I. K. GUJRAL PUNJAB TECHNICAL UNIVERSITY JALANDHAR

QUESTION PAPER Ph.D. ENTRANCE TEST-2024

Time: 120 Minutes **Max Marks: 100**

Discipline: Computer Science & Engineering **Sr. No.**

Name: …….. Father's Name: …….

Roll Number: …….. Roll No. in words:……..

Discipline:…… Date:……

Signature of candidate:…….. Signature of Invigilator: ……...

INSTRUCTIONS FOR CANDIDATES

1. Do not open seal before start of exam.
2. Question paper consists of two sections. Section-I is discipline specific and Section-II is of Research Methodology. Each section contains 50 multiple choice questions. Total 100 questions of one mark each.
3. Please check your question paper and answer sheet pages and report for any damaged or missing page, before attempting and report the same to invigilator immediately.
4. Carefully fill all your details in top portion of this question paper. Don't leave any column blank.
5. Use blue/black ball point pen to fill details on question paper and answer sheet. Using pencil is strictly prohibited. Write only in capital letters.
6. Carefully fill all the details and signatures on top portion of answer sheet.
7. Qualifying marks shall be 50% for General Category and 45% for Reserved Categories.
8. All questions are compulsory. No negative marking for wrong answers.
9. There are four alternative answer options (A, D, C and D) for each question out of which only one is correct.
10. Write A or B or C or D or E as answer against the question number as per correct choice on the provided Answer Sheet using pen. If the candidate does not want to attempt the Question, then he/she must mark option (E) in the available choice i.e. Not Attempted.
11. Questions left blank or attempted with two or more options/answers will not be evaluated.
12. Do not use marker or white fluid on the answer sheet.
13. The medium of the examination is English only.
14. No extra sheet will be provided for the rough work. Use the space inside the question paper pages for rough work.
15. Carrying mobile phones, calculators, electronic gadgets, notes or extra papers in examination hall is strictly prohibited.
16. Log tables may be provided for calculation work, if required.
17. Indulging in any form of unfair means, canvassing, impersonation or misbehavior with examination staff will result in disqualification of your candidature.

Do not open seal before start of exam

SECTION I (COMPUTER SCIENCE & ENGINEERING)

1. What is the cardinality of the power set of {a,b,c}?
   A) 3
   B) 6
   C) 7
   D) 8
2. 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
3. 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 $2x-\cos(y)=2$
4. If A is an n×n matrix and v is a non-zero vector, under what condition is v called an eigenvector of A?
   A) If $Av=1$
   B) If $Av=\lambda v$ for some scalar λ
   C) If $Av=0$
   D) If $Av=A\lambda$ for some scalar λ
5. $f(x)=x^2$ on the interval [1,3], at what point *c* does the Mean Value Theorem guarantee that $f'(c)$ equals the average rate of change?
   A) c=3
   B) c=2.5
   C) c=2
   D) c=1.5
6. Which of the following functions does NOT satisfy the conditions of the Mean Value Theorem on the interval [0,1]?
   A) $f(x)=|x|$
   B) $f(x)=x^2$
   C) $f(x)=e^x$
   D) $f(x)=x^3$

7. Which of the following is true about the mean and variance of a Poisson distribution?
    A) The mean is always less than the variance.
    B) The mean and variance are equal.
    C) The mean is greater than the variance.
    D) The variance is twice the mean.
8. In a normal distribution, what percentage of data falls within one standard deviation of the mean?
    A) 99.7%
    B) 95%
    C) 68%
    D) 50%
9. If two events A and B are independent, what is the conditional probability P(A|B)?
    A) P(A∩B)
    B) P(A)·P(B)
    C) P(A)
    D) P(A)/P(B)
10. 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
11. The minimum number of gates required to implement the boolean function (A+BC) if we have to use only the NOR gates is
    A) 7
    B) 6
    C) 5
    D) 4
12. The minimum number of NAND gates required to implement full adder is
    A) 4
    B) 5
    C) 9
    D) 13
13. Two NAND gates are used to make S-R latch by cross coupling. The result of S=R=0 is
    A) Q=0 and Q'=1
    B) Q=1 and Q'=0
    C) Q=1 and Q'=1
    D) Intermediate State

14. To find the 2's complement representation of the number 47 is
    A) 00101111
    B) 11010001
    C) 11010000
    D) 11101111
15. In which flip-flop, the relationship between the input (I) and the output (Q) is that Q follows I after a delay of one clock cycle.
    A) S-R flip-flop
    B) T flip-flop
    C) D flip-flop
    D) J-K flip flop
16. Which flip-flop can eliminate the indeterminate state that occurs in an SR flip-flop when both inputs are 1?
    A) D Flip-Flop
    B) JK Flip-Flop
    C) T Flip-Flop
    D) RS Flip-Flop
17. Recursive languages are
    A) Closed under intersection
    B) Recursively Enumerable
    C) Closed under complementation
    D) Open under intersection
18. What is the highest Type number be applied to the following grammar

    S-> Aa, A-> Ba, B-> abc

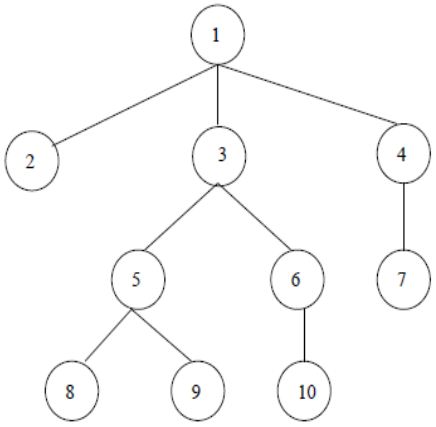
    A) Type 0
    B) Type 1
    C) Type 2
    D) Type 3
19. The smallest finite automaton which accepts language consisting of all strings over {a, b} that end with 'ab' contains how many states?
    A) 2
    B) 3
    C) 4
    D) 5
20. Consider the following grammar: $S \rightarrow ASB \mid \epsilon$

    $A \rightarrow a$

    $B \rightarrow b$

    What is the language generated by this grammar?
    A) $\{\epsilon, ab, aabb, aaabbb, \ldots\}$
    B) $\{a^n b^m \mid n, m \geq 1\}$
    C) $\{a^n b^n \mid n \geq 1\}$
    D) $\{(ab)^n \mid n \geq 1\}$

21. Which of the following statements is true about deterministic finite automata (DFA)?
    A) A DFA can have multiple transitions for the same input symbol from a given state.
    B) A DFA can have ε-transitions.
    C) A DFA has exactly one transition for each input symbol from a given state.
    D) A DFA may not have a final state.
22. Self-adjusting binary search tree is called _____
    A) Full binary tree
    B) Complete binary tree
    C) Splay tree
    D) Red black tree
23. Floyed –Warshall algorithm utilizes _____ to solve the all pairs shortest paths problem on a directed graph.
    A) Greedy algorithm
    B) Dynamic programming
    C) Recursion
    D) Linear programming
24. In a hash table two keys may hash to the same slot this is called _____
    A) Collision
    B) Conflict
    C) Direct addressing
    D) Open addressing
25. For the following tree find INORDER traversal



    A) 2 8 9 5 10 6 3 7 4
    B) 1 2 3 4 5 6 7 8 9 10
    C) 2 1 3 5 8 9 6 1 0 4 7
    D) 8 9 10 5 6 7 2 3 4 1
26. Which algorithm is used to find the all pairs shortest paths
    A) Bellman-Ford
    B) Floyd-Warshall
    C) Prim's algorithm
    D) Kruskal's algorithm

27. What will be the output of the following programme

```
int main()
{
int value1=5;
printf("%d  %d  %d   %d ", value1,++value1,value1++, value1-- );
return(0)
}
```

A) 5, 6, 6, 6
B) 5, 6, 7, 6
C) Compile time error
D) Compiler dependent

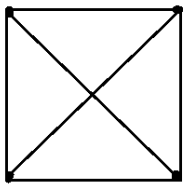
28. What will be the output of the following program?

```
typedef struct{
 int x;
 float y;
}values;
int main ()
        {
        static values var={340, 45.67501};
        printf("%2d  %.2 f", var.i, var.f);
         return (0);
        }
```

A) 340 45.68
B) 340 45.67
C) 34   45.68
D) 34 45.67

29. In the worst case, the number of comparisons needed to search a singly linked list of length n for a given element is
    A) $\log_2 n$
    B) $\log_2 n-1$
    C) n/2
    D) n
30. The data structure that checks if an arithmetic expression has balanced parenthesis
    A) Tree
    B) Linked list
    C) Stack
    D) Struc
31. 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

32. How many spanning trees are there for the graph as shown below?



A) 4
B) 8
C) 16
D) 32

33. Protocol used to find MAC address corresponding to an IP address is_____
A) ARP
B) Reverse ARP
C) DNS
D) Reverse DNS

34. 255.255.0.0 is the mask for
A) class A IP addresses
B) class B IP addresses
C) class C IP addresses
D) It is not a valid Mask

35. 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

36. Paging technique which requires all the pages of the job to be in the memory before execution is known as
A) Demand paging
B) Simple paged allocation technique
C) Swapping
D) Pure paging

37. RAID configuration of disks are used to provide
A) Fault tolerance only
B) High speed only
C) High data density
D) Faulty tolerance and high speed

38. Which of the following addressing modes are suitable for program relocation at run time?
A) Absolute addressing
B) Immediate addressing
C) Relative addressing
D) Indirect addressing

39. The maximum number of cycles needed for the execution of instruction 'add R0, R1' where register transfer interpretation for the instruction is R0←R0+R1
    A) 2
    B) 3
    C) 4
    D) 5
40. When an interrupt occurs, an operating system
    A) Ignores the interrupt
    B) Always block the interrupted process and schedules another process
    C) Always resumes the execution of interrupted process after processing current instruction
    D) May change the state of interrupted process to 'blocked' and schedules another process
41. Contents of a register after the execution of the following 8085 microprocessor program is

    MVI A, 65H
    MVI C, 15H
    ADD C
    DAA
    A) 7AH
    B) 80H
    C) 70H
    D) 8AH
42. Which scheduling policy is the most suitable for time shared operating systems
    A) Shortest job first
    B) Round robin first
    C) First come first serve
    D) First come first serve
43. A processor needs software interrupt to
    A) Test the interrupt system of the processor
    B) Implement the co-routines
    C) Obtain system services that need execution of the privileged instructions
    D) Return from subroutines
44. Which of the following strategies helps avoid both deadlock and starvation in the Dining Philosophers Problem?
    A) Introduce a random waiting period before picking up a fork.
    B) Limit the number of philosophers that can sit at the table at a time.
    C) Allow philosophers to pick up their right fork first, then their left.
    D) Allow a philosopher to pick up both forks only when both are available.
45. Which of the concurrency control protocols ensure both conflict serializability and freedom from deadlock?
    A) Two phase locking
    B) Timestamp ordering
    C) Two phase locking and timestamp
    D) Timestamp re-ordering

46. In static allocation, names are bound to storage at what time
    A) Compile time
    B) Runtime time
    C) Debugging time
    D) Either at compile or run time
47. 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
48. In SQL _____ operator is used to display records if any of the given conditions is true.
    A) OR
    B) AND
    C) XOR
    D) NOT
49. Which of the following suffices to convert an arbitrary CFG to an LL(1) grammar?
    A) Removing left recursion alone
    B) Factoring the grammar alone
    C) Removing left recursion and factoring the grammar
    D) Eliminate common suffixes
50. Which one of the following is a top–down parser?
    A) LR(k) parser
    B) LALR (R) parser
    C) Operator precedence parser
    D) Recursive descent parser

SECTION II (RESEARCH METHODOLOGY)

51. Research is underpinned by:

A) A framework of philosophy

B) Methods that have been tested for validity and reliability

C) Ethical frameworks

D) All of the above

52. Which of the following is not a characteristic or requirement for the research process?

A) Controlled.

B) Empirical.

C) Radical.

D) Critical

53. Which option is least related to a qualitative research

A) Open

B) Unstructured

C) Flexible

D) Numerical

54. Which option is not associated with a quantitative approach?

A) Rigid

B) Narrative

C) Predetermined

D) Structured

55. In _____ the main purpose is to formulate a problem for more precise investigation

A) Descriptive Study

B) Diagnostic Study

C) Exploratory Study

D) None of the above

56. _____ prevent a researcher from blind research and intellectual wandering

A) Research Design

B) Research Tools

C) Data

D) Sample

57. Date related to geophysical characteristic is called

A) Organizational Data

B) Demographic Data

C) Territorial Data

D) Personal Data

58. The aggregate of all the units pertaining to a study is called

A) Frame

B) Sample

C) Unit

D) Population

59, A statistical measure based upon the entire population is called parameter while measure based upon the sample is called

A) Sample Parameter

B) Inference

C) Statistic

D) None of the above

60. Survey study aims at

i) Knowing Facts about the two existing situations

ii) Comparing the present status with the standard norms

iii) Criticizing the existing situation

iv) Identifying the means of improving the existing situation

A) i) and ii) only

B) i), ii) and iii) only

C) i), ii), iii) and iv)

D) ii) and iii) only

61. The independent variable refers to

A) A variable which serves as the aim of an experiment

B) The variable being manipulated or varied in some way by the researcher

C) The variable which is only used in the control condition

D) The variable which shows us the effect of the manipulation

62. Which of the following statements is correct?

A) Variability is the source of the problem

B) Researcher must possess analytical ability

C) Objectives of the research are stated in the first chapter of the thesis

D) All the above

63. In the process of conducting research "Formulation of Hypothesis" is followed by

A) Analysis of data

B) Collection of data

C) Statement of objectives

D) Selection of research tools

64. If in a research independent variable cannot be manipulated then it is known as

A) Experimental research

B) Non-experimental research

C) Pure or fundamental research

D) Exploratory research

65. If a researcher is studying the effect of using laptops in his classroom to ascertain their merit and worth; he is likely conducting which of the following types of research?

A) Experimental

B) Applied

C) Basic

D) Evaluation

66. A measure is reliable if it provides consistent _____

A) Hypothesis

B) Results

C) Procedure

D) Sensitivity

67. "Officers in my organization have higher than average level of commitment" such a hypothesis is an example of

A) Descriptive hypothesis

B) Directional hypothesis

C) Relational hypothesis

D) All of the above

68. Formulation of hypothesis may not be necessary in

A) Survey studies

B) Fact finding (historical) studies

C) Experimental studies

D) Normative studies

69. …… is concerned with discovering and testing certain variables with respect to their association or disassociation

A) Exploratory

B) Descriptive

C) Diagnostic

D) Descriptive and diagnostic

70. The main objective of …….. study's to acquire knowledge

A) Exploratory

B) Descriptive

C) Diagnostic

D) Descriptive and Diagnostic

71. A statement of the quantitative research question should:

A) Extend the statement of purpose by specifying exactly the question (s the researcher will address

B) Help the research in selecting appropriate participants, research methods, measures, and materials

C) Specify the variables of interest

D) All the above

72. A _____ is a subset of a _____.

A) Sample, population

B) Population, sample

C) Statistic, parameter

D) Parameter, statistic

73. A good hypothesis should be

A) Precise, specific and consistent with known facts

B) Formulated in such a way that it can be tested by the data

C) Limited scope and should not have global significance

D) All of these

74. Which of the following is true regarding research objectives?

A) Research objectives, when achieved, will provide sufficient earnings to obtain a reasonable return on investment.

B) Research objectives, when obtained, will ensure the viability of the marketing research department.

C) Research objectives, when achieved, provide the information necessary to solve the problem.

D) Research objectives are seldom achieved but should be stated as goals to be sought.

75. Your colleague is confused about using the marketing research process, as he knows that something is wrong but is not sure of the specific causes to investigate. He seems to be having problems with _____, which is often the hardest step to take.

A) Developing the research plan

B) Determining a research approach

C) Defining the problem and research objectives

D) Selecting a research agency

76. What is the primary goal of data visualization?

A) To collect more data

B) To represent data accurately

C) To make data more accessible and understandable

D) To hide data from the audience

77. Which of the following is NOT a common visual element used in data visualization?

A) Bar chart

B) Line chart

C) Data table

D) Pie chart

78. Which type of data visualization is best suited for showing the distribution of a single numerical variable?

A) Bar chart

B) Line chart

C) Scatter plot

D) Pie chart

79. Which data visualization is commonly used to show the relationship between two numerical variables?

A) Bar chart

B) Line chart

C) Scatter plot

D) Pie chart

80. What is the purpose of “legend” in data visualization?

A) Explain the meaning of colours or symbols in a chart

B) Provides data context

C) Represent the main context

D) Adds decorative elements

81. What type of chart is useful for showing trends or changes over time?

A) Pie chart

B) Column chart

C) Line chart

D) Dot graph

82. If the mean of five observations is 20, and one of them is 24, what is the mean of the remaining four observations?

A) 16

B) 18

C) 20

D) 22

83. The sum of deviations of a set of observations from their mean is always:

A) Zero

B) Negative

C) Positive

D) Undefined

84. The value which occurs most frequently in a set of observations is called:

A) Mean

B) Mode

C) Median

D) None of the above

85. The formula to find the median of a set of observations is:

A) $\frac{(n+1)}{2}$

B) $\frac{(n-1)}{2}$

C) $\frac{n}{2}$

D) None of the above

86. The interquartile range is defined as the difference between:

A) The third and first quartiles

B) The maximum and minimum values

C) The mean and median

D) The second and third quartiles

87. The coefficient of variation is the ratio of the standard deviation to the:

A) Arithmetic mean

B) Geometric mean

C) Harmonic mean

D) Median

88. The range of a data set is:

A) The difference between the largest and smallest values in the set

B) The sum of all the values in the set

C) The product of all the values in the set

D) None of the above

89. If the mode of a data set is 10, and the mean is 15, what can be said about the shape of the distribution?

A) Skewed left

B) Skewed right

C) Symmetrical

D) Cannot be determined

90. The abscissa of the point of intersection of the less than type and of the more than type cumulative frequency of a grouped data gives its:

A) Mean

B) Median

C) Mode

D) All of these

91. If the mean of first n natural numbers is 5n/9, then n =?

A) 6

B) 7

C) 9

D) 10

92. If 35 is removed from the data, 30, 34, 35, 36, 37, 38, 39, 40 then the median increases by:

A) 2

B) 1.5

C) 1

D) 0.5

93. The Median when it is given that mode and mean are 8 and 9 respectively, is:

A) 8.57

B) 8.67

C) 8.97

D) 9.24

94. There are lottery tickets labelled with numbers from 1 to 500. I want to find the number which is most common in lottery tickets. What quantity do I need to use?

A) Mode

B) Mean

C) Median

D) None of the above

95. Which of the following is not a measure of central tendency?

A) Mode

B) Range

C) Median

D) Mean

96. The mean of 4 numbers is 37. The mean of the smallest three of them is 34. If the range of data is 15, what is the mean of largest three?

A) 41

B) 38

C) 40

D) 39

97. Which of the following can not be determined graphically?

A) Mean

B) Median

C) Mode

D) None of these

98. The median of set of 9 distinct observations is 20.5. If each of the largest 4 observations of the set is increased by 2, then the median of the new set

A) is increased by 2

B) is decreased by 2

C) is two times of the original number

D) Remains the same as that of the original set.

99. Let $a, b \in R$. Let the mean and variance of 6 observations -3, 4, 7, -6, a, b be 2 and 23, respectively. The mean deviation about the mean of these 6 observations is:

A) 13/3

B) 16/3

C) 11/3

D) 14/3

100. If mean of 25, 29, 25, 32, 24 and x is 27, then what will be the median?

A) 32

B) 27

C) 26

D) 25