SECTION I [APPLIED SCIENCE (MATHEMATICS)]

1. If a sequence of real number has a cluster points, then
   A) It is convergent
   B) It is divergent
   C) Limit exist
   D) Existence of limit is not definite

2. The sequence $\left\{\cos\left(\frac{1}{2}\tan^{-1}\left(-\frac{n}{2}\right)^{n}\right)\right\}$ is
   A) Monotone and convergent
   B) Monotone but not convergent
   C) Convergent but not monotone
   D) Neither monotone nor convergent

3. The series $\sum_{n=1}^{\infty}\frac{n^2}{3^n}$ is
   A) Divergent
   B) Convergent
   C) Unbounded
   D) None of these

4. For a continuous function $f: R \to R$ let $Z(f) = \{x \in R: f(x) = 0\}$. Then $Z(f)$ is always
   A) Compact
   B) Open
   C) Connected
   D) Closed

5. An example of a function on the real line that is continuous but not uniformly continuous
   A) Constant function
   B) Identity function
   C) $\sin x$
   D) x^2

6. The set $X = R$ with the metric $d(x, y) = \frac{|x-y|}{1+|x-y|}$ is
   A) Bounded but not compact
   B) Bounded but not complete
   C) Complete but not bounded
   D) Compact but not complete

7. The metric space X is compact, then
   A) It is sequentially compact
   B) It is not sequentially compact
   C) It does not satisfies Bolzano Weierstrass
   D) None of these

8. If f is an absolutely continuous function on $[a, b]$, then
   A) f is of bounded variation
   B) f is not of bounded variation
   C) f is not continuous
   D) None of these

9. If T is a linear transformation from vector space V onto W and $\dim V = \dim W$, then
   A) T is singular
   B) T is non-singular
   C) T is zero transformation
   D) None of these

10. If the constant term in the characteristic polynomial of a square matrix is other than zero, then the matrix is
   A) Necessarily singular
   B) Always non-singular
   C) Cannot say
   D) Data insufficient

11. Let A be a 5×5 matrix with real entries, then A has
   A) An eigenvalue which is purely imaginary
   B) At least one real eigenvalue
   C) At least two eigenvalues which are not real
   D) At least two distinct real eigenvalues

12. The orthogonal complement of finite dimensional inner product space V is
   A) Zero subspace
   B) V itself
   C) Any subspace
   D) None of these

13. The minimum possible value of $|z|^2 + |z - 3|^2 + |z - 6i|^2$, where z is a complex number and $i = \sqrt{-1}$, is
   A) 15
   B) 45
   C) 30
   D) 20

14. A bounded harmonic function in the unit disc centered at origin and taking the value $\sin 2\theta$ on the boundary is
   A) $r^2 \sin 2\theta$
   B) $r \sin 2\theta$

C) $\frac{1}{r}\sin 2\theta$

D) $\frac{1}{r^2}\sin 2\theta$

15. Consider $S = \{f | f : C \to C, f(z)\ and\ \overline{f(z)}\ both\ are\ analytic\}$. Than
    A) Cardinality S = finite
    B) Cardinality S = zero
    C) Cardinality S = infinite
    D) Cardinality S = 1

16. If $f(z)$ is an entire function and $u(x,y) = Re\ f(z)$ is bounded in C, then
    A) $f(z)$ is constant
    B) Only $u(x,y)$ is constant
    C) $u(x,y)$ is not constant
    D) None of these

17. The residue of $f(z)$ at $z = 2$, where $f(z) = \frac{e^{-z}}{(z-2)^4}$, is
    A) $\frac{1}{6}$
    B) $\frac{e^2}{6}$
    C) $-\frac{1}{6e^2}$
    D) $\frac{1}{6e^2}$

18. Let $f: G_1 \to G_2$ be a group homomorphism and $O(G_1) = 20, O(G_2) = 25$, then possible order for Kernel of f is
    A) 1
    B) 2
    C) 3
    D) 4

19. Pick out the true statements:
    A) Every group of order 36 is abelian.
    B) A group, in which every element is of order at most 2, is abelian.
    C) Every group of order 36 is non abelian.
    D) None of the above.

20. Let H_1, H_2 be two distinct subgroups of a finite group G, each of order 2. Let H be the smallest subgroup containing $H_1\ and\ H_2$, then the order of H is
    A) Always 2
    B) Always 4
    C) Always 8
    D) None of the above

21. For the ideal $I = \langle x^2 + 1 \rangle$ of $Z[x]$, which of the following is true?
    A) I is a maximal ideal but not a prime ideal
    B) I is a prime ideal but not a maximal ideal
    C) I is neither a prime ideal nor a maximal ideal
    D) I is both prime and maximal ideal

22. There exist zero-divisors in
    A) The ring of integers modulo a prime p
    B) The ring of real matrices of order p
    C) The ring of polynomials and a field of characteristic p
    D) The ring of entire functions

23. Let G denote the group of all the automorphisms of the field $F_{3^{100}}$ that consists of 3^{100} elements. Then the numbers of distinct subgroups of G is equal to
    A) 4
    B) 3
    C) 100
    D) 9

24. Let $(X, \mathcal{T})$ be a topological space. Which of the following statements is correct regarding connectedness?
    A) If a set is disconnected, its complement in X is connected.
    B) All singleton sets in $(X, \mathcal{T})$ are connected.
    C) The union of two connected sets is always connected.
    D) The intersection of two connected sets is always connected.

25. The basis $\mathcal{B}$ of a set X generates a discrete topology on X, if it contains all elements as…….
    A) Singletons
    B) Sets with 2 elements
    C) Sets with 3 elements
    D) The set X

26. The initial value problem $x\frac{dx}{dy} = y + x^2, x > 0; y(0) = 0$, has
    A) Infinitely many solutions
    B) Exactly two solutions
    C) A unique solution
    D) No solution

27. Which of the following functions is a solution of the Fredholm type equation
$$f(x) = x + \int_0^1 [xt\, f(t)]\, dt \text{ ?}$$
    A) $\frac{2x}{3}$
    B) $\frac{3x}{2}$
    C) $\frac{3x}{4}$
    D) $\frac{4x}{3}$

28. Consider the boundary value problem

$$u_{xx} + u_{yy} = 0, \quad x \in (0,\pi), y \in (0,\pi),$$
$$u(x,0) = u(x,\pi) = u(0,y) = 0$$

Any solution of this boundary value problem is of the form

A) $\sum_{n=1}^{\infty} a_n \sinh(nx)\sin(ny)$
B) $\sum_{n=1}^{\infty} a_n \cosh(nx)\sin(ny)$
C) $\sum_{n=1}^{\infty} a_n \sinh(nx)\cos(ny)$
D) $\sum_{n=1}^{\infty} a_n \cosh(nx)\cos(ny)$

29. Consider the wave equation

$$\frac{\partial^2 u}{\partial t^2} = 4\frac{\partial^2 u}{\partial x^2}, \quad 0 < x < \pi, \quad t > 0 \ with$$
$$u(0,t) = u(\pi,t) = 0, u(x,0) = \sin x \quad and$$
$$\frac{\partial u}{\partial t} = 0 \ \ at \ \ t = 0. \quad Then\, u\left(\frac{\pi}{2},\frac{\pi}{2}\right) \ is$$

A) 2
B) 1
C) 0
D) -1

30. The double root of the equation $x^3 - x^2 - x - 1$

A) 1.0001
B) 1.0032
C) 1.0091
D) 1.0010

31. If $f(x) = 2x^3 - 4x^2 + 3x + 1$ then the value of $\Delta^3 f(x)$ is

A) 6
B) 12
C) 24
D) 36

32. Consider the I.V.P. $y' = y^{\frac{1}{5}}$, $y(0)$ and S be the set of all solutions of the above I.V.P. then choose incorrect

A) Cardinality of set S is 2
B) S is a finite set
C) S is countable set
D) S is uncountable set

33. The integral equation $y(x) = 1 + k\int_0^{\pi/2} \cos(x-t)\, y(t)\, dt$ has

A) A unique solution for $k \neq \frac{4}{\pi+2}$

B) A unique solution for $k \neq \frac{4}{\pi-2}$

C) No solution for $k = \frac{4}{\pi+2}$, but the corresponding homogenous equation has non trivial solution

D) No solution for $k = \frac{4}{\pi-2}$, but the corresponding homogenous equation has non trivial solution

34. Extremal for the variational problem $I[y(x)] = \int_a^{x^2} (e^{-x}y'^2 - e^x y^2)\ dx$ satisfies the differential equation.

A) $y^2 + y' + e^{2x}y = 0$

B) $y^2 - y' + e^{2x}y = 0$

C) $y^2 + y' + e^{x}y = 0$

D) $y^2 - y' + e^{x}y = 0$

35. Which of the following is correct

A) The number of the degree of the freedom of two particle (connected by a light rod of length L) system in a vertical plane where one of the particles is constrained to move horizontally is two.

B) The number of degree of freedom of a door swinging on its hinges is three.

C) The number of independent generalized coordinates needed to specify the simple pendulum moving in a vertical plane is two.

D) The number of scalar equations needed to determine the motion of a unconstrained N particle system in N.

36. Consider $J[y] = \int_0^1 [(y')^2 + 2y]dx$ subject to $y(0) = 0, y(1) = 1$. Then $\inf J[y]$ is

A) $\frac{23}{12}$

B) $\frac{21}{24}$

C) $\frac{18}{25}$

D) Does not exist

37. Linear combination of solution of an ordinary differential equation are also solution, if the differential equation is

A) Linear, non homogenous

B) Linear, homogenous

C) Non-Linear, homogenous

D) Non-Linear, non homogenous

38. Consider the system of differential equations

$$\frac{dx}{dt} = 2x - 7y$$
$$\frac{dy}{dt} = 3x - 8y$$

Then the critical point $(0,0)$ of the system is an

A) Asymptotical stable mode
B) Unstable node
C) Asymptotical stable spiral
D) Unstable spiral

39. Let $X_1, X_2, \ldots$ ..be i.i.d. random variables with uniform distribution on the interval $[0,1]$. Let $Y_{n,k}$ denote the kth order statistic based on the sample $X_1 \ldots \ldots X_n$ (e.g.$Y_{n,1} = \min\{X_1, \ldots X_n\}$.What is the probability that $Y_{21,7} = Y_{22,7}$?
A) $\frac{1}{2}$
B) $\frac{2}{3}$
C) $\frac{7}{11}$
D) $\frac{15}{22}$

40. A newly developed algorithm for random number generation need to be tested. The first step is to check whether the sequence of numbers generated can be considered a random sample from the uniform distribution on the interval $(0,1)$. Which of the following is an appropriate nonparametric test?
A) Wilcoxon signed rank test
B) Sign test
C) Paired t test
D) Kolmogorov-Smirnov test

41. Consider M/M/1queueing system with traffic intensity$\rho < 1$. The probability of having n customers in the system at the steady state is given by
A) ρ^n
B) $\rho(1-\rho^n)$
C) $\rho^{n-1}(1-\rho)$
D) $\rho^n(1-\rho)$

42. Consider a BIBD (Balanced Incomplete Block Design) with v treatments in b blocks, each of which has k plots. Let r denote the number of blocks in which each treatment occurs. Let λ be the number of blocks in which each pair of treatment occurs. Which of the following statements is necessarily true?
A) $vb = rk$
B) $vr = bk$
C) $r(b-1) = \lambda(k-1)$
D) $r(v-1) = \lambda(b-1)$

43. Let $X_1, X_2, \ldots X_{16}$ be a random sample from normal distribution with unknown mean μ and variance 4. Suppose $\sim N(0,1)$. For the most powerful test for testing $H_0: \mu = 3$ vs $H_1: \mu = 0$ which one of the following is the p -value where the observed sample mean is 2.5
A) $p(Z > 1)$
B) $p(Z > -1)$

C) $p(Z > 0.5)$
D) $p(Z > 0.5)$

44. Suppose $(x_1, y_1), (x_2, y_2), \ldots\ldots (x_n, y_n)$ are bivariate measurements where > 2 . Assume that all the x_i are distinct and all the y_i are distinct too. Let r_p denote the ordinary (Pearson) correlation coefficient and r_s denote the (Spearman) rank correlation coefficient. Suppose $r_p = 1$. Which of the following is true?
A) $0.5 < r_s < 1$
B) $r_s = 0.5$
C) $r_s = 1$
D) $r_s = -1$

45. Suppose that Y has Exponential distribution with mean μ and that the conditional distribution of X given $Y = y$ is Normal with mean 0 and variance , for all $y > 0$. Identity the characteristic function of X (defined as $(t) = E[e^{itx}]$) from the following.
A) $e^{\mu t^2/2}$
B) $e^{t^2/2\mu}$
C) $1/(1 + \frac{\mu t^2}{2})$
D) $\mu/(\mu + \frac{\mu t^2}{2})$

46. What is the optimal solution for the following LPP

$$\max z = 4x + 5y$$
$$s.t. \quad 2x + 3y \leq 14$$
$$x + 2y \leq 9$$
$$x + y \leq 6$$
$$x, y \geq 0$$

A) 24
B) 26
C) 27
D) 35

47. Consider the random sample{3,6,9} of size 3 from a normal distribution with mean m ε $(-\infty, 5]$ and variance 1.Then the maximum likelihood estimate of mean m is
A) 6
B) 5
C) 3
D) 9

48. If f(x) is a probability density on the real line, then which of the following is not a valid Probability density

A) $f(x+1)$
B) $f(2x)$
C) $2f(2x-1)$
D) $3x^2 f(x^3)$

49. Let $X_1, X_2, \ldots \ldots X_n$ be I.I.D. with the common PFD $f(x|t) = \frac{t}{x^{t+1}}$, for $x > 1$ where $t > 1$ is an unknown Parameter. Which of the following estimators of t are consistent?

A) $\frac{1}{n}\sum_{i=1}^{n} X_i$
B) $\frac{1}{n}\sum_{1}^{n} \log(X_i)$
C) $\frac{n}{\sum_{i=1}^{n} X_i}$
D) $\frac{n}{\sum_{i=1}^{n} \log(X_i)}$

50. Let $\{Xn : n \geq 0\}$be a two state Markov chain with state space $\{0,1\}$ and transition matrix $P = \begin{bmatrix} 1/2 & 1/2 \\ 1/3 & 2/3 \end{bmatrix}$ Assuming $X_0 = 0$ the expected return time to 0 is

A) 5/3
B) 9/4
C) 3/2
D) 3

SECTION II (RESEARCH METHODOLOGY)

51. Research is
   A) Producing available knowledge again and again
   B) Finding solution to any problem
   C) Working in a scientific way to search for truth of any problem.
   D) None of the above

52. Computed measure of how much scores vary around the mean score.
   A) range
   B) standard deviation
   C) normal curve
   D) skewed distribution

53. Which of the following statements is true?
   A) The mean is a continuous variable.
   B) The variance and standard deviation of a normal population are equal.
   C) For large samples, the distribution of scores is approximately normal.
   D) None of the above

54.Taking someone else's words or ideas and taking credit for them as your own.
   A) cite
   B) plagiarism
   C) paraphrase
   D) credit

55. What steps are involved in a central tendency test?
   A) Addition, subtraction, and division.
   B) Determination of mean, median, and mode.
   C) Addition, subtraction, multiplication, and division.
   D) None of the above

56. Random sampling is also called _____.
   A) Availability sampling
   B) Probation sampling
   C) Probability sampling
   D) Prospect sampling

57. What is the Median of the following data sample?
   2, 7, 4, 8, 9, 10, 6, 12, 13
   A) 8
   B) 11
   C) 9
   D) 10

58. Which of the following statements is CORRECT?
   A) Research is a hurried activity.
   B) Research starts with a problem and ends with a problem.
   C) Research is not a contributing factor of progress.
   D) Research is an investigation where you look for answers that are already there.

59. Which of the following has same mean median and mode?

A) 6,5,2,4,3,4,1
B) 4,2,2,1,3,2,3
C) 2,3,7,3,8,3,2
D) 4,3,4,3,4,6,4

60. Resource libraries, economic census, trade shows & associations would be examples of what kind of data sources?

A) Tertiary
B) Secondary
C) Primary
D) Unprofessional

61. The purpose of correlation research is to:

A) study the relationship between two or more than two variables
B) predict the criterion variable on the basis of predictor variable
C) Both (1) and (ii)
D) Neither (i) Nor(ii)

62. It is sometimes called “central location” or just “center”. It is a way to describe what’s typical for a set of data. It is called.

A) Middle destination
B) Center fold
C) Central Tendency
D) Mid frequency

63. Which is NOT a step of the scientific method?

A) Hypothesis
B) Analyse data
C) Count items
D) Report Findings

64. In order to pursue the research, which of the following is priorly required?

A) Developing a research design
B) Formulating a research question
C) Deciding about the data analysis procedure
D) Formulating a research hypothesis

65. Every person in the population has an equal chance of being selected -which sampling method

A) Systematic sampling
B) Quota sampling
C) Volunteer sampling
D) Random sampling

66. When a distribution of scores is skewed, which of the following is the most representative measure of central tendency?

A) Inference
B) Standard deviation
C) Mean
D) Median

67. An even spread of a variable that is symmetrical about the mean median and mode.

A) bar graph
B) histogram
C) scatter graph
D) normal distribution

68. A diagram with rectangles showing values or numbers.

A) Pictogram
B) Pie chart
C) Bar chart
D) Line graph

69. Type of research that solve practical issues is;

A) Fundamental research
B) Exploratory research
C) Applied research.
D) Empirical research

70. What should not be included in the conclusion?

A) literature review
B) summary
C) implication
D) major findings

71. A variable that is being manipulated is____

A) Independent variable
B) dependent variable
C) confounding variable
D) extraneous variable

72. What is qualitative research?

A) Observation and description of activities, situations, attitudes, or behaviors of a specific group of people.
B) Analysis of numerical data.
C) Numerical comparisons and statistical inferences.
D) None of above

73. A standard deviation can never be

A) positive
B) negative
C) zero
D) None

74. The sample standard deviation is denoted by:
A) s
B) p
C) Σ
D) σ

75. First step of an investigation is _____ .
A) collection of data.
B) presentation of data.
C) analysis of data.
D) explanation of data.

76. The sum of absolute deviations about median is _____.
A) the least
B) the greatest
C) zero
D) equal

77. When the value of r=0, it is said to be _____.
A) no correlation.
B) positive.
C) perfect positive.
D) perfect negative.

78. The straight-line trend is represented by the equation _____.
A) y=a+bx
B) y=mx
C) y=ax/ay
D) y=a*bx

79. In discrete and continuous frequency distributions N= ___ .
A) the sum of frequency.
B) number of observations.
C) minimum value.
D) maximum value.

80. _____ is used to compare the variability of two or more than two series.
A) Mean.
B) Standard deviation.
C) Coefficient of variation.
D) Mean deviation.

81. The simplest device for ascertaining whether two variables are related is to prepare a dot chart is called_____ .
A) graphical method.
B) scatter diagram method.
C) method of least square.
D) concurrent deviation method.

82. A bag contains 10 black and 20 white balls; a ball is drawn at random. What is the probability that it is black?
A) 1/2
B) 1/3
C) 0
D) 3

83. Diagrams are for _____
A) the use of exports.
B) better quantitative picture.
C) better mental appeal
D) the use of imports.

84. Which of the following is not a type of research design?
A) Experimental design
B) Descriptive design
C) Correlational design
D) Probability design

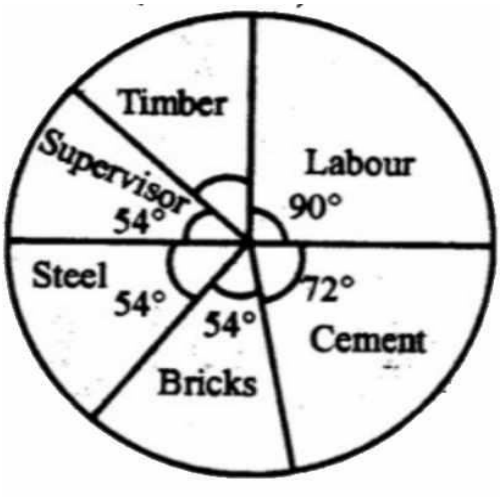
85. What is a research hypothesis?
A) A tentative explanation for a phenomenon
B) A statement that is proven to be true
C) A prediction of what the researcher expects to find
D) A statement of fact

86. What is the purpose of a pilot study?
A) To test the feasibility of the research design
B) To test the reliability and validity of the measures
C) To determine the appropriate sample size
D) To collect preliminary data

87. In five One-Day Internationals, a batsman has scored 31,97,112, 63, and 12 runs. the quality deviation of the info is-
A) 21.78
B) 23.79
C) 25.79
D) 26.77

88. Determine the mode of the decision received seven days in a row: 11,13,13,17,19,23,25
A) 11
B) 13
C) 17
D) 23

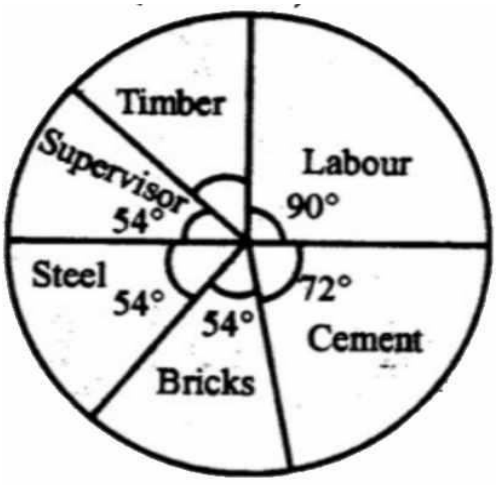
89. The following pie chart comprises the cost of constructing one house. The total cost was Rs. 6 lakhs



The amount spent on cement is

A) Rs.2,00,000
B) Rs.1,60,000
C) Rs.1,20,000
D) Rs.1,00,000

90. Referring to chart below,



the amount spent on cement, steel and supervision is what percent of the total cost of construction?

A) 40%
B) 45%
C) 50%
D) 55%

91. Table shows the mobile phones sold on different days by different sellers. Read the table carefully and answer the questions.

Mobiles Phones Sellers	Day						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
P	40	45	48	28	50	24	20
Q	90	92	27	12	16	98	26
R	80	36	30	13	28	62	47
S	60	46	12	64	52	34	76
T	48	18	58	69	70	10	15

Find the difference of mobile phones sold by P and R together on Monday to the mobile phones sold by S and T on Wednesday.

A) 60
B) 50
C) 80
D) 20

92. Referring to above table, Find the ratio of mobile phones sold by Q on Tuesday and Saturday together to the mobile phones sold by R on Thursday and Sunday together.

A) 7 : 19
B) 19 : 5
C) 19 : 6
D) 2 : 5

93. The frequency distribution of a numerical data can be graphically represented by a _____

A) Histogram
B) Telegram
C) Monogram
D) Anagram

94. Which one of the following is not the graphical representation of statistical data:

A) Bar graph
B) Histogram
C) Frequency polygon
D) Cumulative frequency distribution

95. In a histogram, each class rectangle is constructed with base as

A) frequency
B) class-intervals
C) range
D) size of the class

96. What does the command \documentclass{article} do in LaTeX?
A) It sets the document class as an article
B) It creates a new section in the document
C) It sets the font style of the document
D) It creates a new document

97. What does the command \begin{center} do in LaTeX?
A) It creates a new center-aligned section.
B) It sets the font size to center aligned.
C) It creates a new paragraph.
D) It centers the text or content.

98. Which of the following procedures would not be included in a programme of qualitative research?
A) Assessment of effect size.
B) Development of appropriate research questions.
C) Clarification of the logic linking the data to research propositions.
D) Explanation of criteria for data interpretation.

99. What is the most common method of data collection in quantitative research?
A) Interviews
B) Focus groups
C) Observation
D) Surveys/questionnaires

100. Which statistical test is used to determine if there is a significant difference between the means of two or more groups in quantitative research?
A) t-test
B) ANOVA (Analysis of Variance)
C) Chi-square test
D) Regression analysis