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QUESTION PAPER Ph.D. ENTRANCE TEST-2024

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

Discipline: Civil 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 (CIVIL ENGINEERING)

1. Consider the differential equation
   $y''+4y'+4y=0$
   Which of the following is the general solution to this differential equation?

   A. $y(t)= C_1 e^{-2t} + C_2 e^{2t}$
   B. $y(t)= C_1 e^{-2t} + C_2 te^{-2t}$
   C. $y(t)= C_1 e^{2t} + C_2 te^{2t}$
   D. $y(t)= C_1 e^{-2t} + C_2 te^{2t}$

2. A factory produces widgets that are either defective or non-defective. The probability that a widget is defective is 0.1. If a widget is defective, the probability that it fails a quality test is 0.95. If a widget is non-defective, the probability that it fails the quality test is 0.02. What is the probability that a widget is defective given that it failed the quality test?

   A. 0.095
   B. 0.32
   C. 0.83
   D. 0.95

3. A call center receives an average of 5 calls per hour. What is the probability that exactly 3 calls will be received in a given hour?

   A. 0.1404
   B. 0.2650
   C. 0.1847
   D. 0.1008

4. Consider the non-linear equation $f(x) = x^3-x-2=0$. Using the Newton-Raphson Method, which of the following is the next approximation x_1 if the initial guess x_0 is 1.5?

   A. 1.347
   B. 1.379
   C. 1.421
   D. 1.481

5. Consider the function $f(x) = e^x \cos(x)$. What is the coefficient of x^3 in the Taylor Series expansion of f(x) about x=0?

   A. 0
   B. -1/3
   C. 1/3
   D. -1/6

6. If p is the standard consistency of cement the amount of water used in condition the initial setting time test on cement is

A. 0.65p
B. 0.85p
C. 0.6p
D. 0.8p

7. Before the testing setting time of cement one should test for

A. Soundness
B. Strength
C. Fineness
D. Consistency

8. The test on cement designed to accelerate the slaking process of the ingredient of cement and to determine the resulting expansion in a short time is

A. Setting time test
B. Soundness test
C. Normal consistency test
D. Accelerated test

9. A quick- setting cement has an initial setting time of about

A. 50 minutes
B. 40 minutes
C. 15 minutes
D. 5 minutes

10. Guniting is the application of mortar

A. On a surface under pneumatic pressure
B. On a vertical surface
C. On brickwork by manual method
D. Of fluid consistency for repair works

11. The stress level, below which a material has a high probability of not falling under reversal of stress, is known as

A. Elastic limit
B. Endurance limit
C. Proportional limit
D. Tolerance limit

12. A steel wire of 20mm diameter is bent into a circular shape of 10 m radius. If the modulus of elasticity is 2*10^6 kg/cm^2, then the maximum stress induced in the wire is

A. 10^3 kg/cm^2
B. $2*10^3$ kg/cm^2
C. $4*10^3$ kg/cm^2
D. $6*10^3$ kg/cm^2

13. Parallelogram law of forces states that if two forces acting simultaneously at a point be represented in magnitude and direction by two adjacent sides of a parallelogram, their resultant may be represented in magnitude and direction by

A. Longer side of the other two sides
B. Shorter side of the other two sides
C. Diagonal of the parallelogram which does not pass through their point of intersection
D. Diagonal for parallelogram which passes through their point of intersection

14. A copper bar of 25cm length is fixed by means of supports at its ends. Supports can yield by 0.01cm. If the temperature of the bar is raised by 100^0C, then the stress induced in the bar for $\alpha_c=20x10^{-6}$ ^{o}C and $E_c=1x10^6$kg/cm^2 will be

A. $2x10^6$kg/cm^2
B. $4x10^6$kg/cm^2
C. $8x10^6$kg/cm^2
D. $16x10^6$kg/cm^2

15. A bar of 40mm diameter and 400mm length is subjected to an axial load of 100kN. It elongates by 0.150 mm and the diameter decreases by 0.005mm. What is the Poisson's ratio of the material bar?

A. 0.25
B. 0.28
C. 0.33
D. 0.37

16. A beam is made of two identical metal flats soldered together. What is the ratio of the stiffness of this beam to the stiffness of a beam in which the two flats are soldered and which acts independently?

A. 2
B. 4
C. 6
D. 8

17. Given E as the Young's modulus of elasticity of a material, what can be the minimum value of its bulk modulus of elasticity?

A. E/2
B. E/3
C. E/4
D. E/5

18. In a simply supported wooden beam under uniformly distributed load, a hole has to be made in direction of width at mid span to provide a pipeline. From structural strength point of view, it would be advisable to have the hole made at

A. The bottom
B. The top
C. Mid-depth
D. ¼ depth either from the top or the bottom

19. The distance of centroids of area above and below the equal area axis in a solid circular section from its centre (R is the radius of circular section) is

A. $4R/3\pi$
B. $4\pi/3R$
C. $3R/4\pi$
D. $3\pi/4R$

20. Out of the two beams of same material and same cross sectional area one is of circular cross section and other is of square cross –section. If these are subjected to bending moment of same magnitude, then

A. Both sections would be equally strong
B. Both sections would be equally economically
C. Square section would be more economically then circular cross section
D. Square section would be less economically then circular cross section

21. According to maximum shear stress criterion, at what ratio of maximum shear stress of material take place?

A. 2
B. $2/\sqrt{3}$
C. $1/\sqrt{3}$
D. ½

22. A timber beam is 100mm wide and 150mm deep. The beam is simply supported and carries a central concentrated load W. If the maximum stress in shear is 2 N/mm^2 what would be the corresponding load W on the beam?

A. 20kN
B. 30kN
C. 40kN
D. 25kN

23. A steel beam is replaced by a corresponding aluminium beam of same cross-sectional shape and dimensions, and is subjected to same loading. The maximum bending stress will

A. Be unaltered
B. Increase
C. Decrease
D. Vary in a proportion to their modulus of elasticity

24. The variation of the hoop stress across the thickness of a thick cylinder is

A. Linear
B. Uniform
C. Parabolic
D. Hyperbolic

25. If f_{cu} and f_y are cube compressive strength of concrete and yield stress of steel respectively and E_s is the modulus of elasticity of steel for all grades of concrete, the ultimate flexural strain in concrete can the taken as

A. 0.002
B. $f_{cu}/1000$
C. 0.0035
D. $(f_y/1.15E_s)+0.002$

26. Shrinkage deflection in case of rectangular beams and slabs can be eliminated by putting

A. Compression steel equal to tensile steel
B. Compression steel more than tensile steel
C. Compression steel less than tensile steel
D. Compression steel 25% greater than tensile steel

27. Unequal top and bottom reinforcement in a reinforced concrete section leads to

A. Creep deflection
B. Shrinkage deflection
C. Long term deflection
D. Large deflection

28. When assessing the strength of structure as per limit state of collapse, the value of partial safety factor for steel is taken as

A. 2.0
B. 1.5
C. 1.15
D. 1.00

29. In limit state design of reinforced concrete deflection is computed by using

A. Initial tangent modulus
B. Secant modulus
C. Tangent modulus
D. Short and long term value of young modulus

30. As compare to working stress method of design, the limit state method takes concrete to

A. Higher stress level
B. Lower stress level
C. The same stress level
D. Sometime higher but generally lower stress level

31. The reinforcement for tension, when required in members , shall consist of

A. Only longitudinal reinforcement in the tension face
B. Only longitudinal reinforcement in compression face
C. Only two legged closed loops enclosing the corner reinforcement
D. Both longitudinal and transverse reinforcement

32. Stress strain curve of concrete is

A. A perfect straight line upto failure
B. Straight line upto 0.002% strain value and than parabolic upto failure
C. Nearly parabolic upto 0.002% strain value and then a straight line upto failure
D. Hyperbolic upto 0.002% strain value and than a straight line upto failure

33. A doubly reinforced beam is considered less economical than singly reinforced beam because

A. Tensile steel required is more than that for a balanced section
B. Shear reinforcement is more
C. Concrete is not stressed to its full value
D. Compressive steel is under stressed

34. A steel plate is 30 cm wide and 10 mm thick. A rivet of nominal diameter 18 mm is driven. The net sectional area of the plate is

A. 18.00 cm^2
B. 28.20 cm^2
C. 28.05 cm^2
D. 32.42 cm^2

35. Which one of the following methods of design is not suitable for structure subjected to impact and fatigue?

A. Simple design
B. Semi rigid design
C. Rigid design
D. Plastic design

36. A structural member carrying a pull of 700kN is connected to a gusset plate using rivets. If the pulls required to shear the rivet, to crush the rivet and to tear the plate per pitch length are respectively 60 kN and 70 kN, then the number of rivets required will be

A. 22
B. 20
C. 18
D. 12

37. The maximum longitudinal pitch allowed in bolted joints of tension member is

A. 16 times the diameter of the bolt
B. 32 times the diameter of the bolt
C. 16 times the thickness of the plate
D. 32 times the thickness of the plate

38. The liquid limit and plastic limit of sample are 65% and 29% respectively. The percentage of the soil fraction with grain size finer than 0.002 mm is 24. The activity ratio of soil sample is

A. 0.50
B. 1.00
C. 1.50
D. 2.00

39. A soil sample is having a specific gravity of 2.6 and a void ratio 0.78. The water content in percentage required to fully saturate the soil at that void ratio would be

A. 10
B. 30
C. 50
D. 70

40. Given the plasticity index (PI) of local soil = 15 and plasticity index of sand = zero, for a desired PI of 6, the % of sand in the mix should be

A. 70
B. 60
C. 40
D. 30

41. A fill having a volume of 150000 cum is to be constructed at a void ratio of 0.8. The borrow pit soil has a void ratio of 1.4. The volume of soil required (in cubic meters) to be excavated from the borrow pit will be

A. 187500

B. 200000

C. 210000

D. 250000

42. The true length of a line is known to be 200m. When this is measured with a 20m tape, the length is 200.80m. The correct length of 20m tape is

A. 19.92m
B. 19.98m
C. 20.04m
D. 20.08m

43. In an instrument, the bubble tube with divisions of 1mm and and a radius of 0.9m has the sensitivity of

A. 1/2
B. 1/70
C. 1/90
D. 1/900

44. The bearing of line AB is 150^0 and the angle ABC is 124^0 Bearing of line BC is

A. 94^0
B. 98^0
C. 198^0
D. 90^0

45. If a descending gradient of 1 in 25 meets an ascending gradient of 1 in 40, then the length of valley curve required for a head light sight distance of 100m will be

A. 30m
B. 130m
C. 310m
D. 630m

46. The design speed of a highway is 80 kmph and radius of circular curve is 150m in plain topography. Which one of the following is the minimum length of transition curve?

A. 115m

B. 85m

C. 64m

D. 43m

47. Balanced depth of cutting of canal is

A. Half the total depth of a canal

B. Half of full supply depth

C. The maximum cut that an excavator can take

D. Where volume of cutting is equal to volume of filling

48. The least expensive and most suitable excreta disposal unit for rural areas would be

A. Soak pit

B. Pit privy

C. Leaching cesspool

D. Septic tank

49. In a canal irrigation project, 76% of the CCA remained without water during Kharif season and 58% of CCA remained without water during Rabi season in a particular year. Rest of the areas got irrigated in each crop respectively. What is the intensity of irrigation for the project in the year?

A. 134%

B. 76%

C. 66%

D. 58%

50. For an irrigated field having field capacity = 30%, permanent wilting point = 10%, permissible depletion of available moisture = 40%. Dry wt. of soil = 14.70 KN/cu.m, unit weight of water = 9.8 KN/cu.m, effective rainfall = 30mm. What is the net irrigation requirement per m depth of soil?

A. 300mm

B. 150mm

C. 120mm

D. 90mm

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