129/2023

Maximum : 100 marks

Time : 1 hour and 30 minutes

1. If D_1 and D_2 are two diagonal matrices, then :

(A) $D_1 D_2$ is a diagonal matrix

(B) $D_1 D_2 = D_2 D_1$

(C) both of the above

(D) $D_1 D_2$ may or may not be defined

2. The value of the determinant of a square matrix of order '4' is the sum of how many number of terms?

(A) 4 (B) 8

(C) 12 (D) 24

3. If A is any square matrix of order 'n', then $Adj(Adj\, A)$ is :

(A) $|A|^n$ (B) $|A|^n A$

(C) $|A^n| I$ (D) $|A|^{n-2} A$

4. The value of $\sin\frac{\pi}{4}\cos\frac{\pi}{12}+\cos\frac{\pi}{4}\sin\frac{\pi}{12}$ is :

(A) 1 (B) $\frac{\sqrt{3}}{2}$

(C) $\frac{1}{2}$ (D) $\frac{1}{\sqrt{2}}$

5. The value of $(1.01)^{\frac{1}{2}} - (0.99)^{\frac{1}{2}}$ correct to 5 decimal places is :

(A) 0.02131

(B) 0.01000

(C) 0.04203

(D) None of the above

6. $\lim_{x \to 0} \left(1 + \frac{x}{a}\right)^{\frac{1}{x}}$ is :

(A) $\log a$ (B) $\log \frac{1}{a}$

(C) $e^{\frac{1}{a}}$ (D) e^{a}

7. The function defined by $f(x) = \begin{cases} x^2 \sin \frac{1}{x}, & x \neq 0 \\ 0, & x = 0 \end{cases}$ is :

(A) continuous but not differentiable at $x = 0$

(B) differentiable at $x = 0$

(C) neither continuous nor differentiable at $x = 0$

(D) none of the above

8. The line $y - x + 2 = 0$ cuts the line joining (3, –1) and (8, 9) in the ratio :

(A) 3 : 4 (B) 2 : 3

(C) 3 : 2 (D) None of the above

9. The area bounded by the curve $y = x^3$, the y-axis, the lines $y = 1$ and $y = 8$ is :

(A) 12 (B) 6

(C) $\frac{45}{4}$ (D) 20

10. The differential equation of all circles of radius 'a' is given by :

(A) $\frac{dy}{dx} = \frac{y^2 - x^2}{2xy}$ (B) $\left\{1 + \left(\frac{dy}{dx}\right)^2\right\}^3 = a^2 \left(\frac{d^2y}{dx^2}\right)^2$

(C) $\left[1 + \left(\frac{d^2y}{dx^2}\right)^2\right]^{\frac{3}{2}} = a^2 \left(\frac{dy}{dx}\right)^2$ (D) $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}} = a^2 \left(\frac{d^2y}{dx^2}\right)^2$

11. The alkaline salt present in the bricks, absorbs moisture from the air which on drying :

(A) makes the bricks brittle and weak

(B) leaves high powder deposit on the brick

(C) leaves pores and makes the bricks porous

(D) all of these

12. When heavy structural loads from columns are required to be transferred to a soil of low bearing capacity, the most economical foundation is :

(A) deep foundation
(B) shallow foundation
(C) grillage foundation
(D) raft foundation

13. The error in measured length due to sag of chain or tape is known as :

(A) Compensating error
(B) Negative error
(C) Positive error
(D) Instrumental error

14. A staff reading taken on a point whose elevation is to be determined as on a change point is called :

(A) Back sight reading
(B) Fore sight reading
(C) Intermediate sight reading
(D) None of these

15. The workability of cement concrete can be improved by :

(A) Increasing the quantity of sand
(B) Increasing the quantity of cement
(C) Increasing the quantity of coarse aggregate
(D) All of the above

16. Zinc liners between the leaves of spring are sometimes used to :

(A) Provide damping
(B) Prevents squeaking
(C) Improve fatigue life
(D) Decrease vibration

17. Consider the following statements regarding a CI engine :

(1) CI engine knock can be reduced by increasing compression ratio.
(2) Thermal efficiency of CI is lower relative to a SI engine.
(3) CI engines has a higher specific output relative to SI engine
(4) CI engines use leaner mixture relative to SI engine

Which of the above statements are correct?

(A) 1 and 3
(B) 2 and 4
(C) 1 and 4
(D) 1, 2, 3 and 4

18. For the same compression ratio and heat input, the cycles in decreasing order of thermal efficiencies are :

(A) Otto, dual, diesel
(B) Diesel, otto, dual
(C) Dual, diesel, otto
(D) Otto, diesel, dual

19. If each fission of Uranium 235 releases 200 MeV, how many fissions occur per second to produce a power of 1 MW?

(A) 312×10^{16}/sec
(B) 31.2×10^{16}/sec
(C) 3.12×10^{16}/sec
(D) 0.312×10^{16}/sec

20. An aircraft flying horizontally at a speed of 900 Km/hr is propelled by a jet leaving the nozzle at a speed of 500 m/s. The propulsive efficiency is :

(A) 0.334
(B) 0.426
(C) 0.556
(D) 0.667

21. The curve representing Ohm's law is :

(A) Parabola
(B) Sine function
(C) Linear
(D) Hyperbola

22. A capacitor offers :

(A) Easy path to AC but block DC
(B) Easy path to DC but block AC
(C) Easy path to both AC and DC
(D) Block AC

23. A series circuit has a resistor; capacitor combination is connected to a voltage source. If the potential difference across the capacitor is equals to the potential difference of the source, then the capacitor is :

(A) Discharging
(B) Charging
(C) Fully discharged
(D) Fully charged

24. A magnetic field can be defined as :

(A) The current through the space around a permanent magnet
(B) The space through which a magnetic force acts
(C) The space around an inductor
(D) The force that drives current through a resistor

25. A wire has a resistance of 12 Ω. It is bent and ends are connected in the form of a circle. The effective resistance between the two points on any diameter of the circle is :

(A) 3 Ω (B) 6 Ω

(C) 12 Ω (D) 24 Ω

26. Select the resistance value of a resistor having the following colour band sequence :

Yellow, violet, gold, gold

(A) 4.2 ± 5% (B) 3.8 ± 5%

(C) 4.7 ± 5% (D) 2.7 ± 7%

27. Form factor of a full-wave bridge rectifier is :

(A) 1.21 (B) 1.11

(C) 1.47 (D) 2.1

28. The technique that SMPS utilizes to control the average value of output voltage :

(A) PAM (B) PCM

(C) PWM (D) FM

29. State the number of data bits and number of address bits in Intel 8051 microcontroller :

(A) 8 bits data and 16 bits address

(B) 16 bits data and 8 bits address

(C) 16 bits data and 32 bits address

(D) 16 bits data and 16 bits address

30. CDMA is based on the technology

(A) FM

(B) AM

(C) TDMA

(D) Spread Spectrum

31. Breakeven point can be lowered by :

(A) increasing fixed cost

(B) increasing variable cost

(C) decreasing slope of income line

(D) reducing variable cost

32. When ordering cost is increased to four times the EOQ will be increased to :

(A) Two times
(B) Four times
(C) Eight times
(D) Sixteen times

33. In a queuing theory the number of arrivals per unit time estimated by :

(A) Binomial distribution
(B) Poisson distribution
(C) Normal distribution
(D) Bath tub analogy

34. Process capability explains :

(A) Maximum capacity of machine
(B) Mean value of the measured variable
(C) Lead time of process
(D) Maximum deviation of the measured variable of the component

35. In production planning and control the document which authorizes the start of an operation in shop floor :

(A) Dispatch order
(B) Route plan
(C) Loading chart
(D) Schedule

36. In Time study the rating factor is applied to calculate :

(A) Standard time of a job
(B) Merit rating of worker
(C) Fixation of incentive rates
(D) Normal time of job

37. Which of the following statement is not correct?

(A) Work sampling is a technique of work measurement
(B) Method study is an improved methods
(C) Synthetic data is not a technique covered under predetermined motion time system
(D) Select is the first step of motion study

38. Which of the following is not a technique of PMTS?

(A) Synthetic data

(B) Stop watch time study

(C) Work factor

(D) MTM

39. The type of layout suitable for group technology concept is :

(A) Product layout

(B) Process layout

(C) Fixed position layout

(D) Cellular layout

40. Operating Characteristic curve (OC curve) is a plot between

(A) Consumer risk and producer risk

(B) Probability of acceptance and probability of rejection

(C) Percentage of defective and probability of acceptance

(D) Average outgoing quality and probability of acceptance

41. Value is usually a relationship between :

(A) Utility and Cost

(B) Profit and Cost

(C) Reliability and Psychology

(D) Appearance and Utility

42. In PERT and CPM network the dummy activity :

(A) Consume time

(B) Consume resources

(C) Is used to preserve the logic

(D) Is a real activity

43. The area under the beta distribution curve divided into two equal halves by a vertical ordinate through :

(A) optimistic time

(B) pessimistic time

(C) expected time

(D) most likely time

44. Shadow price in linear programming refers :

(A) lowest sales price

(B) maximum cost per item

(C) value assigned to one-unit

(D) cost of bought-out items

45. Preheating is essential in welding :

(A) high speed steel (B) cast iron

(C) non ferrous metal (D) none of these

46. Which structure has maximum hardness?

(A) Pearlite (B) Martensite

(C) Sorbite (D) None of these

47. Tempering of hardened steel is done to increase :

(A) grain size (B) surface condition

(C) ductility (D) carbon content

48. Age hardening is generally applicable to :

(A) Cast iron

(B) medium carbon steel

(C) high alloy steel

(D) alloys of alumnium, magnesium, nickel

49. What is the atomic packing factor for FCC crystal structure?

(A) 0.64 (B) 0.68

(C) 0.74 (D) 0.78

50. Burgers vector in screw dislocation :

(A) perpendicular to the dislocation line

(B) inclined to dislocation line

(C) parallel to dislocation line

(D) opposite to dislocation line

51. Which of the following material require largest size of riser for the same size of casting?

(A) aluminum

(B) cast iron

(C) steel

(D) copper

52. When solidification starts iron will appear in which form?

(A) Gamma (B) Alpha

(C) Delta (D) Beta

53. In arc welding the arc length should be approximately equal to :

(A) diameter of electrode

(B) half the diameter of electrode

(C) one and half times

(D) twice the size of electrode

54. Chaplets is used in moulding process :

(A) ensure directional solidification

(B) provide efficient venting

(C) connect moulding box

(D) support the cores

55. Which method is used for the manufacturing of collapsible tooth paste tubes?

(A) Impact extrusion

(B) Direct extrusion

(C) Piercing

(D) Indirect Extrusion

56. In atomic hydrogen welding hydrogen gas acts as :

(A) Heating agent

(B) One of the gases to generate flame

(C) Effective shielding gas to protect weld

(D) Lubricant to increase flow characteristics of weld metal

57. Helical groove in twist drill is to :

(1) improve stiffness

(2) save tool material

(3) provide space for chip removal

(4) provide rake angle for cutting edge

(A) (1) and (2) (B) (2) and (3)

(C) (3) and (4) (D) (1) and (4)

58. Which one is not a synthetic abrasive material?

(A) Silicon carbide (B) Alumnium oxide

(C) Titanium Nitride (D) Cubic boron nitride

59. Stability of floating body depends upon :

(A) its volume

(B) its weight

(C) its metacentric height

(D) specific weight of fluid

60. The value of coefficient of velocity depends upon :

(A) slope of orifice (B) size of orifice

(C) head of liquid above orifice (D) friction at the orifice surface

61. In a flow measurement a Venturimeter is preferred over an orifice plate :

(A) Pressure drop is minimum

(B) Cheaper

(C) Energy or head loss is less

(D) Space is limited

62. For maximum power transmission through a pipe line the frictional head loss equals :

(A) H/3 (B) H/2

(C) 3H/5 (D) H/4

63. In flow through a pipe the transition from laminar to turbulent flow does not depend :

(A) velocity of the fluid (B) density of fluid

(C) length of pipe (D) diameter of pipe

64. Flow occurring in a pipe line when a valve is opened :

(A) steady (B) unsteady

(C) laminar (D) vortex

65. Hydraulic grade line for any flow system as compared to energy line is :

(A) Above

(B) Below

(C) Same level

(D) May be below or above depending upon the velocity of flow

66. Air vessel is provided at the summit of a syphon :

(A) Increase velocity

(B) increase discharge

(C) maintain pressure difference

(D) avoid interruption in flow

67. For a given centrifugal pump :

(A) head varies inversely as a square of speed

(B) discharge varies directly as speed

(C) discharge varies directly as square of speed

(D) power varies directly as speed

68. The work saved by Fitting an air vessel to a single reciprocating pump is :

(A) 28.9% (B) 32.7%

(C) 68.45 (D) 84.8%

69. Efficiency of Pelton wheel shall be maximum if the ratio of jet velocity to tangential velocity of wheel is :

(A) 1/2 (B) 1

(C) 2 (D) 4

70. The use of a draft tube in a reaction turbine helps to :

(A) prevent air entering

(B) increase the flow rate

(C) convert kinetic energy to pressure energy

(D) eliminates eddies in the downstream

71. Multi- stage centrifugal pump is used :

(A) high discharge
(B) high speed
(C) high head
(D) high efficiency

72. Impulse turbine is generally fitted :

(A) little above tail race
(B) same level of tail race
(C) slightly below tail race
(D) about 2.5 meters below the tail race

73. Which of the following about Poisson ratio is / are correct?

(1) Applicable with in elastic limit
(2) Ratio of lateral stress by longitudinal strain
(3) Ratio of lateral strain by longitudinal strain
(4) Ratio of longitudinal strain by lateral strain

(A) only (1) and (2)
(B) only (1) and (3)
(C) only (2) and (3)
(D) only (3) and (4)

74. If Poissons ratio of material is 0.5 then elastic modulus of material is ———— the shear modulus.

(A) equal to
(B) two times
(C) three times
(D) four times

75. Match the list :

In the cone of friction

List I	List II
(a) Axis of cone	(1) Limiting factor of friction
(b) Generator of cone	(2) Normal reaction
(c) Base radius of cone	(3) Resultant force

	(a)	(b)	(c)
(A)	1	2	3
(B)	1	3	2
(C)	2	3	1
(D)	3	2	1

76. A perfect frame contains members equal to (n = no. of joints in frame) :

(A) $2n-1$ (B) $2n-2$

(C) $n-3$ (D) $2n-3$

77. Throat thickness of a single fillet lap joint is given by :

(A) $\frac{t}{2\sqrt{2}}$ (B) $\sqrt{2}\,t$

(C) $\frac{t}{\sqrt{2}}$ (D) $2\sqrt{2}\,t$

where t is the thickness of plate.

78. A cylindrical pipe 1 m in diameter contains fluid at a pressure of 1 N/mm^2. If the maximum permissible tensile stress in metal is 20 N/mm^2, the thickness of metal required would be :

(A) 2.5 cm (B) 2 cm

(C) 1 cm (D) 0.5 cm

79. The ratio of crippling load for a column of length (l) with both ends fixed to the crippling load of the same column with both ends hinged according to Euler's theory of long column is equal to :

(A) 2 (B) 4

(C) 0.5 (D) 1.0

80. The included angle of V-thread is :

(A) 30° (B) 45°

(C) 60° (D) 90°

81. Which type of screw is used in lead screw of a lathe?

(A) Square thread

(B) Knuckle thread

(C) Buttress thread

(D) Acme thread

82. Two intersecting shafts can be connected by ———————— gear.

(A) straight spur

(B) spiral

(C) cross helical

(D) straight bevel

83. Which of the following is an inversion of single slider crank chain?

(A) Beam engine

(B) Oscillation cylinder engine

(C) Watts indicator mechanism

(D) Elliptical trammel

84. The circle drawn to the cam profile with minimum radius is called the :

(A) Prime circle (B) Cam circle

(C) Pitch circle (D) Base circle

85. If the axes of first and last gear of a compound gear train are coaxial the gear train is known as ———————— train.

(A) simple

(B) complex

(C) reverted

(D) epicyclic

86. The governor is said to be ———————— when the speed of the engine fluctuates continuously above and below the mean speed.

(A) isochronous

(B) hunting

(C) insensitive

(D) stable

87. For some compression ratio and heat addition air standard efficiencies is of the order :

(A) Otto cycle > diesel cycle > dual cycle

(B) Otto cycle > dual cycle > diesel cycle

(C) Diesel cycle > dual cycle > otto cycle

(D) Diesel cycle > otto cycle > dual cycle

88. Two reference fuels used for Cetane rating are :

(A) Cetane and ISO-octane

(B) Cetane and n-heptane

(C) Cetane and Tetra ethyl lead

(D) Cetane and α-methyl napthalene

89. Which of the following is NOT a method to determine the friction power of an engine?

(A) Willan's line
(B) Wilson line
(C) Motoring test
(D) Morse test

90. The purpose of ignition coil in an automobile ignition system is to :

(A) step up the voltage in a spark plug
(B) step down the voltage in a spark plug
(C) step up the voltage in a diesel injector
(D) step down the voltage in a diesel injector

91. For thermosyphon cooling, radiator should be placed :

(A) same level as that of the engine
(B) below the engine
(C) above the engine
(D) all of these

92. Which one of the following heat exchangers gives parallel straight line pattern of temperature distribution for both hot and cold fluid?

(A) parallel flow with unequal heat capacities
(B) parallel flow with equal heat capacities
(C) counter flow with unequal heat capacities
(D) counter flow with equal heat capacities

93. The temperature distribution for a plane wall, for steady state heat flow and constant value of thermal conductivity is :

(A) logarithmic
(B) linear
(C) parabolic
(D) cubic

94. Prandtl number value greater than one indicates that hydrodynamic boundary layer is :

(A) greater than thermal boundary layer thickness
(B) less than thermal boundary layer thickness
(C) equal to thermal boundary layer thickness
(D) independent of thermal boundary layer thickness

95. The wavelength of maximum emissive power is given by :

(A) Kirchoff's law
(B) Stefan Boltzman law
(C) Wein's law
(D) Fourier law

96. For a perfectly black body :

(A) absorptivity = 1 reflectivity = 1 transmittivity = 1
(B) absorptivity = 1 reflectivity = 0 transmittivity = 0
(C) absorptivity = 0 reflectivity = 1 transmittivity = 0
(D) absorptivity = 0 reflectivity = 0 transmittivity = 1

97. Identify the correct statement :

(A) reciprocating compressors are used to supply large quantities of air at a lower pressure ratio
(B) centrifugal compressors are used to supply large quantities of air at a lower pressure ratio
(C) reciprocating compressors are used to supply small quantities of air at a lower pressure ratio
(D) centrifugal compressors are used to supply small quantities of air at a higher pressure ratio

98. A two stage compressor takes air at 3.6 bar and discharges at 10 bar. For maximum efficiency the intermediate pressure is :

(A) 4 bar
(B) 5.6 bar
(C) 6 bar
(D) 6.8 bar

99. One ton refrigeration is equivalent to :

(A) 3.5 kJ/s
(B) 3.5 kJ/min
(C) 3.5 J/s
(D) 3.5 J/min

100. During adiabatic cooling of moist air :

(A) specific humidity remains constant
(B) relative humidity remains constant
(C) dry bulb temperature remains constant
(D) wet bulb temperature remains constant

SPACE FOR ROUGH WORK

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