ENTRANCE EXAMINATION, 2014

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 : 100

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 the example below :

Wrong	Wrong	Wrong	Wrong	Correct
● ⓑ ⓒ ●	Ⓐ ⓑ ⓒ ⓓ	Ⓐ ⓑ ⓒ Ⓓ	◉ ⓑ ⓒ ●	ⓐ ⓑ ⓒ ●

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. What is the length of the longer diagonal of the parallelogram constructed on $5\bar{a}+2\bar{b}$ and $\bar{a}-3\bar{b}$ if it is given that $|\bar{a}|=2\sqrt{2}$, $|\bar{b}|=3$ and the angle between $\bar{a}$ and $\bar{b}$ is $\frac{\pi}{4}$?

(a) 15

(b) $\sqrt{115}$

(c) $\sqrt{593}$

(d) $\sqrt{369}$

2. What of the following is defined, when an object acts and reacts in terms of state changes and message passing?

(a) Identity of an object

(b) Behaviour of an object

(c) State of an object

(d) Attributes of an object

3. Which of the following is the closest in the meaning to the word 'quack'?

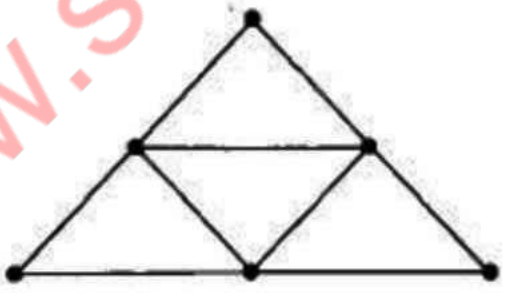
(a) Victim

(b) Dilemma

(c) Pyromaniac

(d) Charlatan

4. How many spanning trees are possible from the graph given below?



(a) 24

(b) 34

(c) 44

(d) 54

5. Five leaders from undivided India—Jawaharlal Nehru, Mahatma Gandhi, Rajendra Prasad, Subhash Chandra Bose and Sardar Patel participated during 2nd Round Table Conference in London in 1930. It was noted that Pt. Nehru sat two seats to the left of Rajendra Prasad and Mahatma Gandhi sat two seats to the right of Rajendra Prasad. If Subhash Chandra Bose didn't sit next to Gandhi, then who sat between Gandhi and Subhash Chandra Bose?

(a) Jawaharlal Nehru

(b) Rajendra Prasad

(c) Sardar Patel

(d) Not possible to determine

6. If P, Q and R are three languages, P and R are regular and $PQ = R$, then

(a) Q cannot be regular

(b) Q need not be regular

(c) Q has to be regular

(d) Q cannot be a CFL

7. Consider the following matrices

$$A=\begin{bmatrix}1 & 4\\ 4 & 1\end{bmatrix},\quad B=\begin{bmatrix}1 & -1\\ 4 & 0\end{bmatrix},\quad C=\begin{bmatrix}1 & -1\\ -1 & 4\end{bmatrix}$$

Among them

(a) only the matrix A is positive definite

(b) only the matrix B is positive definite

(c) only the matrix C is positive definite

(d) None of the above

8. What will be the size of logical address for a memory system having 32 segments of 1 K each?

(a) 5 bits

(b) 10 bits

(c) 15 bits

(d) 20 bits

9. There are three ways of going from city X to city Z, *(i)* 20 km long toll highway with toll ₹ 20 per entry, *(ii)* 10 km long tunnel with toll ₹ 40 per entry and *(iii)* two-lane toll-free highway going 30 km east to city Y and then 20 km north-west to city Z. Running cost for motorist is ₹ 2/km. Which of the following is the costliest way of going from city X to city Z?

(a) Tunnel

(b) Toll highway

(c) Toll-free highway

(d) Tunnel or toll-free highway

10. Suppose that the 1998 state of land use in a city of 50 square miles of (non-vacant) area is

(i) residential use 30%

(ii) commercial use 20%

(iii) industrial use 50%

Find the states in 2003, assuming that the transition probabilities for 5-year interval given by the matrix

$$A = \begin{bmatrix} 0{\cdot}8 & 0{\cdot}1 & 0{\cdot}1 \\ 0{\cdot}1 & 0{\cdot}7 & 0{\cdot}2 \\ 0 & 0{\cdot}1 & 0{\cdot}9 \end{bmatrix}$$

where A_{ij} defines the transition probabilities from state i to state j.

(a) (i) (26%), (ii) (20%), (iii) (54%)

(b) (i) (26%), (ii) (22%), (iii) (52%)

(c) (i) (24%), (ii) (22%), (iii) (54%)

(d) (i) (24%), (ii) (20%), (iii) (56%)

11. If an ER diagram is mapped to tables, which of the following relationships may not be mapped to tables?

(a) Whose cardinality is $1 : n$

(b) That are weak

(c) Both (a) and (b)

(d) Neither (a) nor (b)

12. What is the advantage of the chained hash table over open addressing scheme?

(a) Deletion is easier

(b) Space occupied is less

(c) Worst-case complexity of search operation is less

(d) None of the above

13. The rank of a matrix A does not change, if

(a) we change the order of the rows

(b) we multiply one of the rows by a non-zero constant

(c) we take a linear combination by adding a multiply of a row to another row

(d) All of the above

14. Which of the following words is nearly same in the meaning to the word 'convene'?

(a) Propose

(b) Question

(c) Restore

(d) Gather

15. Which of the following uses an 8B/6T encoding scheme?

(a) 100 base-T1

(b) 100 base-T4

(c) 100 base-TX

(d) 100 base-FX

16. If G is simply connected and $f : G \to C$ is an analytic function in G such that $f(z) \neq 0$ for any $z \in G$, then which of the following statements is true?

(a) There is an analytic function $f : G \to C$ such that $f(z) = \exp g(z)$

(b) There is an analytic function $f : G \to C$ such that $f(z) = \log g(z)$

(c) There is an analytic function $f : G \to C$ such that $f(z) = \sin g(z)$

(d) There is an analytic function $f : G \to C$ such that $f(z) = \cos g(z)$

17. Complete the given sentence with the most appropriate word from the given options :

Mr. Sharma —— his son for breaking the windscreen.

(a) chastised

(b) coerced

(c) expropriated

(d) relegated

18. What is the smallest number of keys that will force a B-tree of order 3 to have a height 3?

(a) 7

(b) 10

(c) 12

(d) None of the above

19. A cubic function $f(x) = (x+2)(px^2 + qx + r)$ has a relative maxima/minima at $x = -1$ and $x = \frac{1}{3}$. If $\int_{-1}^{1} f(x)dx = \frac{14}{3}$, then p equals to

(a) -5

(b) -3

(c) 0

(d) 1

20. Which of the following is not a step in object-oriented analysis using OMT?

(a) Class/Object modeling

(b) Collaborative modeling

(c) Dynamic modeling

(d) Functional modeling

21. $\int_0^{\pi/3} \cos^4 3\phi \sin^2 6\phi \, d\phi$ is equal to

(a) $\frac{\pi}{32}$

(b) $\frac{7\pi}{96}$

(c) $\frac{5\pi}{96}$

(d) None of the above

22. If yesterday was Saturday's tomorrow and tomorrow was Wednesday's yesterday, what day would it be today?

(a) Sunday

(b) Monday

(c) Tuesday

(d) Wednesday

23. A DMA controller transfers 16-bit words to memory using cycle stealing. The words are assembled from a device that transmits 8-bit characters at the rate of 2400 characters per second. The CPU is fetching and executing instructions at an average rate of 1 million instructions per second. By how much percent can the CPU be slowed down because of the DMA transfer?

(a) 0·12%

(b) 0·24%

(c) 3%

(d) 4%

24. Three different faces of a cube are colored in three different colors—black, green and blue. This cube is now cut into 216 smaller but identical cubes. What is the largest number of small cubes that have only one face colored?

(a) 64

(b) 72

(c) 84

(d) 86

25. Of the following statements, which is true about doubly linked list?

(a) It must contain a header node

(b) It may be either linear or circular

(c) It will occupy same memory space as that of a linear linked list, both having same number of nodes

(d) All of the above

26. Introducing a man, Reshma said he is the husband of the granddaughter of the father of my father. How is the man related to Reshma?

(a) Son

(b) Brother

(c) Son-in-law

(d) Brother-in-law

27. If a triangle has its orthocentre at (1, 1) and circumcentre at (3/2, 3/4) and if centroid and nine-point centre are (α, β) and (γ, δ) respectively, then the value of $6\alpha + 12\beta + 4\gamma + 8\delta$ must be

(a) 200

(b) 40

(c) 30

(d) 50

28. Which of the following is the most general phase structured grammar?

(a) Context-sensitive

(b) Context-free

(c) Regular

(d) None of the above

29. Consider a linear programming problem

Maximize $Z = 10x + 15y$

subject to

$$2x + y \leq 26$$
$$x + 2y \leq 28$$
$$y - x \leq 5$$

and $x \geq 0,\ y \geq 0$

For which values of x and y, the optimal solution is obtained?

(a) $x = 8,\ y = 10$

(b) $x = 6,\ y = 1$

(c) $x = 6,\ y = 10$

(d) $x = 8,\ y = 8$

30. Which of the properties of rapid prototyping is the most important?

(a) It determines the client's needs

(b) It can be developed rapidly

(c) It can be modified quickly

(d) The design team can gain insights

31. The maximum value of $x_1^2 + 2x_2^2 + 4x_3$

subject to $x_1 + 2x_2 + x_3 \leq 8$

and $x_1, x_2, x_3 \geq 0$

is defined as

(a) 64

(b) 46

(c) 32

(d) 8

32. C++ does not support *virtual constructor*, because

(i) it needs 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

Identify the correct combination.

(a) (i) and (ii)

(b) (i), (ii) and (iii)

(c) (i), (iii) and (iv)

(d) (i) and (iii)

33. Predictive parsers can be

(a) recursive

(b) non-recursive

(c) constructive

(d) Both (a) and (b)

34. Let $I = [0, 1]$ be the closed interval and let $f : I \to \Re$ be a real-valued function defined by

$$f(x) = \begin{cases} x, & \text{when } x \text{ is rational} \\ 1 - x, & \text{when } x \text{ is irrational} \end{cases}$$

Then the function f is continuous at

(a) uncountable number of points

(b) countable infinite number of points

(c) finite number of points

(d) None of the above

35. In C language, what is sizeof( )?

(a) Operator

(b) Function

(c) Both (a) and (b)

(d) None of the above

36. Suppose that the random variable X has a Poisson distribution with parameter 2. What will be the value of $E[X^2]$?

(a) 2

(b) 6

(c) 1

(d) 0

37. An operating system contains 3 user processes each requiring 2 units of resource R. What will be the minimum number of units of R such that no deadlocks will ever occur?

(a) 3

(b) 4

(c) 5

(d) 6

38. Consider two series whose nth terms are

(i) $\frac{n^n}{(n+1)^{n+1}}$

(ii) $\frac{(n+1)^n}{n^{n+1}}$

Identify the correct statement.

(a) Both (i) and (ii) are convergent series

(b) Only (i) is a convergent series

(c) Only (ii) is a convergent series

(d) Both (i) and (ii) are divergent series

39. Which of the methods is used for finding solutions of differential equations?

(a) Gauss-Jacobi method

(b) Gauss-Hermite method

(c) Euler method

(d) None of the above

40. There was a four-direction pole situated at a crossroad with arrows pointing towards east, west, north and south. Due to some accident, the pole was damaged and now east pointer is towards south. Unfortunately, a man wanted to go northwards took the help of this direction pole and started moving towards north. Which direction this man is actually moving towards?

(a) West

(b) North

(c) South

(d) East

41. Suppose X is a continuous random variable whose probability density function is given by

$$f(x) = \begin{cases} (4x - 2x^2), & 0 < x < 2 \\ 0, & \text{otherwise} \end{cases}$$

What is the value of $P(X > 1)$?

(a) 0·66

(b) 0·40

(c) 0·50

(d) 0·33

42. The solution of differential equation $(x - y)^2 \frac{dy}{dx} = 1$ is

(a) $y = \frac{1}{2}\log\left|\frac{x - y - 1}{x - y + 1}\right| + C$

(b) $y = \frac{1}{2}\log\left|\frac{x + y - 1}{x + y + 1}\right| + C$

(c) Both (a) and (b)

(d) None of the above

43. Consider the following two statements :

(i) The Gauss-Seidel iterative method converges for the solution of the matrix equation $Ax = b$ for any initial starting vector $x^{(0)}$ if the matrix A is strictly diagonally dominant.

(ii) The rate of convergence of Gauss-Seidel scheme is twice that of Jacobi scheme.

Identify the correct option.

(a) Both the statements are true

(b) Only statement (i) is true

(c) Only statement (ii) is true

(d) Both the statements are false

44. Which of the following is not a mode supported by JPEG?

(a) Hierarchical

(b) Network

(c) Lossless

(d) Sequential

45. A number X is chosen at random from the set {1, 2, 3, ..., n}. Let $p(n)$ denote the probability that $(X^2 - 1)$ is divisible by 10. What is the probability of $p(n)$?

(a) 0·1

(b) 0·2

(c) 0·3

(d) 0·4

46. Mrs. Saxena has six children namely *P*, *Q*, *R*, *S*, *T* and *U*. They all were born on 3rd October but each in different six consecutive year. It is also known that

(i) *P* is elder to *R*

(ii) *Q* is elder to both *S* and *T*

(iii) *U* is two years older than *S*

(iv) *P* was born either in the year 2002 or 2003

(v) the oldest child was born in the year 2000

If *U* is the eldest child, which of the following is definitely true?

(a) *Q* was born in 2002

(b) *S* was born in 2001

(c) *R* was born in 2004

(d) *P* was born in 2004

47. Testing system is made more difficult by which of the combinations of the following three characteristics of object-oriented system?

(i) Encapsulation

(ii) Inheritance

(iii) Polymorphism

(a) Both (i) and (ii)

(b) Both (ii) and (iii)

(c) Both (i) and (iii)

(d) All of the above

48. A machine needs a minimum of 100 seconds to sort 1000 names by quicksort. What is the minimum time approximately needed to sort 100 names?

(a) 50·2 seconds

(b) 6·7 seconds

(c) 11·2 seconds

(d) 35 seconds

49. $\int \frac{dx}{x^{1/2}(1+x^2)^{5/4}}$ is equal to

(a) $\frac{-2\sqrt{x}}{(1+x^2)^{1/4}} + C$

(b) $\frac{2\sqrt{x}}{(1+x^2)^{1/4}} + C$

(c) $\frac{-\sqrt{x}}{(1+x^2)^{1/4}} + C$

(d) $\frac{\sqrt{x}}{(1+x^2)^{1/4}} + C$

50. How many numbers of binary trees are possible with three nodes for which postorder traversals are *A*, *B*, *C*?

(a) 5

(b) 3

(c) 4

(d) None of the above

51. There are two married couples in a joint family of seven *A*, *B*, *C*, *D*, *E*, *F* and *G*. *G* is a housewife and her husband is a lawyer. *C* is wife of *B*, *A* is an engineer and is granddaughter of *G*, *D* is father-in-law of a doctor *C* who is also father of a professor *E*. *F* is *A*'s brother and *B*'s son. How is *F* related to *C*?

(a) Brother

(b) Son

(c) Daughter

(d) Insufficient data

52. What is the minimum number of interchanges that is required to convert the array with the elements as 89, 19, 14, 40, 17, 12, 10, 2, 5, 7, 11, 6, 9, 70 into a heap with maximum element at the root?

(a) 0

(b) 1

(c) 2

(d) 3

53. If the coefficients of the three consecutive terms in the expression of $(1+x)^n$ are in the ratio 1 : 7 : 42, what will be the value of n?

(a) 55

(b) 60

(c) 70

(d) None of the above

54. Consider a relation schema $R(A, B, C, D, E)$ with the functional dependencies $F = \{BD \rightarrow E, A \rightarrow C\}$ and the contents as

A	B	C	D	E
1	2	3	4	5
1	8	3	4	4

The decomposition of R into $R1 = (A, B, C)$ and $R2 = (D, E)$ is

(a) lossless and dependency preserving

(b) lossless and not dependency preserving

(c) lossy but dependency preserving

(d) lossy and not dependency preserving

55. Consider the differentiability of the following functions defined on $\Re$, the set of real numbers :

$$f(x) = |x| + |x+1| \text{ and } g(x) = |x| + 2x$$

Which of the following is correct?

(a) Both f and g are differentiable

(b) Only f is differentiable

(c) Only g is differentiable

(d) None of them is differentiable

56. Two processes have mutual exclusion when

(a) they do not share a resource

(b) they are disjoint and do not interact

(c) they share resource

(d) None of the above

57. What is the value of natural number n for which $I_n = \int_0^1 e^x (x-1)^n \, dx = 16 - 6e$?

(a) 2

(b) 3

(c) 4

(d) 5

58. What of the following is the use of working set model?

(a) Avoid deadlock

(b) Avoid starvation

(c) Avoid preemption

(d) Avoid thrashing

59. The vectors $\bar{a}$, $\bar{b}$ and $\bar{c}$ are of the same length and taken pairwise, form equal angles. If $\bar{a} = \hat{i} + \hat{j}$ and $\bar{b} = \hat{j} + \hat{k}$; then what is the value of $\bar{c}$?

(a) $\frac{1}{2}(\hat{i} + \hat{k})$

(b) $\hat{i} + 2\hat{j} + 3\hat{k}$

(c) $-\hat{i} + \hat{j} + 2\hat{k}$

(d) $\frac{1}{3}(-\hat{i} + 4\hat{j} - \hat{k})$

60. What is the function of the control unit in the CPU?

(a) To transfer data to primary storage

(b) To store program instruction

(c) To perform logic operations

(d) To decode program instruction

61. What are the eigenvalues of the matrix defined by the matrix given below?

$$\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$

(a) −1, −1, 8

(b) 1, −2, 0

(c) −3, −3, 5

(d) None of the above