In a BST, the inorder traversal is sorted; hence preorder or postorder alone uniquely identifies the tree.

16. Answer: A
Explanation: $h(56) = 56 \bmod 11 = 1$, which is empty, so no collision occurs.

17. Answer: A
Explanation: Only two pointer updates are required in a doubly circular linked list deletion.

18. Answer: B
Explanation: Computed address $= 1000 + 4[(15 - 10) \times 11 + (25 - 20)] = 1240$.

19. Answer: B
Explanation: Minimum AVL nodes follow $N(h) = N(h-1) + N(h-2) + 1$.

20. Answer: B
Explanation: Bellman-Ford handles negative weights and detects negative cycles.

21. Answer: B
Explanation: By Master Theorem, $T(n) = \Theta(n^{\log_2 3})$.

22. Answer: D
Explanation: Optimal matrix chain multiplication cost is 36,000.

23. Answer: A
Explanation: Solving one NP-complete problem in polynomial time implies $P = NP$.

24. Answer: C
Explanation: Kraft-McMillan inequality is violated; sum exceeds 1.

25. Answer: C
Explanation: $f(n) = n/\log n$ does not fit any Master Theorem case.

26. Answer: C
Explanation: Kosaraju's algorithm uses DFS on the graph and its transpose.

27. Answer: C
Explanation: $\{a^n b^n c^n\}$ is context-sensitive, not context-free.

28. Answer: B
Explanation: Universality of CFGs is undecidable.

29. Answer: B
Explanation: Total DFA states required $= 3 \times 4 = 12$.

30. Answer: A
Explanation: $C \setminus R = C \cap R'$, which remains a CFL.

31. Answer: B
Explanation: A stationary head TM can be simulated by a standard TM.

32. Answer: C
Explanation: Pumping lemma is used only to prove non-regularity.

33. Answer: C
Explanation: LR(1) parsers avoid conflicts using full lookahead.

34. Answer: B
Explanation: FIRST(S) = {a, ϵ}, $FOLLOW(S) = \{b, \$\}$.

35. Answer: B
Explanation: $Left factoring removes ambiguity for predictive parsing.$

36. Answer: B
Explanation: $S-attributed grammars use only synthesized attributes.$

37. Answer: D
Explanation: $Three-address code uses at most four fields.$

38. Answer: C
Explanation: $Peephole optimization improves local instruction sequences.$

39. Answer: A
Explanation: $The system is in a safe state; deadlock cannot occur.$

40. Answer: A
Explanation: $Fault rate must be approximately 10^{-5}.$

41. Answer: B
Explanation: SJF minimizes average waiting time optimally.

42. Answer: C
Explanation: Belady's anomaly occurs in FIFO page replacement.

43. Answer: C
Explanation: Race condition causes outputs of -1, 0, or 1.

44. Answer: B
Explanation: Bounded-buffer problem models IPC using semaphores.

45. Answer: B
Explanation: Per-process open-file table limits files per process.

46. Answer: C
Explanation: Relation is in 3NF but not BCNF.

47. Answer: A
Explanation: B+ tree nodes must be at least half full.

48. Answer: C
Explanation: Cycle in precedence graph implies not conflict serializable.

49. Answer: B
Explanation: BCNF requires every determinant to be a superkey.

50. Answer: B
Explanation: Isolation ensures serial equivalence.

51. Answer: B
Explanation: HAVING filters groups after aggregation.

52. Answer: B
Explanation: A /27 subnet gives 30 usable IP addresses.

53. Answer: B
Explanation: Timeout resets TCP congestion window to 1 MSS.

54. Answer: C
Explanation: Count-to-infinity occurs in distance-vector routing.

55. Answer: C
Explanation: Minimum frame size required is 10,000 bits.

56. Answer: B
Explanation: Presentation layer handles encryption and compression.

57. Answer: C
Explanation: IPv6 header size is fixed at 40 bytes.

58. Answer: B
Explanation: ARP maps IP addresses to MAC addresses.

59. Answer: B
Explanation: Single parity has Hamming distance 2.

60. Answer: B
Explanation: Frame size = 20,000 bits for 50% utilization.

61. Answer: C
Explanation: Determinant = product of eigenvalues = -24.

62. Answer: C
Explanation: Rank condition gives infinitely many solutions.

63. Answer: B
Explanation: Orthogonal matrix satisfies $Q^TQ = I$.

64. Answer: A
Explanation: Integral evaluates to $\pi/4$.

65. Answer: B
Explanation: Directional derivative equals $6/\sqrt{3}$.

66. Answer: A
Explanation: Max at $x = 0$, min at $x = 2$.

67. Answer: A
Explanation: Even real signals yield real even Fourier transforms.

68. Answer: A
Explanation: Laplace transform becomes $\frac{4}{(s-3)^2+16}$.

69. Answer: B
Explanation: Residue at $z = 1$ equals -1.

70. Answer: B
Explanation: Cauchy's integral theorem gives zero integral.

71. Answer: A
Explanation: $i^i = e^{-\pi/2}$.

72. Answer: B
Explanation: Newton-Raphson converges quadratically.

73. Answer: B
Explanation: Simpson's rule uses quadratic interpolation.

74. Answer: D
Explanation: Runge-Kutta 4 has global error $O(h^4)$.

75. Answer: A
Explanation: Probability = 252/1024.

76. Answer: B
Explanation: Exponential distribution is memoryless.

77. Answer: B
Explanation: Poisson probability equals e^{-4}.

78. Answer: B
Explanation: Eigenvectors of real symmetric matrices are orthogonal.

79. Answer: C
Explanation: Independent variables have zero covariance.

80. Answer: A
Explanation: Probability equals 1/7.

81. Answer: B
Explanation: Unresolved bugs = 260.

82. Answer: B
Explanation: Total backlog next year = 380 bugs.

83. Answer: A
Explanation: Next term is 479.

84. Answer: B
Explanation: Correct term is N18.

85. Answer: B
Explanation: Correct coded form is RSSTBVTQD.

86. Answer: A
Explanation: Reversed alphabetic positions give 5-20-9-8-23.

87. Answer: D
Explanation: Suresh is the father of the boy.

88. Answer: D
Explanation: A is the granddaughter of D.

89. Answer: D
Explanation: Given data is insufficient to determine seating uniquely.

90. Answer: C
Explanation: Exactly two faces painted cubes = $12 \times 2 = 24$.