

26

QUESTION PAPER
SERIES CODE
A

Registration No. :

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Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

ENTRANCE EXAMINATION, 2013

M.Phil./Ph.D. & M.Tech./Ph.D.
COMPUTER & SYSTEM SCIENCES

[Field of Study Code : COMP—SCSP (158)/MTCP (157)]

Time Allowed : 3 hours

Maximum Marks : 480
Weightage : 70

INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

- (i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.
- (ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**
- (iii) All questions are compulsory.
- (iv) Answer all the 120 questions in the Answer Sheet provided for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with **BALLPOINT PEN** only against each question in the corresponding Circle. Any overwriting or alteration will be treated as wrong answer.
- (v) Each correct answer carries 4 marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**
- (vi) Answer written by the candidates inside the Question Paper will not be evaluated.
- (vii) Calculators and Log Tables may be used.
- (viii) Pages at the end have been provided for Rough Work.
- (ix) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

INSTRUCTIONS FOR MARKING ANSWERS

- 1. Use only Blue/Black Ballpoint Pen (do not use pencil) to darken the appropriate Circle.
- 2. Please darken the whole Circle.
- 3. Darken **ONLY ONE CIRCLE** for each question as shown in example below :

Wrong	Wrong	Wrong	Wrong	Correct
<input type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)	<input checked="" type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)	<input checked="" type="radio"/> (a) <input checked="" type="radio"/> (b) <input type="radio"/> (c) <input checked="" type="radio"/> (d)	<input type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input checked="" type="radio"/> (d)	<input type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input checked="" type="radio"/> (d)

- 4. Once marked, no change in the answer is allowed.
- 5. Please do not make any stray marks on the Answer Sheet.
- 6. Please do not do any rough work on the Answer Sheet.
- 7. Mark your answer only in the appropriate space against the number corresponding to the question.
- 8. **Ensure that you have darkened the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

1. Consider a logical address space of eight pages of 1024 words each mapped onto a physical memory of 32 frames. How many bits are there in logical address and physical address respectively?
- (a) 13, 15
 - (b) 15, 13
 - (c) 10, 15
 - (d) 13, 10
2. Let L be a set accepted by a non-deterministic finite automaton. The number of states in non-deterministic finite automaton is $|S|$. The maximum number of states in equivalent deterministic finite automaton that accepts L is
- (a) $|S|$
 - (b) $2|S|$
 - (c) $2^{|S|} - 1$
 - (d) $2^{|S|}$
3. The number of real and complex roots of the polynomial $x^3 - 5x + 1 = 0$ is
- (a) 2, 2
 - (b) 3, 0
 - (c) 1, 2
 - (d) 1, 0
4. The Boolean expression $(X + Y)(X + \bar{Y})(\bar{X} + Y)$ is equivalent to
- (a) $\bar{X}Y$
 - (b) $X\bar{Y}$
 - (c) XY
 - (d) $\bar{X}\bar{Y}$

5. Which of the following is 850% greater than 8×10^3 ?
- (a) 6.4×10^4
- (b) 6.8×10^4
- (c) 7.6×10^4
- (d) 1.6×10^4
6. The number of defects found on a roll of carpet has a Poisson distribution with parameter λ . If four rolls of carpet are inspected and found to have 12, 4, 9 and 15 defects, respectively, find the maximum likelihood estimate for λ .
- (a) 10
- (b) 4
- (c) 15
- (d) 5
7. The necessary and sufficient condition on k , so that Gauss-Seidel converges for solving the systems of equations $AX = b$, where

$$A = \begin{bmatrix} 1 & 0 & k \\ 2 & 1 & 3 \\ k & 0 & 1 \end{bmatrix} \text{ and } b \text{ arbitrary, is}$$

- (a) $|k| < 2$
- (b) $|k| < 3$
- (c) Any value of k
- (d) $|k| < 1$
8. What would be the sequence of nodes in post-order traversal of a binary tree whose in-order and pre-order traversals are as under?

In-order : B D C F E A
Pre-order : A B C D E F

- (a) D E F C B A
- (b) D F E C A B
- (c) D F E C B A
- (d) D F E B C A

9. Consider the following wffs

- I. $\forall x \text{ Purple}(x) \wedge \text{Mushroom}(x) \rightarrow \text{Poisonous}(x)$
- II. $\forall x \text{ Purple}(x) \wedge (\text{Mushroom}(x) \rightarrow \text{Poisonous}(x))$
- III. $\forall x \text{ Mushroom}(x) \wedge (\text{Purple}(x) \rightarrow \text{Poisonous}(x))$

Which of the following statements is **True** ?

- (a) I and II are not equivalent
- (b) II and III are not equivalent
- (c) I, II, and III are equivalent
- (d) None of the above

10. What is the largest prime factor of 255?

- (a) 5
- (b) 17
- (c) 51
- (d) 255

11. Let (X, Y) be a bivariate random variable with joint pdf

$$f(x, y) = \frac{x^2 + y^2}{4\pi} e^{-\left(\frac{x^2 + y^2}{2}\right)}, \quad \infty < x, y < \infty$$

Compute $E[XY]$.

- (a) 0
- (b) $\frac{1}{4}$
- (c) $\frac{\pi}{4}$
- (d) None of the above

12. If P, Q and R are three atomic variables, what will be the principal disjunctive normal form for $(P \rightarrow (Q \wedge R)) \vee (\sim P \rightarrow (Q \vee R))$?

- (a) $(P \wedge Q \wedge \sim R) \vee (P \vee \sim Q \vee \sim R)$
- (b) $(\sim P \wedge Q \wedge R) \vee (\sim P \vee \sim Q \vee \sim R)$
- (c) $(P \wedge Q \wedge R) \vee (\sim P \vee \sim Q \vee \sim R) \vee (\sim P \vee Q \vee R)$
- (d) $(P \wedge Q \wedge R) \vee (\sim P \vee \sim Q \vee \sim R)$

13. In a Poisson process with parameter λ , the probability of observing an even number of events in $(0, t]$ is $\sum_{k=0}^{\infty} e^{-\lambda t} \frac{(\lambda t)^k}{k!}$, k is even. Thus P [even number in $(0, t]$ is
- (a) $1 + e^{-2\lambda t}$
- (b) $\frac{1 + e^{-2\lambda t}}{2}$
- (c) $e^{-\lambda t}$
- (d) $e^{-2\lambda t}$
14. Let R is a relational schema $R(A, B, C, D)$ and $F = \{A \rightarrow B, B \rightarrow C, C \rightarrow A\}$ is the set of functional dependencies. How many candidate keys are there?
- (a) 1
- (b) 2
- (c) 3
- (d) None of the above
15. Rohini is now three times as old as Ravi, but 5 years ago, she was 5 times as old as he was. How old is Rohini now?
- (a) 18
- (b) 24
- (c) 30
- (d) 36
16. For what value of k is the function $f(x) = \frac{1}{\sqrt{\pi}} e^{-x^2 + x - k}$, $-\infty < x < \infty$ a probability density function?
- (a) $\frac{1}{4}$
- (b) 0
- (c) 1
- (d) 2

17. The equation of the tangent to the hyperbola $4y^2 = x^2 - 1$ at the point (1, 0) is
- (a) $x = 1$
 - (b) $y = 1$
 - (c) $y = 4$
 - (d) $x = 4$
18. Given n processes to be scheduled on one processor, how many different schedules will be possible?
- (a) n
 - (b) n^2
 - (c) $n!$
 - (d) 2^n
19. Assume that an upper triangular matrix $a[0 \dots n-1, 0 \dots n-1]$ is stored in a linear array $b[0 \dots \frac{1}{2}n(n+1) - 1]$ in lexicographical order. If $a[700, 900]$ is stored in $b[0]$, where is $a[700, 900]$ stored in b array for $n = 1000$?
- (a) $b[455552]$
 - (b) $b[455550]$
 - (c) $b[455510]$
 - (d) $b[455551]$
20. If 120% of A equal to 80% of B ; which of the following is equal to $A + B$?
- (a) $1.5A$
 - (b) $2A$
 - (c) $2.5A$
 - (d) $3A$

21. If A , B and C are independent events such that $P(A) = 0.2$, $P(B) = 0.1$ and $P(C) = 0.4$, find $P(A \cup B \cup C)$.
- (a) 0.568
 - (b) 0.700
 - (c) 0.008
 - (d) 0.560
22. From a four-input OR gate the number of input conditions, that will produce HIGH output are
- (a) 0
 - (b) 1
 - (c) 8
 - (d) 15
23. Which of the following is true for the static variable in C language?
- (a) Lifetime and scope of the variable is entire program
 - (b) Scope of the variable is entire program but lifetime is the segment where variable is declared
 - (c) Lifetime of the variable is entire program but scope is the segment where variable is declared
 - (d) None of the above
24. Given a relation $R(A, B, C, D, E)$ with functional dependencies $A \rightarrow B$, $B \rightarrow C$ and $BD \rightarrow E$. Which of the following could be result of the decomposition of R into BCNF?
- (a) AB, BC, BDE
 - (b) AD, BDE, ABC
 - (c) ABD, BE, CE
 - (d) AB, ACD, BCE

25. For what value of x is $8^{2x-4} = 16^x$?
- (a) 3
 (b) 4
 (c) 6
 (d) 8
26. Let A_n be the area bounded by the curve $y = (\tan x)^n$ and the lines $x = 0$, $y = 0$ and $x = \frac{\pi}{4}$. For $n > 2$, $(A_n + A_{n-2})$ equals
- (a) $\frac{1}{2n+2}$
 (b) $\frac{1}{2n-2}$
 (c) $\frac{1}{n-1}$
 (d) None of the above
27. The orthocentre of the triangle formed by the lines $xy = 0$ and $x + y = 1$ is
- (a) $\left(\frac{1}{2}, \frac{1}{2}\right)$
 (b) $\left(\frac{1}{3}, \frac{1}{3}\right)$
 (c) $(0, 0)$
 (d) $\left(\frac{1}{4}, \frac{1}{4}\right)$
28. The minimum number of nodes in an AVL tree (height balanced binary tree) of height 11 is
- (a) 230
 (b) 233
 (c) 231
 (d) 232

- 29.** CSMA with P-persistent
- (a) sends frames immediately if the channel is idle
 - (b) sends the channel with probability p
 - (c) sends with probability p if the channel is idle
 - (d) sends with probability $1-p$ if the channel is idle
- 30.** If $x^2 - y^2 = 28$ and $x - y = 8$, what is the average of x and y ?
- (a) 1.75
 - (b) 3.5
 - (c) 7
 - (d) 10
- 31.** If X is a continuous random variable with cumulative distribution function F and density function f , define random variable $Y = X^2$. Express its cdf F_y in terms of F and f .
- (a) $F(\sqrt{Y})$
 - (b) $F(-\sqrt{Y})$
 - (c) $F(\sqrt{Y}) - F(-\sqrt{Y})$
 - (d) $F(\sqrt{Y}) + F(-\sqrt{Y})$
- 32.** What is a unicursal graph?
- (a) A connected graph with exactly two vertices of odd degree
 - (b) A connected graph with exactly two vertices of even degree
 - (c) A connected graph with all vertices of odd degree
 - (d) A connected graph with all vertices of even degree
- 33.** Maximize $(-\sum_{i=1}^n p_i \log p_i)$, $p_i \geq 0$
 subject to $\sum_{i=1}^n p_i = 1$
- (a) $2 \log n$
 - (b) $\log n$
 - (c) n
 - (d) n^2

34. Identify the correct statement(s) from the following :

- I. Let G be a group of order $2p$, where p is prime number. Then every proper subgroup of G is cyclic.
- II. Let $f(x, y, z)$ be a function such that for any real value α , $f(\alpha x, \alpha y, \alpha z) = \alpha^n f(x, y, z)$ for some n and n is a positive integer. When the function f is differentiable, then

$$x \frac{\partial f}{\partial x} + y \frac{\partial f}{\partial y} + z \frac{\partial f}{\partial z} = (n+1)f(x, y, z) \text{ is satisfied.}$$

- (a) Only I is true
- (b) Only II is true
- (c) Both I and II are true
- (d) None of the above is true

35. If the value of $\left(\frac{1}{a} + a\right)^2 = 100$, what is the value of $\frac{1}{a^2} + a^2$?

- (a) 32
- (b) 64
- (c) 98
- (d) 128

36. The round-off error to the second decimal place has the uniform distribution on the interval $(-0.05, 0.05)$. What is the probability that the absolute error in the sum of 1000 numbers is less than 2? If X_i 's are independent uniform random variables in $(-0.05, 0.05)$, we have according to central limit theorem, $P\left[\left|\sum_{i=1}^{1000} X_i\right| < 2\right]$ approximately equals to

- (a) $\Phi(2.19)$
- (b) $2\Phi(2.19)-1$
- (c) $\Phi(2.00)$
- (d) $\Phi(2.19)-\Phi(-2.19)$

$$\text{Note } \Phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^x e^{-\frac{u^2}{2}} du$$

37. The Cholesky's method for solving $AX = b$, where A is symmetric and positive definite requires
- (a) n^2 operations
 - (b) n^3 operations
 - (c) $\frac{n^3}{3}$ operations
 - (d) $\frac{n^3}{6}$ operations
38. If a file of size $n = 1000$ takes 6 sec for sorting using heap sort algorithm, then approximately how much time would it take to sort a file of size $n = 1000000000$? (Assume that all data are available in the main memory)
- (a) 18 sec
 - (b) 1800000 sec
 - (c) 18000000 sec
 - (d) 18000 sec
39. Identify the most suitable answer if $\vec{a} \times \vec{b} = \vec{a} - \vec{b}$.
- (a) $\vec{a} = \vec{b}$
 - (b) $\vec{a} \neq \vec{b}$ but \vec{a} is parallel to \vec{b}
 - (c) \vec{a} is perpendicular to \vec{b}
 - (d) None of the above
40. What is the area of a circle whose radius is the diagonal of a square whose area is 4?
- (a) 2π
 - (b) $2\pi\sqrt{2}$
 - (c) 4π
 - (d) 8π

41. Let U_1 and U_2 be two independent uniform $[0, 1]$ random numbers u_1 and u_2 . Let $X = \min(U_1, U_2)$. Find the probability density function f_x of X .
- (a) $(2 - 2x), 0 \leq x \leq 1; 0$ otherwise
 - (b) $x, 0 \leq x \leq 1; 0$ otherwise
 - (c) $1 - x, 0 \leq x \leq 1; 0$ otherwise
 - (d) $2, 0 \leq x \leq 1; 0$ otherwise

42. Consider the following Newton-Raphson like method for finding the roots of $f(x) = 0$

$$x_{n+1} = x_n - \frac{f(x_0)}{f'(x_0)}, n = 0, 1, 2, \dots$$

The order of convergence of the above method is

- (a) 1
 - (b) 2
 - (c) 1.67
 - (d) 0
43. What is the maximum number of vertices in a complete binary tree of height h ?
- (a) $2^{h+1} - 1$
 - (b) $2^h - 1$
 - (c) $2^{h+1} + 1$
 - (d) $2^h + 1$
44. Which is not the correct statement?
- (a) The class of regular sets is closed under homomorphisms
 - (b) The class of regular sets is not closed under inverse homomorphisms
 - (c) The class of regular sets is closed under quotient
 - (d) The class of regular sets is closed under substitution

45. If A is the area and C is the circumference of a circle, which of the following is an expression for A in terms of C ?

(a) $\frac{C^2}{4\pi}$

(b) $\frac{C^2}{4\pi^2}$

(c) $\frac{C^2\sqrt{\pi}}{4}$

(d) $2C^2\sqrt{\pi}$

46. X is normally distributed with mean 0 and variance 1, i.e., $X \sim N(0, 1)$. Compute $E[e^{-X}]$.

(a) e

(b) $e^{\frac{1}{2}}$

(c) $e^{\frac{3}{2}}$

(d) 1

47. The interval of stability of second-order Runge-Kutta method is

(a) $(0, \infty)$

(b) $(-2, 0)$

(c) $(-1, 0)$

(d) $(0, 2)$

48. In PUTNAM estimation model, effort is inversely proportional to the fourth power of the development time. Doubling the time schedule for a 100 person-month (PM) project would reduce the effort to

(a) 50 PM

(b) 7.16 PM

(c) 25 PM

(d) 6.25 PM

49. 15000-bit frames are transmitted over 1-Mbps channel with a delay of 6 milliseconds. Compute the maximum link utilization using stop-and-wait protocol.
- (a) 20%
 - (b) 30%
 - (c) 40%
 - (d) 60%
50. If $0 < x < 1$, which of the following lists the numbers in increasing order?
- (a) \sqrt{x}, x, x^2
 - (b) x^2, x, \sqrt{x}
 - (c) x^2, \sqrt{x}, x
 - (d) x, x^2, \sqrt{x}
51. Suppose X and Y are independent random variables, each distributed uniformly on $[0, 1]$. Calculate $P(X^2 + Y^2 \leq 1)$.
- (a) $\frac{\pi}{4}$
 - (b) $\frac{1}{\pi}$
 - (c) $\frac{1}{2\sqrt{3}}$
 - (d) $\frac{\pi}{2\sqrt{3}}$
52. To count from 0 to 1024, the number of flip-flops required is
- (a) 10
 - (b) 11
 - (c) 12
 - (d) 20

53. An array $A[1 \dots n]$ is said to be k -ordered if $A[i - k] \leq A[i] \leq A[i + k]$ for each i such that $k < i \leq n - k$. In a 2-ordered array of $2n$ elements, what is the maximum number of positions that an element can be from its position if the array were 1-ordered?
- (a) 2
 - (b) $n/2$
 - (c) $2n - 1$
 - (d) n
54. A relation $R(A, B, C, D)$ with functional dependencies $A \rightarrow B$, $A \rightarrow C$ and $C \rightarrow D$ is decomposed into $R_1(A, B, C)$ with functional dependencies $A \rightarrow B$, $A \rightarrow C$ and $R_2(C, D)$ with $C \rightarrow D$. This decomposition is
- (a) dependency preserving and lossy
 - (b) dependency preserving and lossless
 - (c) lossy and not dependency preserving
 - (d) lossless and not dependency preserving
55. Which of the following pairs of words has relationship most likely the relationship expressed between FIRE and ASHES?
- (a) EVENT : MEMORIES
 - (b) WATER : WAVES
 - (c) ACCIDENT : DELAY
 - (d) WOOD : SPLINTERS
56. Suppose there are two electrical components. The chance that the first component fails is 10%. If the first component fails, the chance that second component fails is 20%. But if the first component works, the chance that the second component fails is 5%. Calculate the probability that the second component works.
- (a) 0.980
 - (b) 0.935
 - (c) 0.125
 - (d) 0.955

57. How many different 2-digit numbers can be made from the digits 0 to 9, when repetition is not allowed?
- (a) 100
 (b) 90
 (c) 18
 (d) None of the above
58. $(\bar{P} \cup Q) \cap Q$ is equivalent to
- (a) $(P \cap Q) \cup \bar{P}$
 (b) $(\bar{P} \cap Q) \cup P$
 (c) $(P \cap \bar{Q}) \cup (P \cap Q)$
 (d) $(\bar{P} \cap Q) \cup Q$
59. To digitize a signal 256 quantization levels are used and the amplitude of the signal swings between -6 volts and +6 volts. The quantization error during digitization using uniform quantization will be
- (a) 0.135
 (b) 0.0135
 (c) 0.125
 (d) 0.0125
60. If LIBERATE is coded as 56423172, then TRIBAL will be coded as
- (a) 736415
 (b) 673451
 (c) 476315
 (d) 743615
61. The error in two-point Gauss-Legendre method is given by
- (a) $\frac{1}{135} f^{(4)}(\xi), -1 < \xi < 1$
 (b) $\frac{1}{35} f'''(\xi), -1 < \xi < 1$
 (c) $\frac{1}{240} f^{(4)}(\xi), -1 < \xi < 1$
 (d) $\frac{1}{135} f^{(5)}(\xi), -1 < \xi < 1$

62. If the parse tree of a word w generated by a Chomsky normal form grammar has no path of length greater than k , then the word w is of length
- no greater than 2^{k+1}
 - no greater than 2^k
 - no greater than 2^{k-1}
 - no greater than k
63. What is the output of the following C code segment?
- ```
#define product(a,b) a*b
main()
{
 int x=5,y=2;
 printf("%d",product(x+4,y-3));
}
```
- 10
  - 9
  - 15
  - Error
64. Find  $\lim_{n \rightarrow \infty} (\sqrt[5]{2^{5n} - 2^4} - x)$ .
- $-\frac{1}{5}$
  - $\frac{1}{5}$
  - $\frac{\pi}{4}$
  - None of the above
65. In a certain code 'QUESTION' is written as NXBVQLLQ. How is 'REPLY' written in that code?
- OBMIV
  - UHSOB
  - OHMOV
  - OFMMV

66. When implementing evolutionary prototype, parts of the system

- (a) you understand best are developed first
- (b) you understand least are developed first
- (c) which are unrelated are developed first
- (d) can be developed in any order

67. Find the space of the set of all solutions of the following homogeneous matrix equation in  $R^3$

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

- (a)  $\{(x_1, 0, 0) : x_2, x_3 \text{ in } R\}$
- (b)  $\{(0, x_2, 0) : x_2 \text{ in } R\}$
- (c)  $\{(0, 0, x_3) : x_3 \text{ in } R\}$
- (d) None of the above

68. If  $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$  is transformed by the equation  $x = r \cos \theta$  and  $y = r \sin \theta$ , what is the resultant integral?

- (a)  $\int_0^{\frac{\pi}{2}} \int_0^\infty e^{-r^2} r dr d\theta$
- (b)  $\int_0^{2\pi} \int_0^\infty e^{-r^2} dr d\theta$
- (c)  $\int_0^{\frac{\pi}{2}} \int_0^\infty e^{-r^2} \frac{r}{2} dr d\theta$
- (d)  $\int_0^{2\pi} \int_0^\infty e^{-r^2} r dr d\theta$

69. Shift-reduce parsers are

- (a) top-down parsers
- (b) bottom-up parsers
- (c) may be both top-down and bottom-up parsers
- (d) None of the above

70. A cube is colored RED on one face, GREEN on the opposite face, YELLOW on another face, and BLUE on a face adjacent to the YELLOW face. The other two faces are left uncolored. The cube is then cut into 125 smaller cubes of equal size. How many cubes are uncolored on all the faces?
- (a) 24
  - (b) 36
  - (c) 48
  - (d) 64
71. Area of the quadrilateral formed by the lines  $|x| + |y| = 1$  is
- (a) 4
  - (b) 2
  - (c) 8
  - (d) 16
72. To implement  $y = ABCD$  using only two-input NAND gates, minimum number of requirement of gates is
- (a) 3
  - (b) 4
  - (c) 5
  - (d) 6
73. If a vector  $\vec{r}$  makes an angle  $\alpha$ ,  $\beta$  and  $\gamma$  with the positive sides of the X, Y and Z axis respectively, then the value of  $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma$  is equal to
- (a) 0
  - (b) 1
  - (c) -1
  - (d) 2

74. C++ does not support virtual constructor because

- I. It needs the information about the exact type of the object it is creating
- II. A constructor is different from ordinary functions
- III. Constructor interacts with memory management routines
- IV. Constructor always needs a pointer to itself

Which one of the following is correct?

- (a) I and II only
- (b) I, II and III only
- (c) I, II and IV only
- (d) All of the above

75. Which of the following is not a leap year?

- (a) 1896
- (b) 1900
- (c) 1904
- (d) 1980

76. While performing unit testing, it is found that a maximum of 90% of the code is tested successfully with a probability of 0.9 for a given set of data. The reliability of the module is

- (a) greater than 0.9
- (b) equal to 0.9
- (c) at most 0.81
- (d) at least  $\frac{1}{0.81}$

77. What is the order of operations required in deadlock safety algorithm that is used to detect the safe sequence of the processes? Assume  $m$  the number of resources and  $n$  the number of processes in the system

- (a)  $m \times n$
- (b)  $m \times n^2$
- (c)  $m^2 \times n$
- (d)  $n^2$

78. Consider the periodic function  $f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos nx + b_n \sin nx)$  where  $a_0, a_n, b_n$  are constants, identify which one of the following conditions do not apply to obtain Fourier series expansion of  $f(x)$ .
- $f(x)$  is periodic, single valued and finite
  - $f(x)$  must not be discontinuous
  - $f(x)$  is a bounded function with at most a finite number of maxima and minima within a periodic
  - The integral over one period of  $|f(x)|$  must converge
79. Let  $A$  be an  $n \times n$  real matrix with characteristic polynomial of the form  $f(x) = (x - c_1)^{d_1} \dots (x - c_k)^{d_k}$ , that is, having root  $c_j$  with multiplicity  $d_j$  and  $j = 1, 2, \dots, k$ . Then  $c_1 d_1 + c_2 d_2 + \dots + c_k d_k$  will be equal to
- determinant of  $A$
  - trace of  $A$
  - rank of  $A$
  - None of the above
80. The uncle of Neha's father is grandson of Bhushan's father. Bhushan is the only child of his father. What is the relationship of Neha with Bhushan?
- Grandfather
  - Uncle
  - Great grandfather
  - Son
81. Consider the following sequence of virtual addresses from a 460-byte program :
- 10, 11, 104, 170, 73, 309, 185, 245, 246, 434, 458, 364
- Assuming the initial frames to be empty and a page size to be 100 bytes, what will be the number of page faults in 200 bytes of physical memory with OPT page replacement algorithm?
- 8
  - 2
  - 6
  - 5

82. The solution of the differential equation  $ydx + (x + x^2y)dy = 0$  is

(a)  $-\frac{1}{xy} = c$

(b)  $-\frac{1}{xy} + \log y = c$

(c)  $\frac{1}{xy} + \log y = c$

(d)  $\log y = cx$

83. A relation  $R(A, B, C, D, E, P, G)$  with a set of functional dependencies  $\{AB \rightarrow CD, DE \rightarrow P, C \dots \rightarrow E, P \dots \rightarrow E\}$  is

(a) in BCNF

(b) in 3NF, but not in BCNF

(c) in 2NF, but not in 3NF

(d) not in 2NF

84. Consider the following statements

I. Every unitary matrix is diagonalizable

II. Every eigenvalue of a Hermitian matrix is real

III. Let  $p(\cdot)$  be the characteristic polynomial of square matrix  $A$ . This implies  $p(A) = 0$ .

Then among the statements I, II and III

(a) exactly one statement is true

(b) exactly two statements are true

(c) all the statements are true

(d) none of the statements is true

85.  $F$  is brother of  $A$ .  $C$  is daughter of  $A$ .  $K$  is sister of  $F$  and  $G$  is brother of  $C$ . Whose uncle is  $C$ ?

(a)  $K$

(b)  $F$

(c)  $G$

(d)  $A$

86. What is the output of this C code?

```
#include<stdio.h>
main()
{ int n=0, m=0;
 if (n>0)
 if (m>0) printf("True");
 else printf("False");
}
```

- (a) True
- (b) False
- (c) No output
- (d) Error

87. The quadratic form  $7x_1^2 + 10x_2^2 + 7x_3^2 - 4x_1x_2 + 2x_1x_3 - 4x_2x_3$  is

- (a) positive definite
- (b) negative definite
- (c) positive semi-definite
- (d) negative semi-definite

88. Three vectors  $\vec{A}$ ,  $\vec{B}$  and  $\vec{C}$  satisfy the relation  $\vec{A} \cdot \vec{B} = 0$  and  $\vec{A} \cdot \vec{C} = 0$ , then the vector  $\vec{A}$  is parallel to

- (a)  $\vec{B} + \vec{C}$
- (b)  $\vec{B} - \vec{C}$
- (c)  $\vec{B} \cdot \vec{C}$
- (d)  $\vec{B} \times \vec{C}$

89. Which of the following statements in the context of object-oriented system is not correct?

- (a) Abstraction and encapsulations are complementary
- (b) Polymorphism and dynamic binding go hand by hand
- (c) State change of an object defines the behavior of the object
- (d) Inheritance and abstraction are supplementary

90. If 'south-east' is called as 'north' and 'north-east' is called as 'west', in which direction the sun will rise?
- (a) North-west  
 (b) East  
 (c) West  
 (d) West-south
91. The curve described parametrically by  $x = t^2 + t + 1$ ,  $y = t^2 - t + 1$  represents
- (a) a pair of straight lines  
 (b) an ellipse  
 (c) a parabola  
 (d) a hyperbola
92. Which of the following definitions generates the same Language as  $L$ , where  $L = \{WW^R \mid W \in \{0, 1\}^*\}$ ?
- (a)  $S \rightarrow 0S1 \mid 1S0 \mid \epsilon$   
 (b)  $S \rightarrow 0S0 \mid 1S1 \mid \epsilon$   
 (c)  $S \rightarrow 0S1 \mid 1S0 \mid 0S0 \mid 1S1 \mid \epsilon$   
 (d)  $S \rightarrow 0S1 \mid 1S0 \mid 0S0 \mid 1S1$
93. The vectors  $\lambda i + j + 2k$ ,  $i + \lambda j - k$  and  $2i - j + \lambda k$  are coplanar if
- (a)  $\lambda = 2$   
 (b)  $\lambda = 1 \pm \sqrt{3}$   
 (c)  $\lambda = \sqrt{3}$   
 (d)  $\lambda = 0$
94. Let  $S = 1 - \left(\frac{1}{3}\right) + \left(\frac{1}{5}\right) - \left(\frac{1}{7}\right) + \left(\frac{1}{9}\right) \dots$ . Then  $S$  equals
- (a)  $\sqrt{\pi}$   
 (b)  $\frac{\pi}{4}$   
 (c)  $e^{-1}$   
 (d) Divergent series



95. What is the next number to come in the series 10, 13, 19, 30, 48, 75, 113?
- (a) 167
  - (b) 166
  - (c) 164
  - (d) 162
96. Cohesion refers to the degree to which the elements of a module belong together. The order of most required cohesion to least required cohesion of the following types is
- 1. coincidental
  - 2. temporal
  - 3. logical
  - 4. communicational
- (a) 4, 3, 2, 1
  - (b) 4, 2, 3, 1
  - (c) 4, 1, 2, 3
  - (d) 3, 1, 2, 4
97. What is critical section in a program?
- (a) A portion that is complicated to understand
  - (b) A portion that is difficult to execute
  - (c) A portion that is difficult to debug
  - (d) A portion in which mutually exclusive shared resources are to be used
98. A radio system uses 9600 bps channel and 120-bit long frame. Maximum throughput of ALOHA protocol using this system if ALOHA gives an efficiency of 18% will be
- (a) 12 frames/sec
  - (b) 14 frames/sec
  - (c) 80 frames/sec
  - (d) 96 frames/sec

99. The differential equation of the family of circles with fixed radius 5 units and centre on the line  $y = 2$  is

(a)  $(x - 2)\left(\frac{dy}{dx}\right)^2 = 25 - (y - 2)^2$

(b)  $(y - 2)\left(\frac{dy}{dx}\right)^2 = 25 - (y - 2)^2$

(c)  $(y - 2)^2\left(\frac{dy}{dx}\right)^2 = 25 - (y - 2)^2$

(d)  $(x - 2)^2\left(\frac{dy}{dx}\right)^2 = 25 - (y - 2)^2$

100. In a family, the age of father is three times the age of his daughter. The son's age is half of the mother's age. The wife is 9 years younger than her husband. The brother is 7 years older than his sister. What is the age of mother?

(a) 45 years

(b) 50 years

(c) 55 years

(d) 60 years

101. What is output of the following C program segment?

```
#include <stdio.h>
main()
{
 int i=5;
 i=(++i)+(++i)+(i++)+(i+1);
 printf("%d", i);
}
```

(a) 23

(b) 24

(c) 28

(d) 29

102. Let  $V$  be the vector space of all polynomial functions of degree two or less in a single variable. Let  $D$  be the differentiation operator on  $V$ . Let  $B$  be the ordered basis for  $V$  consisting of the three functions  $f_1, f_2, f_3$  defined by  $f_j(x) = x^{j-1}, j = 1, 2, 3$ . Then the matrix of  $D$  in the ordered basis  $B$  is

(a) 
$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

(b) 
$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 2 \\ 0 & 0 & 0 \end{bmatrix}$$

(c) 
$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 2 \\ 1 & 0 & 0 \end{bmatrix}$$

- (d) None of the above

103. Let  $X_1$  and  $X_2$  be independent normal random variables with mean  $\mu$  and variance  $\sigma^2$ . The mean square errors of two estimators

$$\hat{\mu}_1 = \frac{X_1 + X_2}{2} \text{ and } \hat{\mu}_2 = \frac{X_1 + X_2}{k}$$

are

(a)  $\sigma^2, \frac{\sigma^2}{k^2}$

(b)  $\frac{\sigma^2}{2}, \frac{\sigma^2}{\left(\frac{k^2}{2}\right)}$

(c)  $\sigma, \frac{\sigma}{k}$

(d)  $\sigma^2, k^2\sigma^2$

104. Collision detection is not possible in multiple access in a wireless channel because of

- (a) path loss  
 (b) noise  
 (c) interference  
 (d) attenuation

105. The number of common tangents of the circles  $x^2 + y^2 - 2x - 1 = 0$  and  $x^2 + y^2 - 2y - 7 = 0$  is
- (a) 1  
 (b) 2  
 (c) 3  
 (d) 4
106. Find the only possible solution to the problem  
 $\max xy$  subject to  $2x + y = m$
- (a)  $x = y = \frac{m}{2}$   
 (b)  $x = m, y = \frac{m}{2}$   
 (c)  $x = \frac{m}{4}, y = \frac{m}{2}$   
 (d)  $x = \frac{m}{2}, y = m$
107. The vector  $\vec{i} + \vec{j} + 3\vec{k}$  is rotated through an angle  $\theta$  and doubled in magnitude, then it becomes  $4\vec{i} + (4x - 2)\vec{j} + 2\vec{k}$ . The values of  $x$  are
- (a)  $\left\{-\frac{2}{3}, 2\right\}$   
 (b)  $\left\{\frac{1}{3}, 2\right\}$   
 (c)  $\left\{\frac{2}{3}, 0\right\}$   
 (d)  $\{2, 7\}$

**108.** Consider the following first-order predicate calculus formulas :

$$S_1 : \neg \text{smaller}(b, a)$$

$$S_2 : \text{package}(a)$$

$$S_3 : \text{package}(b)$$

$$S_4 : \text{inroom}(a, 27) \vee \text{inroom}(a, 28)$$

$$S_5 : \text{inroom}(b, 27)$$

$$S_6 : \text{package}(X) \wedge \text{package}(Y) \wedge \text{inroom}(X, 27) \wedge \text{inroom}(Y, 28) \rightarrow \text{smaller}(X, Y)$$

Applying resolution refutation, which one of the following is inferred from clauses  $S_1, \dots, S_6$ ?

- (a)  $\text{smaller}(a, b)$
- (b)  $\neg \text{package}(c)$
- (c)  $\neg \text{inroom}(a, 28)$
- (d)  $\text{inroom}(a, 27)$

**109.** The maximum frame size for a CSMA/CD network running at 1 Gbps over 1-km cable with no repeaters and a signal speed of 200000 km/sec is

- (a) 10000 bits
- (b) 5000 bits
- (c) 20000 bits
- (d) 15000 bits

**110.** The distance between the foci of the ellipse  $5x^2 + 9y^2 = 45$  is

- (a)  $2\sqrt{2}$
- (b) 4
- (c)  $4\sqrt{2}$
- (d) 2

111. Predictive parsing is possible only for

- (a) LR(k) grammar
- (b) LALR(1) grammar
- (c) LL(k) grammar
- (d) CLR(1) grammar

112. Consider the relational schema  $R(A, B, C)$  with dependencies  $A \rightarrow BC$ ,  $B \rightarrow C$ ,  $A \rightarrow B$ ,  $AB \rightarrow C$ . The canonical form for this set is

- (a)  $A \rightarrow BC$  and  $B \rightarrow C$
- (b)  $A \rightarrow BC$  and  $A \rightarrow B$
- (c)  $A \rightarrow B$  and  $B \rightarrow C$
- (d) None of the above

113.  $\int_1^8 \left( \frac{5\sqrt[3]{x^2}}{3} - \frac{2}{3\sqrt[3]{x}} \right) dx = ?$

- (a) 28
- (b) 31
- (c)  $\frac{140}{3}$
- (d)  $\frac{56}{3}$

114. Which one of the following statements is **True** ?

- (a) Production rules are the building blocks of rules-based expert systems
- (b) Bayesian networks are building blocks of semantic networks
- (c) A transition networks parser can represent an arbitrary finite state machine
- (d) PROLOG is functional language while LISP is a logic programming language

115. For a function of two variables boundary values analysis yields

- (a) 11 test cases
- (b) 9 test cases
- (c) 6 test cases
- (d) None of the above

116. Consider the following statements :

- I. Breadth-first search are performed by exploring all nodes at a given depth before proceeding to the next level.
- II. An algorithm of a depth-first search is the same as that for breadth-first except in the ordering of the nodes placed in the queue.
- III. The time complexity of breadth-first is  $O(b^d)$  and that of depth-first search is  $O(d)$ , where  $b$  is the branching factor of the search tree with goal depth  $d$ .
- IV. Hill climbing is like depth-first searching, where the most promising child is selected for expansion.

Pertaining to the truth values of the above statements, which one of the following options is **False**?

- (a) I and II
- (b) II and III
- (c) I and IV
- (d) None of the above

117. 
$$\int_{-\frac{\pi}{3}}^{\frac{\pi}{3}} \frac{\sin^3(x) + \sin(x)\cos^2(x)}{\cos^2(x)} dx = ?$$

- (a) 0
- (b)  $\frac{2\pi}{3}$
- (c)  $\frac{\pi}{3}$
- (d)  $\pi$

118. The grammar 'G1'  $S \rightarrow aSa|bSb|a|b \in$  and the grammar 'G2' is  $S \rightarrow 0s|0s1|X, X \rightarrow X0|0$ . Which is the correct statement?

- (a) G1 is ambiguous, G2 is unambiguous
- (b) G1 is unambiguous, G2 is ambiguous
- (c) Both G1 and G2 are ambiguous
- (d) Both G1 and G2 are unambiguous

119. Consider the following 8085 instructions :

|     |        |
|-----|--------|
| XRA | A      |
| MVI | B, 4AH |
| SUI | 4FH    |
| ANA | B      |
| HLT |        |

The contents of register A and B are respectively

- (a) 05, 4A
- (b) 4F, 00
- (c) B1, 4A
- (d) None of the above

120. The curve represented by  $x = a(\cosh \theta + \sinh \theta)$  and  $y = b(\cosh \theta - \sinh \theta)$  is

- (a) a hyperbola
- (b) an ellipse
- (c) a parabola
- (d) a circle

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