I. K. GUJRAL PUNJAB TECHNICAL UNIVERSITY JALANDHAR

QUESTION PAPER Ph.D. ENTRANCE TEST-2024

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

Discipline: Electrical 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 (ELECTRICAL ENGINEERING)

1. An inverted V-curve of a synchronous motor shows the variation of
    A) power actor and dc excitation at constant load
    B) supply voltage and field current at constant excitation
    C) power factor and supply voltage during hunting
    D) supply voltage and excitation current at constant load

2. When transformer is subjected to short circuit, the adjoining turns of the same winding experience
    A) an attractive force
    B) a repulsive force
    C) no force
    D) depends on operating point of the B-H curve

3. In an induction motor, if the air-gap is increased
    A) speed will reduce
    B) efficiency will improve
    C) power factor will be lowered
    D) breakdown torque will reduce

4. In a self excited induction generator, to keep the frequency of generated voltage constant with the increase in load, the speed of the induction machine should be
    A) increased
    B) decreased
    C) maintained less than the rated synchronous speed
    D) maintained more than the rated synchronous speed

5. Which type of motor is most suitable for a computer printer drive
    A) Reluctance motor
    B) Hysteresis motor
    C) Shaded pole motor
    D) Stepper motor

6. The stator and rotor pole number may be different in a
    A) pole changing induction motor
    B) reluctance motor
    C) repulsion motor
    D) synchronous motor

7. Armature reaction is attributed to:
    A) The effect of magnetic field set up by armature current
    B) The effect of magnetic field set up by field current
    C) Copper losses in the armature
    D) The effect of magnetic field set up by back emf
8. If the excitation and terminal voltage of a synchronous motor are kept constant and the load is increased then

    A) Armature current decreases and power factor becomes more leading

    B) Armature current increases and power factor becomes more leading

    C) Armature current increases and power factor becomes more lagging

    D) None of these

9. The full pitch coil in an alternator, has a span of 18 slots. If it is desired to eliminate the third harmonic of voltage, the coil span should be

    A) 18 slots

    B) 15 slots

    C) 12 slots

    D) 9 slots

10. An induction motor has a slip of 2% at normal voltage. The slip when developing the same torque at 10% below normal voltage is
    A) 1.65%

    B) 2.47%

    C) 2.22%

    D) 1.82%

11. A lossless line terminated with its surge impedance has a
    A) Sag of voltage at midpoint

    B) Swell of voltage at midpoint

    C) Flat voltage profile

    D) Uniform voltage dips along length of line

12. Shunt reactors are needed

A) to boost receiving end voltage under light loads

B) to boost receiving end voltage under heavy loads

C) to bring down receiving end voltage at light loads

D) to bring down receiving end voltage under heavy loads

13. The Y_{bus} of a 3-bus system is given by

$$Y_{bus}=\begin{bmatrix} -j10 & j5 & j5 \\ j5 & -j10 & j5 \\ j5 & j5 & -j10 \end{bmatrix}$$

A line of impedance *j*0.4 pu is removed. The line is connected between 1-2. What is Y_{bus} after removal?

A) $\begin{bmatrix} j12.5 & j7.5 & j5.0 \\ j7.5 & -j12.5 & j5.0 \\ j5.0 & j5.0 & -j10.0 \end{bmatrix}$

B) $\begin{bmatrix} -j7.5 & j2.5 & j5.0 \\ j2.5 & -j7.5 & j5.0 \\ j5.0 & j5 & -j10 \end{bmatrix}$

C) $\begin{bmatrix} -j10 & j7.5 & j5.0 \\ j7.5 & -j10.0 & j5.0 \\ j5.0 & j5.0 & -j10.0 \end{bmatrix}$

D) $\begin{bmatrix} -j12.5 & j2.5 & j5.0 \\ j2.5 & -j12.5 & j5.0 \\ j5.0 & j5.0 & -j10.0 \end{bmatrix}$

14. A turbine generator set has a regulation constant 5% on the generator rating of 100MVA, 50Hz.The generator frequency decreases by 0.02 Hz. The increase in turbine output power for steady state operation is steady state operation is

A) 0.8 MW

B) 8MW

C) 3.6 MW

D) 0.2 MW

15. For an arcing fault where the arc resistance is significant an impedance or admittance relay will

A) Over reach

B) Under reach

C) The reach of relay is unaffected

D) The reach will depend on the arcing resistance and may under reach or over reach.

16. The neutral of a 10 MVA, 11kV alternator is grounded through a resistance of 5Ω. The earth fault relay operates at 0.75 A. If CT ratio is 1000:5, what percentage of armature winding is protected?

A) 88.2 %

B) 11.8 %

C) 10 %

D) 100 %

17. A 3 phase 33/6.6 kV Δ-λ transformer is protected by Merz Price (differential) protection scheme. The CT's on 6.6 kV side has a ratio of 100:1. The ratio of CT on 33 kV side is

A) 20:1

B) $\frac{20}{\sqrt{3}} : \sqrt{3}$

C) $20\sqrt{3} : \frac{1}{\sqrt{3}}$

D) $20 : \sqrt{3}$

18. A transformer has a core loss of 64 W and copper loss of 144 W, when it is carrying 20% overload current. The load at which this transformer will operate at the maximum efficiency is

A) 80%

B) 66%

C) 120%

D) 44%

19. The purpose of skewing of rotor slots in induction motor is

A) To reduce magnetic hum of motor

B) To increase the distribution factor

C) To reduce the locking tendency of motor

D) To increase the breadth factor

20. A 500V, 50 Hz motor takes a full load current of 40A at 0.85 p.f lagging. If a capacitor of 80μF is connected cross the motor terminals, the p.f becomes

A) 0.72

B) 0.85

C) 0.97

D) 1.00

21. A synchro-transmitter is rotated through an angle of 45 degrees. The change in the angle is called

    A) Correspondence

    B) phase shift

    C) Signal

    D) Error

22. A feedback system has its characteristic equation as $1 + \frac{k}{s(s+1)(s+2)} = 0$

    The centroid of the asymptotes will be equal to

    A) -1

    B) -2

    C) -3

    D) -4

23. If the system specifications are given in time domain, best approach for designing is

    A) Nyquist plot

    B) Bode's plot

    C) Root locus

    D) None of these

24. A feedback control system has an open loop transfer function given by

    HG (jω) = 40/ {jω [1+j(ω/5)]}, the phase margin is

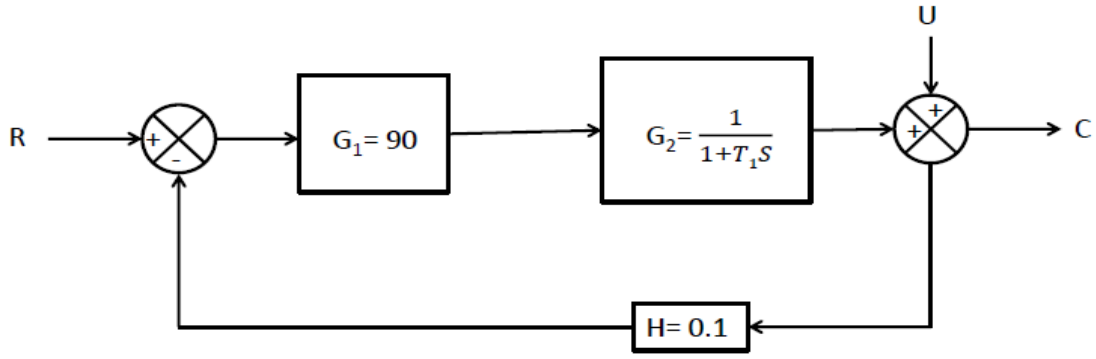
    A) 21.8 deg

    B) 43.6 deg

    C) 44 deg

    D) None of these

25. The transfer function $\frac{\mathbf{C(s)}}{\mathbf{R(s)}}$ of a closed loop system shown in the figure below will be



A) $\frac{G_1 G_2}{1 + G_1 G_2 H}$

B) $(G_1 G_2)/(1+G_1 H)$

C) $\frac{1}{1 + G_1 G_2 H}$

D) $\frac{G_1}{1 + G_2 H}$

26. The value of K for which the system $S^3 + 3S^2 + 3S + 1 + K = 0$ becomes stable is

A) K>8

B) K=8

C) K=7

D) None of these

27. The describing equation of a mass-damper spring system is given by

$$2\frac{d^2x}{dt^2} + \frac{dx}{dt} + 0.5x = f(t)$$

where *f(t)* is the external force acting on the system and *x* is the displacement of mass. The steady state displacement corresponding to a force of 2 Newton is given by

A) 4 m

B) 0.5m

C) 2 m

D) 0.25 m

28. The damped natural frequency of an under-damped second-order system is given by

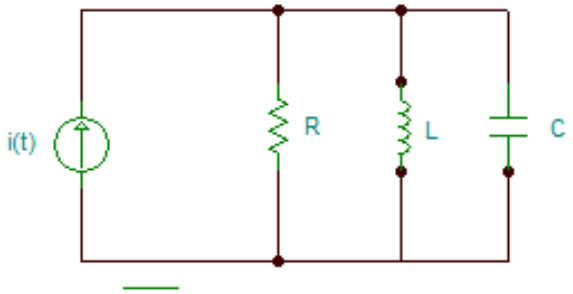
A) ω_n

B) $\xi\omega_n$

C) $\omega_n\sqrt{1-\xi^2}$

D) None of these

29. The circuit shown has i(t) = 10sin(120πt). The power (time average power) dissipated in R is (given) L= $\frac{1}{120}\pi H$, C = $\frac{1}{60}\pi H$, R = 1 ohm



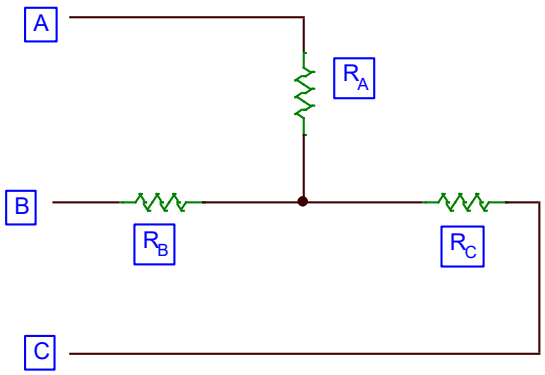
A) 25 Watts

B) 100 Watts

C) $10/\sqrt{2}$ Watts

D) 50 Watts

30. Consider the star network shown in the given figure. The resistance between terminals A and B with C open is 6Ω, between terminals B and C with A open is 11 Ω, and between terminals C and A with B open is 9 Ω. Then



A) R_A = 4 Ω, R_B = 2 Ω, R_C = 5 Ω

B) R_A=2 Ω, R_B = 4 Ω, R_C = 7Ω

C) R_A = 3 Ω, R_B = 3 Ω, R_C = 4Ω

D) R_A=5 Ω, R_B = 1 Ω, R_C = 10 Ω

31. If each branch of a Delta circuit has impedance $\sqrt{3}$ Z, then each branch of the Wye circuit has impedance

    A) Z/$\sqrt{3}$

    B) 3Z

    C) 3$\sqrt{3}$ Z

    D) Z/3

32. Laplace transform of the function *i(t)* is I(s) = $\frac{10S+4}{S(S+1)\,(S^2+4S+5)}$, its final value will be

    A) 4/5

    B) 5/4

    C) 4

    D) 5

33. About the Fourier series expansion of periodic function, it can be said that

    A) Even functions have only a constant term and cosine terms in their expansion

    B) Odd functions have only sine terms in their expansion.

    C) Functions with half-wave symmetry contain only odd harmonics

    D) All of these

34. A circuit with a resistor, inductor and capacitor in series is resonant at f_o Hz. If all the component values are now doubled, the new resonant frequency is

    A) 2 f_o

    B) still f_o

    C) $f_o/2$

    D) $f_o/4$

35. The Fourier series representation of a periodic current is [2 + 6 $\sqrt{2}$ cos ωt + $\sqrt{48}$ sin 2ωt] A. The effective value of current is

    A) (2 + 6 + $\sqrt{24}$)A

    B) 8A

    C) 6A

    D) 2A

36. In a Kelvin's double bridge, two sets of readings are taken when measuring a low resistance, one with the current in one direction and other with the direction of current reversed. This is done to eliminate the effect of

    A) Contact resistance

    B) Resistance of leads

    C) Changes in battery voltage

    D) Thermo-electric emf's

37. In an LVDT the two secondary windings are connected in differential to obtain

    A) Higher output

    B) An output voltage which is phase sensitive i.e. the output voltage has a phase which can lead us to a conclusion whether the displacement of core took place from right to left or from left to right.

    C) In order to establish the null or the reference point for the displacement of the core.

    D) Both B and C

38. Ratio of the readings of two watt meters connected to measure power in a balanced 3- phase load is 5:3 and the total load is inductive. The power factor of load is

    A) 0.917 lead

    B) 0.917 lag

    C) 0.6 lead

    D) 0.6 lag

39. A PMMC type ammeter and a MI type ammeter are connected in series in a resistive circuit fed from output of a half wave rectifier voltage source. If the moving iron type instrument read 5A, the PMMC type instrument is likely to read

    A) 0

    B) 2.5A

    C) 3.18A

    D) 5A

40. A 10 bit A/D converter is used to digitize an analog signal in the 0 to 5 V range. The maximum peak to ripple voltage that can allowed in the D.C. supply voltage is

    A) nearly 100 mV

    B) nearly 50 mV

    C) nearly 25 mV

    D) nearly 5.0 mV

41. The digital multiplexer is basically a combinational logic circuit to perform the operation

    A) AND-AND

    B) OR-OR

    C) AND-OR

    D) OR-AND

42. In a 8085 microprocessor, the following sequence of instructions is executed:

```
STC
CMC
MOVE A,B
RAL
MOVE B,A
```

After the last instruction, the output will

A) rotate the contents of the accumulator and store it in B

B) get the contents of B register into the accumulator and rotate it to left by one bit

C) double contents of B register

D) manipulate carry in A and B

43. A memory system has a total of 8 memory chips, each with 12 address lines and 8 data lines. Total size of the memory system is

A) 6 kbytes

B) 32 kbytes

C) 48 kbytes

D) 64 kbytes

44. A single-phase half wave controlled rectifier has 400 sin314 *t* as the input voltage and R as the load. For the firing angle of 60^0 for the SCR, the average output voltage is

A) $\frac{400}{\pi}$

B) $\frac{300}{\pi}$

C) $\frac{240}{\pi}$

D) $\frac{200}{\pi}$

45. When a line commutated converter operates in the inverter mode

A) it draws both real and reactive power of the A.C. supply

B) it delivers both real and reactive power to the A.C. supply

C) it delivers real power to the A.C. supply

D) it draws reactive power from the A.C. supply

46. An ideal chopper is operating at a frequency of 500 Hz from a 60 V battery input. It is supplying a load having 3Ω resistance and 9mH inductance. Assuming the load is shunted by a perfect commutating diode and assuming battery is lossless, what is the mean load current at an on/off ratio of 1/1?

A) 10 A

B) 15 A

C) 20 A

D) None of these

47. Double integration of unit step function would lead to

    A) An impulse

    B) A parabola

    C) A ramp

    D) A doublet

48. Maxwell's divergence equation for the magnetic field is given by

    A) ∇ X B = 0

    B) ∇ . B = 0

    C) ∇ X B = ρ

    D) ∇ . B = ρ

49. The probability of getting a number between 1 and 100 which is divisible by one and itself only is

    A) 27/185

    B) 23/97

    C) 25/98

    D) none of these

50. The convergence of which of the following method is sensitive to starting value?

    A) False position

    B) Gauss Seidal method

    C) Newton-Raphson method

    D) All of these

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