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QUESTION PAPER Ph.D. ENTRANCE TEST-2024

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

Discipline: Mechanical 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 (MECHANICAL ENGINEERING)

1. A material obeys hook's law up to
   A. Plastic limit
   B. Elastic limit
   C. Yield point
   D. Limit of proportionality

2. Principal planes are planes having
   A. Maximum shear stress
   B. No shear stress
   C. Minimum shear stress
   D. None of the above

3. A hollow shaft of same cross-section area as compared to a solid shaft transmit
   A. Same torque
   B. Less torque
   C. More torque
   D. Unpredictable

4. Strain energy is the
   A. Energy stored in a body when strained within elastic limits
   B. Energy stored in a body when strained up to the breaking of a specimen
   C. Maximum strain energy which can be stored in a body
   D. Proof resilience per unit volume of a material

5. A composite bar made up of steel and copper bars of equal lengths are heated through 100°C. The stresses developed shall be
   A. Tensile in both the material
   B. Tensile in steel and compressive in copper
   C. Compressive in steel and tensile in copper
   D. Compressive in both the materials

6. Impact strength of a material is an index of its
   A. Toughness
   B. Tensile strength
   C. Capability of being cold worked
   D. Hardness

7. Strain is defined as the ratio of
   A. Change in volume to original volume
   B. Change in length to original length
   C. Change in cross-sectional area to original cross-sectional area
   D. Any one of the above

8. Longitudinal stress in a thin cylinder is
   A. Equal to the hoop stress
   B. Twice the hoop stress
   C. Half of the hoop stress
   D. One fourth of hoop stress

9. A cycle consisting of _____and two isothermal processes is known as Stirling cycle.
   A. Two isentropic
   B. One constant pressure, one constant volume
   C. Two constant volumes
   D. Two constant pressures

10. The main cause for the irreversibility is
   A. Unrestricted expansion
   B. Mechanical and fluid friction
   C. Heat transfer with a finite temperature difference
   D. All of the above

11. A closed system is one in which
   A. Mass does not cross boundaries of the system, though energy may do so
   B. Mass crosses the boundary but not the energy
   C. Neither mass nor energy crosses the boundaries of the system
   D. Both energy and mass cross the boundaries of the system

12. Intensive property of a system is one whose value
   A. Depends on the mass of the system, like volume
   B. Does not depend on the mass of the system, like temperature, pressure, etc.
   C. Is not dependent on the path followed but on the state
   D. Is dependent on the path followed and not on the state

13. Which is the incorrect statement about Carnot cycle?
   A. All the heat engines are based on Carnot cycle.
   B. It is used as the alternate standard of comparison of all heat engines.
   C. It provides concept of maximising work output between the two temperature limits.
   D. All of the above

14. According to Kelvin-Planck's statement of second law of thermodynamics,
   A. It is possible to construct an engine working on a cyclic process, whose sole purpose is to convert heat energy into work
   B. It is impossible to construct a device which operates in a cyclic process and produces no effect other than the transfer of heat from a cold body to a hot body
   C. It is impossible to construct an engine working on a cyclic process, whose sole purpose is to convert heat energy into work
   D. None of the above

15. The specific heat at constant volume is
    A. The amount of heat required to raise the temperature of unit mass of gas through one degree, at constant volume
    B. The amount of heat required to raise the temperature of unit mass of gas through one degree, at constant pressure
    C. The amount of heat required to raise the temperature of 1 kg of water through one degree
    D. Any one of the above

16. The door of a running refrigerator inside a room was left open. Which of the following statements is correct?
    A. The room will be cooled to the temperature inside the refrigerator
    B. The room will be cooled very slightly
    C. The room will be gradually warmed up
    D. The temperature of the air in room will remain unaffected

17. A process, in which the gas is heated or expanded in such a way that the product of its pressure and volume remains constant, is called
    A. Isothermal process
    B. Hyperbolic process
    C. Adiabatic process
    D. Polytropic process

18. In radial cams, the follower moves
    A. In a direction parallel to the cam axis
    B. In a direction perpendicular to the cam axis
    C. In any direction irrespective of cam axis
    D. Along the cam axis

19. In replacing the V-belts, a complete set of new belts is used instead of replacing a single damaged belt because
    A. Belts are available in sets
    B. Only one belt cannot be fitted with other used belts
    C. The new belt will carry more than its share and result in short life
    D. New and old belts will cause vibrations

20. Plastic flow in ductile materials
    A. Increases the seriousness of static loading stress concentration
    B. Lessens the seriousness of static loading stress concentration
    C. Has no effect on it
    D. Depends on other considerations

21. Residual stress in materials
    A. Acts when external load is applied
    B. Becomes zero when external load is removed
    C. Is independent of external loads
    D. Is always harmful

22. The objective of idler pulley in belt drive is to
    A. Decrease the tendency of belt to slip
    B. Increase the power transmission capacity
    C. Increase the wrap angle and belt tension
    D. All the above objectives

23. In order to avoid tearing of the plate at an edge, the distance from the centre line of the rivet hole to the nearest edge of the plate should be equal to (where d = Diameter of rivet hole)
    A. d
    B. 1.5 d
    C. 2.5 d
    D. 2 d

24. When the shaft rotates in anticlockwise direction at slow speed in a bearing, it will
    A. Have contact at the bottom most of the bearing
    B. Move towards right of the bearing making no metal to metal contact
    C. Move towards right of the bearing making the metal to metal contact
    D. Move towards left of the bearing making metal to metal contact

25. Jam nut is a locking device in which
    A. One smaller nut is tightened over main nut and main nut tightened against smaller one by loosening, creating friction jamming
    B. A slot is cut partly in middle of nut and then slot reduced by tightening a screw
    C. A hard fibre or nylon cotter is recessed in the nut and becomes threaded as the nut is screwed on the bolt causing a tight grip
    D. Through slots are made at top and a cotter pin is passed through these and a hole in the bolt, and cotter spitted and bent in reverse direction at other end

26. The objective of 'crowning' of the flat pulleys of belt drive is to
    A. Prevent the belt from running off the pulley
    B. Increase the power transmission capacity
    C. Increase the belt velocity
    D. Prevent the belt joint from damaging the belt surface

27. Compression ratio of I.C. Engines is
    A. The ratio of volumes of air in cylinder before compression stroke and after compression stroke
    B. Volume displaced by piston per stroke and clearance volume in cylinder
    C. Ratio of pressure after compression and before compression
    D. Swept volume/cylinder volume

28. It the temperature of intake air in IC engines is lowered, then its efficiency will
    A. Increase
    B. Decrease
    C. Remain same
    D. Increase up to certain limit and then decrease

29. Detonation is harmful due to
    A. Increase in the rate of heat transfer, there is a reduction in the power output and efficiency of the engine
    B. Excessive turbulence which removes most of the insulating gas boundary layer from the cylinder walls
    C. High intensity of knock causes crankshaft vibration and the engine runs rough
    D. None of the above

30. The knocking tendency in compression ignition engines for a given fuel will be
    A. Enhanced by decreasing compression ratio
    B. Enhanced by increasing compression ratio
    C. Dependent on other factors
    D. None of the above

31. Angle of friction is the
    A. Angle between normal reaction and the resultant of normal reaction and the limiting friction
    B. Ratio of limiting friction and normal reaction
    C. The ratio of minimum friction force to the friction force acting when the body is just about to move
    D. The ratio of minimum friction force to friction force acting when the body is in motion

32. Which of the following statement is correct?
    A. The kinetic energy of a body during impact remains constant.
    B. The kinetic energy of a body before impact is equal to the kinetic energy of a body after impact.
    C. The kinetic energy of a body before impact is less than the kinetic energy of a body after impact.
    D. The kinetic energy of a body before impact is more than the kinetic energy of a body after impact.

33. The presence of hydrogen in steel causes
    A. Reduced neutron absorption cross-section
    B. Improved Weldability
    C. Embrittlement
    D. Corrosion resistance

34. Which of the following statements are true for annealing of steels?
    A. Steels are heated to 500 to 700°C
    B. Cooling is done slowly and steadily
    C. Internal stresses are relieved
    D. All of these

35. Steady flow occurs when
    A. The direction and magnitude of the velocity at all points are identical
    B. The velocity of successive fluid particles, at any point, is the same at successive periods of time
    C. The magnitude and direction of the velocity do not change from point to point in the fluid
    D. The fluid particles move in plane or parallel planes and the streamline patterns are identical in each plane

36. The hammer blow in pipes occurs when
    A. There is excessive leakage in the pipe
    B. The pipe bursts under high pressure of fluid.
    C. The flow of fluid through the pipe is suddenly brought to rest by closing of the valve
    D. The flow of fluid through the pipe is gradually brought to rest by closing of the valve

37. A vertical wall is subjected to a pressure due to one kind of liquid, on one of its sides. Which of the following statement is correct?
    A. The pressure on the wall at the liquid level is minimum
    B. The pressure on the bottom of the wall is maximum
    C. The pressure on the wall at the liquid level is zero, and on the bottom of the wall is maximum
    D. The pressure on the bottom of the wall is zero

38. Cavitation will begin when
    A. The pressure at any location reaches an absolute pressure equal to the saturated vapour pressure of the liquid
    B. Pressure becomes more than critical pressure
    C. Flow is increased
    D. Pressure is increased

39. A hydraulic ram is a device used to
    A. Store the energy of water
    B. Increase the pressure of water
    C. To lift water from deep wells
    D. To lift small quantity of water to a greater height when a large quantity of water is available at a smaller height

40. Which of the following would lead to a reduction in thermal resistance?
    A. In conduction, reduction in the thickness of the material and an increase in thermal conductivity.
    B. In convection, stirring of the fluid and cleaning the heating surface.
    C. In radiation, increasing the temperature and reducing the emissivity.
    D. All of the above

41. According to Kirchoff's law, the ratio of emissive power to absorptivity for all bodies is equal to the emissive power of a
    A. Grey body
    B. Brilliant white polished body
    C. Red hot body
    D. Black body

42. In heat exchangers, degree of approach is defined as the difference between temperatures of
    A. Cold water inlet and outlet
    B. Hot medium inlet and outlet
    C. Hot medium outlet and cold water inlet
    D. Hot medium outlet and cold water outlet

43. Kinematic pairs are those which have
    A. Point or line contact between the two elements when in motion
    B. Surface contact between the two elements when in motion
    C. Elements of pairs not held together mechanically
    D. Two elements that permit relative motion

44. Which of the following is false statement in respect of differences between machine and structure?
    A. Machines transmit mechanical work, whereas structures transmit forces
    B. In machines, relative motion exists between its members, whereas same does not exist in case of structures
    C. Machines modify movement and work, whereas structures modify forces
    D. Efficiency of machines as well as structures is below 100%

45. Which of the following statement is correct?
    A. For constant velocity ratio transmission between two gears, the common normal at the point of contact must always pass through a fixed point on the line joining the centres of rotation of gears.
    B. For involute gears, the pressure angle changes with the change in centre distance between gears.
    C. The epicyclic gear trains involve rotation of atleast one gear axis about some other gear axis.
    D. All of the above

46. The coriolis component of acceleration depends upon
    A. Velocity of slider
    B. Angular velocity of the link
    C. Both (A) and (B)
    D. None of these

47. The Klein's method of construction for reciprocating engine mechanism
    A. Is based on acceleration diagram
    B. Is a simplified form of instantaneous center method
    C. Utilises a quadrilateral similar to the diagram of mechanism for reciprocating engine
    D. Enables determination of Cariole's component

48. Crowning on pulleys helps
    A. In increasing velocity ratio
    B. In decreasing the slip of the belt
    C. For automatic adjustment of belt position so that belt runs centrally
    D. Increase belt and pulley life

49. The sense of coriolis component 2 ωv is same as that of the relative velocity vector 'v' rotated at
    A. 45° in the direction of rotation of the link containing the path
    B. 45° in the direction opposite to the rotation of the link containing the path
    C. 90° in the direction of rotation of the link containing the path
    D. 180° in the direction opposite to the rotation of the link containing the path

50. The ratio of actual mass of water vapour in a given volume of moist air to the mass of water vapour in the same volume of saturated air at the same temperature and pressure, is called
    A. Humidity ratio
    B. Relative humidity
    C. Absolute humidity
    D. Degree of saturation

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