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Ph.D. Entrance Examination of COMPUTER SCIENCE AND ENGINEERING

Q1. In a B+-tree where the maximum number of keys in a node is 11, what is the minimum number of keys that any non-root node can have?

a) 4 b) 5
c) 6 d) 7

Q2. For $\Sigma = \{a, b\}$, let us consider the regular language $L = \{x \mid x = a^{2+3k}$ or $x = b^{10+12k}, k \geq 0\}$. Which one of the following can be a pumping length (the constant guaranteed by the pumping lemma) for L?

a) 9 b) 5
c) 24 d) 3

Q3. Ram and Ramesh appeared in an interview for two vacancies in the same department. The probability of Ram's selection is 1/6 and that of Ramesh is 1/8. What is the probability that only one of them will be selected?

a) 14/48 b) 1/4
c) 13/48 d) 1/6

Q4. The pumping lemma for regular languages is primarily used to:

a) Construct regular expressions
b) Minimize finite automata
c) Prove that languages are not regular
d) Convert NFA to DFA

Q5. Increasing the RAM of a computer typically improves performance because:

a) Larger RAMs are faster
b) Fewer page faults occur
c) Virtual memory increases
d) Fewer segmentation faults occur

Q6. Type-checking is normally done during:

a) Lexical Analysis b) Syntax Analysis
c) Syntax-directed translation d) Code Optimization

Q7. Which data structure in a compiler is used for managing information about variables and their attributes?

a) Abstract Syntax Tree
b) Symbol Table
c) Semantic Stack
d) Parse Table

Q8. Dispatch Latency is:

a) The time of dispatching a process from running to ready state and keeping the CPU idle
b) The time to stop one process and start running another one
c) The speed of dispatching a process from running to the ready state
d) The speed of dispatching a process from ready to the running state

Q9. Thread synchronization is required because:

a) All threads of a process share the same address space
b) All threads of a process share the same global variables
c) All threads of a process can share the same files
d) All of the mentioned

Q10. Which of the following algorithm design technique is used in the quick sort algorithm?

a) Dynamic programming
b) Backtracking
c) Divide and Conquer
d) Greedy method

Q11. If n(A) = 2 and n(B) = 3, how many relations are possible from A to B?

a) 6 b) 8
c) 64 d) 32

Q12. A specific counter is using five S-R flip-flops. So, what is the maximum number of states possible?

a) 4 b) 16
c) 32 d) 64

Q13. What type of relation is R if $R \subseteq A \times A$ and every element in A is related to itself?

a) Reflexive
b) Symmetric
c) Transitive
d) Serial

Q14. Which of the following represents a system of linear equations?

a) $x^2+y=1$ and $y-2x=3$
b) $2x+3y=5$ and $4x-y=7$
c) $x+1/y=2$ and $2y=x+3$
d) $\sin(x)+y=0$ and $2x-\cos(y)=2$

Q15. If two events A and B are independent, what is the conditional probability P(A|B)?

a) $P(A \cap B)$ b) $P(A) \cdot P(B)$
c) P(A) d) $P(A)/P(B)$

Q16. Which of the following is a key application of Bayes' Theorem?

a) Calculating the likelihood of independent events
b) Updating the probability of a hypothesis as more evidence becomes available
c) Determining the expected value of a random variable
d) Finding the union of mutually exclusive events

Q17. What is the highest Type number be applied to the following grammar
S-> Aa, A-> Ba, B-> abc

a) Type 0
b) Type 1
c) Type 2
d) Type 3

Q18. The smallest finite automaton which accepts language consisting of all strings over {a, b} that end with 'ab' contains how many states?

a) 2 b) 3
c) 4 d) 5

Q19. Give the maximum height of AVL tree with seven nodes. Assume that a tree with single node is 0

a) 5 b) 4
c) 3 d) 2

Q 20. In a compiler, the module which checks every character of the source text is called

a) Code generator
b) Code optimizer
c) Lexical analyser
d) Syntax analyser

Q21. For which one of the following reason the Internet Protocol IP use the time-to-live (TIL) field in the IP datagram header

a) To prevent packets for looping indefinitely
b) To limit the queue time in the intermediate router
c) For discarding packets that reach late
d) For discarding the packets that reach destination

Q22. Which of the following is logically equivalent to $p \rightarrow q$?

a) $\neg p \vee q$ b) $p \vee q$
c) $\neg q \rightarrow \neg p$ d) Both a and c

Q23. Which English sentence corresponds to the formula $\forall x(\text{Student}(x) \rightarrow \text{Studies}(x,\text{Math}))$?

a) Some students study math.
b) Every student studies math.
c) No student studies math.
d) Only math students exist.

Q24. The constraint that ensures referential integrity in a relational schema is:

a) CHECK constraint
b) PRIMARY KEY constraint
c) FOREIGN KEY constraint
d) UNIQUE constraint

Q25. How many distinct permutations of the word 'MATHEMATICS' exist?

a) 11! b) $\frac{11!}{2!2!2!}$
c) $\frac{11!}{2!2!2!3!}$ d) $\frac{11!}{2!2!2!2!}$

Q26. The generating function for the sequence $a_n = 3^n$ is:

a) $\frac{1}{1-3x}$ b) $\frac{x}{1-3x}$
c) $\frac{3x}{1-x}$ d) $\frac{1}{(1-x)^3}$

Q27. The number of spanning trees in a complete graph K_n is:

a) $n!$ b) n^{n-2}

c) n^{n-1} d) $(n-1)!$

Q28. Two graphs G_1 and G_2 are 'isomorphic' if:

a) They have the same number of edges and vertices

b) Their adjacency matrices are identical up to permutation

c) They are planar

d) Both (a) and (b)

Q29. In Direct Memory Access (DMA), the CPU is:

a) Fully responsible for data transfer

b) Halted until the transfer is complete

c) Bypassed during data transfer between I/O and memory

d) Responsible for initiating every transfer

Q30. Which asymptotic notation describes the upper bound of an algorithm's runtime?

a) Θ-notation b) O-notation

c) Ω-notation d) Lower bound

Q31. Which of the following algorithms is an example of a greedy approach?

a) Bellman-Ford b) Floyd–Warshall

c) Kruskal's MST d) Merge Sort

Q32. Which of the following parsers is used in most modern compilers?

a) LL(1)

b) Top-down recursive parser

c) LR parser

d) Operator-precedence parser

Syntax Directed Translation / SDD

Q33. In syntax-directed translation, attribute values are computed:

a) Before parsing

b) After code generation

c) Over the parse tree or syntax tree

d) During lexical analysis

Q34. Which IPC mechanism is best suited for sending large amounts of data between processes?

a) Signals b) Message Passing

c) Shared Memory d) Semaphores

Q35. Which of the following is used for process synchronization?

a) Fragmentation b) Paging

c) Semaphore d) Spooling

Q36. Which CPU scheduling algorithm may cause starvation?

a) FCFS

b) Round-Robin

c) SJF (Shortest Job First)

d) Priority Scheduling

Q37. The constraint that ensures referential integrity in a relational schema is:
a) CHECK constraint
b) PRIMARY KEY constraint
c) FOREIGN KEY constraint
d) UNIQUE constraint

Q38. Which of the following is a sliding-window-based flow and error control protocol?
a) Stop-and-Wait ARQ
b) Go-Back-N ARQ
c) Hamming Code
d) CRC

Q39. Which of the following is connectionless and does not guarantee ordered delivery?
a) TCP
b) UDP
c) SCTP
d) HTTP

Q40. The OS component that maintains file metadata (like size, type, and location) is:
a) Scheduler
b) File control block (FCB)
c) DMA controller
d) Bootloader

Answer key for Computer science and Engineering

Question No.	Answer Keys
1	b
2	c
3	b
4	c
5	b
6	c
7	b
8	b
9	d
10	c
11	c
12	c
13	a
14	b
15	c
16	b
17	d
18	c
19	c
20	c
21	b
22	d
23	b
24	c
25	b
26	a
27	b
28	d
29	c
30	b
31	c
32	c
33	c
34	c
35	c
36	d
37	c
38	b
39	b
40	b