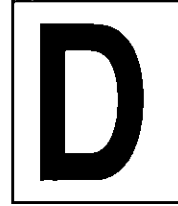


DO NOT OPEN THIS BOOKLET UNTIL YOU ARE ASKED TO DO SO.

2022

TEST BOOKLET

TEST BOOKLET SERIES



Time allowed : 2 hours

Full marks : 200

Answer *all* the questions.

Questions are of equal value.

Serial No. **104728**.....

Roll No.:

Signature of the Candidate:

INSTRUCTIONS

Candidates should read the following instructions carefully before answering the questions:

1. This booklet consists of 24 pages including this front page, containing 100 questions each for Group 'A' and Group 'B'. **Verify the Page Nos. and Test Booklet series on each page and bring at once to the Invigilator's notice any discrepancy.**
2. Answers will have to be given in the Special Answer-Sheet supplied for the purpose.
3. Before you proceed to mark in the Answer-Sheet in response to various items in the Test Booklet, you have to fill in some particulars in the Answer-Sheet as per instructions sent to you in the Admit Card. **Do not fold the Answer-Sheet as this will result in error in your marks.**
4. All questions are of multiple-choice answer-type. You will find *four* probable answers (A), (B), (C) and (D) against each question. Find out which of the four answers appears to be **correct or the best**. Now darken the circle corresponding to the letter of the selected answer in the Answer-Sheet with **Black Ball Point Pen** as per instructions printed on the reverse of the Admit Card and in the Answer-Sheet.
5. One and only one circle is to be fully blackened for answer. Any spot in any other circle (multiple circle) or in wrong circle will be considered as wrong answer.
6. **There will be negative marking for wrong answer. 0.50 mark will be deducted for each wrong answer.**
7. **There are blank pages at the end of this Booklet for Rough Work.**
8. **The Special Answer-Sheet should be handed over to the Invigilator before leaving the Examination Hall. You are permitted to take away the used Test Booklet after completion of the examination.**

The Questions of Group – ‘A’ are meant for the candidates of ELECTRICAL ENGINEERING and those of Group – ‘B’ for the candidates of MECHANICAL ENGINEERING.

Group-A
(Electrical Engineering)

1. The forbidden energy gap in semiconductors
 - (A) lies between the valence band and the conduction band.
 - (B) lies just below the valence band.
 - (C) is the same as the valence band.
 - (D) just lies above the conduction band.

2. Consider an infinitely long straight conductor carrying current I . The magnetic field B due to this current-carrying conductor at a distance d from it is
 - (A) $\frac{\mu_0 I}{2\pi d}$
 - (B) $\frac{2\pi\mu_0 I}{d}$
 - (C) $\frac{\mu_0 I}{d}$
 - (D) $\frac{\mu_0 I}{\pi d}$

3. If $\vec{a} = 2i - 3j - k$, $\vec{b} = -i + k$, $\vec{c} = 2j - k$, then the area of parallelogram, whose diagonals are $(\vec{a} + \vec{b})$ and $(\vec{b} + \vec{c})$ is
 - (A) 1 sq. unit
 - (B) $\frac{1}{2}$ sq. unit
 - (C) 2 sq. unit
 - (D) $\frac{1}{4}$ sq. unit

4. Transient voltages typically last for
 - (A) 10 seconds to 1 minute
 - (B) 1 to 10 seconds
 - (C) few milliseconds to seconds
 - (D) a microsecond to several milliseconds

5. An atom has mass number 37 and atomic number 17. The number of protons is
 - (A) 21
 - (B) 22
 - (C) 17
 - (D) 20

6. What is the purpose of forest certification?
 - (A) To promote deforestation and illegal logging.
 - (B) To increase the demand for non-sustainable forest products.
 - (C) To decrease the market accessibility of forest-based industries.
 - (D) To authenticate the origin, legality and sustainability of forest-based products.

7. A 10 ohm load is connected to the secondary of a single phase 3300 V/110 V power transformer. The effective load on the 3.3 kV bus bar is nearly
 - (A) 0.9 K ohm
 - (B) 9.0 K ohm
 - (C) 10.0 K ohm
 - (D) 300.0 K ohm

8. In the series RLC circuit if the current is leading the voltage, then which of the following condition is correct? (All the symbols have their usual meaning)
 - (A) $X_L < X_C$
 - (B) $X_L > X_C$
 - (C) $X_L = X_C$
 - (D) More than one of the above

9. Free surface of a liquid tends to contact to the smallest possible area due to force of

- (A) Viscosity
- (B) Friction
- (C) Cohesion
- (D) Surface tension

10. Which of the following transformation between the Z (impedance) and h (hybrid) parameters is correct?

(A)
$$\begin{bmatrix} \frac{h_{11}h_{22} - h_{12}h_{21}}{h_{22}} & \frac{h_{12}}{h_{22}} \\ -\frac{h_{21}}{h_{22}} & \frac{1}{h_{22}} \end{bmatrix}$$

(B)
$$\begin{bmatrix} \frac{h_{11}h_{22} - h_{12}h_{21}}{h_{22}} & \frac{h_{12}}{h_{22}} \\ \frac{h_{21}}{h_{22}} & \frac{h_{12}}{h_{22}} \end{bmatrix}$$

(C)
$$\begin{bmatrix} \frac{h_{11}h_{22} - h_{12}h_{21}}{h_{22}} & \frac{h_{12}}{h_{22}} \\ -\frac{h_{21}}{h_{22}} & -\frac{1}{h_{22}} \end{bmatrix}$$

(D)
$$\begin{bmatrix} \frac{h_{11}h_{22} - h_{12}h_{21}}{h_{22}} & -\frac{h_{12}}{h_{22}} \\ -\frac{h_{21}}{h_{22}} & \frac{1}{h_{22}} \end{bmatrix}$$

11. If V is a scalar, then the equation (in spherical coordinate system)

$$\frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial V}{\partial r} \right) + \frac{1}{r^2 \sin \theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial V}{\partial \theta} \right) + \frac{1}{r^2 \sin^2 \theta} \frac{\partial^2 V}{\partial \phi^2} = -\frac{\rho}{\epsilon}$$

is referred to as

- (A) Laplace's equation
- (B) Gradient of V
- (C) Poisson's equation
- (D) divergence of V

12. Pulley and Strings shown in Fig. 3 are smooth and weightless. The value of Q for equilibrium of the system is

- (A) 0°
- (B) 30°
- (C) 45°
- (D) 60°

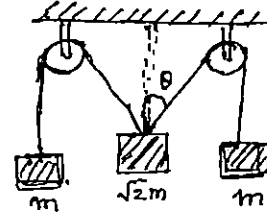


Fig.-3

13. Which among the following is used in astronomical telescopes and optical fibres?

- (A) Long-wavelength infrared
- (B) Medium infrared
- (C) Near-infrared
- (D) Far infrared

14. A fault occurring at the terminals of an unloaded AC generator operating at its rated voltage has resulted in the following sequence currents and voltages. What is the type of fault?

Positive sequence current = $j 3$ p.u.

Negative sequence current = -5.5 p.u.

Zero sequence current = $j 2.5$ p.u.

Positive sequence voltage = 2 p.u.

Negative sequence voltage = 2 p.u.

Zero sequence voltage = 2 p.u.

- (A) Line to line fault
- (B) Line-Line-Ground fault
- (C) Open circuit fault
- (D) 3-phase fault

15. The transform admittance of the Capacitor is

- (A) $1/SC$
- (B) $1/C$
- (C) SC
- (D) C

16. Which relay is used in protection of long transmission lines?

- (A) Reactive relay
- (B) Impedance relay
- (C) Mho relay
- (D) None of the above

Please Turn Over

17. Find the force between two charges when they are brought in contact and separated by 4 cm apart, charges are 2 nc and - 1 nc, in μN .

- (A) 1.44
- (B) 2.44
- (C) 2.404
- (D) 1.404

18. Given two points $[a, f(a)]$, $[b, f(b)]$, the linear Lagrange polynomial $f_1(x)$ that passes through these two points is given by

- (A) $f_1(x) = \frac{x-b}{a-b}f(a) + \frac{x-a}{b-a}f(b)$
- (B) $f_1(x) = f(a) + \frac{f(b)-f(a)}{b-a}(b-a)$
- (C) $f_1(x) = \frac{x}{b-a}f(a) + \frac{x}{b-a}f(b)$
- (D) $f_1(x) = \frac{x-b}{a-b}f(a) + \frac{x-a}{a-b}f(b)$

19. The imaginary part of the complex frequency is called

- (A) Angular Frequency
- (B) Radian Frequency
- (C) Neper Frequency
- (D) Sampling Frequency

20. Sum of pressure head, datum head and kinetic head is called as

- (A) Total energy line
- (B) Total equation line
- (C) Hydraulic gradient
- (D) Transmission line

21. Which of the following motors is most suitable for use in a domestic food mixer?

- (A) Universal motor
- (B) Three phase synchronous motor
- (C) Induction motor
- (D) D.C. shunt motor

22. Transient state stability is generally improved by

- (A) using high speed governors on machines.
- (B) using low inertia machines.
- (C) dispensing with neutral grounding.
- (D) Any of the above

23. D-Alembert's principle is used for which of the following?

- (A) Change the dynamic problem to static problem.
- (B) Change the static problem into dynamic problem.
- (C) To calculate the moment of inertia of rigid bodies.
- (D) To calculate angular momentum of a system of masses.

24. In the bipolar junction transistor, if the current gain is 200 and the collector current is 100mA, the base current is

- (A) 2A
- (B) 0.5 mA
- (C) 20A
- (D) 2 mA

25. A junction/joint of two dissimilar is called

- (A) Reference point
- (B) Solder joint
- (C) Thermocouple
- (D) All of the above

26. Factor of safety is the ratio of

- (A) Permissible stress / Ultimate stress
- (B) Ultimate stress / Permissible stress
- (C) Permissible strain / Ultimate strain
- (D) Ultimate strain / Permissible strain

27. The efficiency of a simple machine is defined as
- Mechanical advantage/Velocity ratio
 - Velocity ratio \times Mechanical advantage
 - Velocity ratio/Mechanical advantage
 - $1/(\text{Velocity ratio} \times \text{Mechanical advantage})$
28. Section 25 of the Electricity Act, 2003 deals with
- National load despatch centre.
 - State transmission utility and functions.
 - Inter-state, regional and inter-regional transmission.
 - Power to recover charges.
29. An ideal OP-AMP is an ideal
- Current Controlled Current Source
 - Current Controlled Voltage Source
 - Voltage Controlled Voltage Source
 - Voltage Controlled Current Source
30. For a parallel plate capacitor with plate area 6 cm^2 and plate separation of 6 mm has voltage $36 \sin 10^3 t \text{ V}$ applied to plates. Displacement current, I_d will be (in nA)
- $\frac{100}{\pi} \cos 10^3 t$
 - $\frac{20}{\pi} \sin 10^3 t$
 - $\frac{50}{\pi} \cos 10^3 t$
 - $\frac{70}{\pi} \sin 10^3 t$
31. Which of the following bands is just above the intrinsic Fermi level for n -type semiconductor?
- Conduction band
 - Acceptor band
 - Valence band
 - Donor band
32. The purpose of differential gear in an automobile is to
- provide balancing of rotating wheels.
 - reduce the speed of propeller shaft.
 - reduce the speed from engine to rear axle.
 - helps in smooth turning of vehicle.
33. The viscous force acting on a solid ball moving in air with terminal velocity v is directly proportional to
- \sqrt{v}
 - v
 - $\frac{1}{\sqrt{v}}$
 - v^2
34. What will be the number of lamps, each having 300 lumens, required to obtain an average illuminance of 50 lux on a $4 \text{ m} \times 3 \text{ m}$ rectangular room?
- 4
 - 6
 - 2
 - 5
35. Find the area of the traverse using Simpson's rule if $d = 12 \text{ m}$ and the values of ordinates are 2.25 m, 1.46 m, 3.23 m, 4.46 m.
- 116.88 sq.m
 - 611.88 sq.m
 - 161.88 sq.m
 - 169.54 sq.m
36. An intrinsic semiconductor, at the absolute zero temperature, behaves like which of the following?
- p-type semiconductor
 - n-type semiconductor
 - Super conductor
 - Insulator

Please Turn Over

37. In case of transmission line voltage surge first counter by

- (A) lightning arrestors
- (B) relays
- (C) switch gear
- (D) step down transformer

38. The following medium is employed for extinction of arc in air circuit breakers:

- (A) Oil
- (B) Water
- (C) Air
- (D) None of the above

39. If the specific gravity of electrolyte (H_2SO_4) in a lead acid cell increases, the internal resistance of the cell

- (A) remain unchanged.
- (B) is increased.
- (C) is decreased.
- (D) is equal to load resistance.

40. A charge Q is uniformly distributed over a large plastic plate. The electric field at a point P close to the centre of the plate is 10 V m^{-1} . If the plastic plate is replaced by a copper plate of the same geometrical dimensions and carrying the same charge Q , the electric field at the point P will become

- (A) Zero
- (B) 10 V m^{-1}
- (C) 5 V m^{-1}
- (D) 20 V m^{-1}

41. For all second degree polynomials with $y = ax^2 + bx + k$, it is seen that the Rolles' point is at $c = 0$. Also the value of k is zero. Then what is the value of b ?

- (A) -1
- (B) 0
- (C) 1
- (D) 56

42. $f(x, y) = \sin(xy) + x^2 \ln(y)$, then f_{yx} at $(0, \pi/2)$ is

- (A) 33
- (B) 3
- (C) 1
- (D) 0

43. What is the use of brushes in DC machines?

- (A) To connect parts of the machine to the external circuit.
- (B) To conduct current between stationary wires and moving parts.
- (C) To conduct current between moving parts.
- (D) Used for smooth conduction of current.

44. The deflection at the free end of a cantilever beam of span L subjected to uniformly distributed load w per unit length as shown in Fig. 4, where EI is the flexural rigidity, is

- (A) $\frac{wL^4}{8EI}$
- (B) $\frac{wL^3}{6EI}$
- (C) $\frac{wL^4}{9EI}$
- (D) $\frac{wL^4}{12EI}$

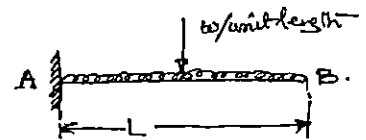


Fig.-4

45. Which statement is used to read input from the user in FORTRAN?

- (A) INPUT
- (B) GET
- (C) IN
- (D) READ

46. Impulse ratios of insulators and lightning arrestors should be

- (A) high and low respectively
- (B) Both low
- (C) Both high
- (D) low and high respectively

47. When is the fluid called laminar?

- (A) Low viscosity
- (B) The density of fluid is high
- (C) Reynolds number is less than 2000
- (D) Reynolds number is greater than 2000

48. Which type of transformers is used in AC welding?

- (A) Equal turns ratio type
- (B) Ferrite core type
- (C) Step up type
- (D) Step down type

49. If the applied voltage to a d.c. motor is 220 volts, then the back e.m.f. for maximum power developed is

- (A) 220 V
- (B) 440 V
- (C) 110 V
- (D) 210V

50. Junction Field Effect Transistor is a

- (A) current controlled device
- (B) has small input impedance
- (C) voltage controlled device
- (D) two terminal device

51. The CG of a semicircular plate of 66 cm diameter, from base as shown in Fig.-2, is

- (A) $\frac{8}{33}$ cm
- (B) 14 cm
- (C) $\frac{1}{14}$ cm
- (D) $\frac{63}{8}$ cm

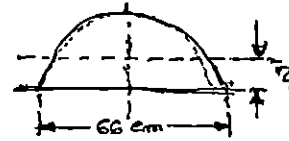


Fig.-2

52. Which wiring is preferred for motor connection in industries?

- (A) CTS wiring
- (B) TRS wiring
- (C) PVC conduct wiring
- (D) Metal conductor wiring

53. With initial approximation of $x_1 = x_2 = x_3 = 0$, what is the next value of x_1 in the following set of simultaneous equations?

$$2x_1 + 6x_2 - x_3 = 81$$

$$6x_1 + 15x_2 + 2x_3 = 75$$

$$x_1 + x_2 + 50x_3 = 110$$

- (A) 3.25
- (B) 2.25
- (C) 4.00
- (D) 3.00

54. The brushes in d.c. machine are normally placed electrically in interpolar region to

- (A) make an angle of 90 degree electrical.
- (B) make an angle of 90 degree mechanical.
- (C) make an angle of 0 degree electrical.
- (D) None of the above mentioned

Please Turn Over

55. Which of the following is the ideal value of earthing resistance used for large power station?

- (A) 1 ohm
- (B) 0.5 ohm
- (C) 5 ohm
- (D) 10 ohm

56. In case of Newton Backward Interpolation Formula which equation is correct to find u ?

- (A) $(x - x_n)h = u$
- (B) $(x - x_n) = uh$
- (C) $(x + x_n) = uh$
- (D) $(x - x_n) = u$

57. V-belts are usually used for

- (A) Long drives
- (B) Short drives
- (C) Long and short drives
- (D) None of the above

58. The illumination at the various points on a horizontal surface illuminated by the same source varies as

- (A) $1/\cos\theta$
- (B) $\cos\theta$
- (C) $\cos^2\theta$
- (D) $\cos^3\theta$

59. Bernoulli's equation is a mathematical expression of

- (A) the ratio of kinetic to viscous forces in a flow stream.
- (B) potential and kinetic energies in a flow stream.
- (C) friction loss as fluid moves through a rough pipe.
- (D) vertical height and pressure for a static fluid.

60. Express the pressure head of 100 meters of water as a liquid of specific gravity 1.5.

- (A) 150 m
- (B) 66.67 m
- (C) 100 m
- (D) 33.33 m

61. A p-n junction diode's dynamic conductance is directly proportional to

- (A) the applied voltage
- (B) its current
- (C) the temperature
- (D) the thermal voltage

62. In a reciprocating pump air vessels are used to

- (A) smoothen the flow
- (B) reduce suction head
- (C) reduce acceleration head
- (D) increase delivery head

63. Find the value of $\lim_{x \rightarrow \infty} 2x \sin\left(\frac{4}{x}\right)$.

- (A) $\frac{1}{2}$
- (B) 2
- (C) 4
- (D) 8

64. The maximum power developed in a synchronous motor occurs at a coupling angle of

- (A) 30°
- (B) 180°
- (C) 60°
- (D) 90°

65. Which of the following power plant is free from environmental pollution?

- (A) Hydro-electric
- (B) Diesel
- (C) Nuclear
- (D) Steam

66. Determine the full-pitch of a 3-phase, 36 slots, 36 coils 6 pole motor.

- (A) 9
- (B) 18
- (C) 12
- (D) 6

67. If $f(x) = \frac{x-4}{2\sqrt{x}}$, then $f'(1)$ is

- (A) $\frac{5}{4}$
- (B) $\frac{4}{5}$
- (C) 1
- (D) 0

68. If the beam is loaded with uniformly varying load, the nature of shear force and bending moment will be

- (A) Linear and circular
- (B) Linear and parabolic
- (C) Parabolic and cubic
- (D) Constant and linear

69. If the field of DC shunt motor is opened while running, what will happen to the speed?

- (A) Speed of the motor will become dangerously high.
- (B) Speed of the motor will remain constant.
- (C) The motor will get locked.
- (D) Speed of the motor will reduce.

70. The angular momentum of a planet of G mass M moving around the sun in an elliptical orbit is \bar{L} . The magnitude of the areal velocity of the planet is

- (A) $\frac{L}{M}$
- (B) $\frac{2L}{M}$
- (C) $\frac{L}{3M}$
- (D) $\frac{L}{2M}$

71. An over-current relay, having a current setting of 12.5% is connected to a supply circuit through a current transformer with a ratio of 400/5. The pick-up value of the current in Amperes is

- (A) 15
- (B) 12.5
- (C) 10
- (D) 0.625

72. The orthogonal trajectories of the given family of curves $y = cx^k$ is given by

- (A) $x^2 - ky^2 = \text{constant}$
- (B) $x^2 + cy^2 = \text{constant}$
- (C) $kx^2 + y^2 = \text{constant}$
- (D) $x^2 + ky^2 = \text{constant}$

73. The moment of force applied on a door is 18 N-m and a force of 4.5 N is applied by a boy. The distance of the handle from the pivot is

- (A) 4.0 m
- (B) 2.25 m
- (C) 0.75 m
- (D) 0.25 m

Please Turn Over

74. A three-phase transformer having a line voltage ratio of 400/33000 V is connected in the star-delta. The CT_s on the 400 V side have a CT ratio of 1000/5. What will be the current through the pilot wire?

- (A) $\frac{5}{\sqrt{3}}$ A
 (B) $5\sqrt{3}$ A
 (C) 5A
 (D) $\frac{1}{5}$ A

75. The luminous flux reaching the working plane list depends on

- (A) colour of the working plane surface.
 (B) proportion of the room.
 (C) the lumen output of the lamps.
 (D) reflection of internal surface.

76. Which of the following is a type of fusion welding?

- (A) Carbon arc welding
 (B) Ultrasonic welding
 (C) Friction welding
 (D) Forge welding

77. Consider the differential equation

$$\frac{dy}{dt} + ay = e^{-bt} \text{ with the initial conditions } y(0) = 0.$$

Then the Laplace transform $Y(s)$ of the solution $y(t)$ is

- (A) $\frac{e^{-a} - e^{-b}}{b - a}$
 (B) $\frac{1}{a(s + b)}$
 (C) $\frac{1}{b(s + a)}$
 (D) $\frac{1}{(s + a)(s + b)}$

78. For the circuit shown in Fig.-6 given below, the maximum power P_{\max} transferred to load Z when

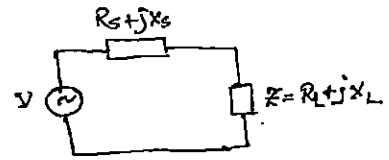


Fig.-6

- (A) $R_S = R_L^2$
 (B) $R_S = X_L$ and $X_L = -R_L$
 (C) $R_S = 2R_L$
 (D) $R_S = R_L$ and $X_L = -X_S$

79. Who invented the first junction transistor?

- (A) Shockley
 (B) Bell
 (C) Faraday
 (D) Marconi

80. If $f(x) = \begin{cases} mx + 1, & \text{if } x \leq \pi/2 \\ \sin x + n, & \text{if } x > \pi/2 \end{cases}$, is continuous at $x = \pi/2$, then

- (A) $m = 1, n = 0$
 (B) $m = \frac{n\pi}{2} + 1$
 (C) $n = \frac{m\pi}{2}$
 (D) $m = n = \pi/2$

81. If a load of 40 N is moved by applying an effort of 10 N on the machine, then the mechanical advantage of the machine is

- (A) 4
 (B) 0.25
 (C) 400
 (D) 200

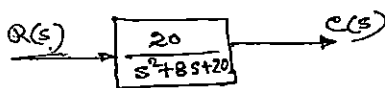
82. What will be the velocity of an object of momentum ' P ' and mass ' m '?

- (A) $P \times m$
- (B) $P + m$
- (C) $\frac{m}{P}$
- (D) $\frac{P}{m}$

83. External "_____" voltages are applied to bias a transistor.

- (A) AC
- (B) Analog
- (C) Both AC and DC
- (D) DC

84. The nature of the response shown below in Fig.-5 is



- (A) Overdamped with $\xi = 0.894$ and $w_n = 20 \text{ rad/sec}$.
- (B) Overdamped with $\xi = 0.894$ and $w_n = 4.472 \text{ rad/sec}$.
- (C) Underdamped with $\xi = 1.894$ and $w_n = 4.472 \text{ rad/sec}$.
- (D) Overdamped with $\xi = 1.894$ and $w_n = 20 \text{ rad/sec}$.

85. The moment of inertia of a ring about a tangent is 4 Kgm^2 . What is the moment of inertia about an axis passing through the centre of the ring and perpendicular to its plane? Mass of the ring is 2 Kg and diameter is 2 m .

- (A) 2 Kgm^2
- (B) 4 Kgm^2
- (C) 8 Kgm^2
- (D) 1 Kgm^2

86. Which type of water is used in electrolyte?

- (A) Ordinary water
- (B) Distilled water
- (C) Coolant
- (D) None of the above

87. According to the Thevenin's theorem, any two terminal bilateral linear DC circuits can be replaced by an equivalent circuit consisting of

- (A) a voltage source in parallel with a resistor.
- (B) a current source and a series resistor.
- (C) a voltage source and a series resistor.
- (D) a current source in parallel with a resistor.

88. A ball rolling on ice with a velocity of 5.6 m/s . stops after travelling 8 metre . If $g = 9.8 \text{ m/sec}^2$, coefficient of friction is

- (A) 0.4
- (B) 0.1
- (C) 0.3
- (D) 0.2

89. Four movable pulleys are arranged as in the first system. If the weight of each pulley is 5 N , calculate the effort which can lift a load of 10 KN .

- (A) 615 N
- (B) 625 N
- (C) 629.7 N
- (D) 650 N

90. During electrical work which one of the following avoids electrical shock?

- (A) Wet rope
- (B) Metal rod
- (C) Dry wood
- (D) Wet wood

Please Turn Over

91. An iron needle floats on the surface of water. This phenomenon is attributed to

- (A) Surface tension
- (B) Gravitational force
- (C) Upthrust of liquid
- (D) More than one of the above

92. Hooke's law holds good upto the limit of

- (A) Breaking point
- (B) Proportionality
- (C) Lateral strain
- (D) Dual strain

93. If the capacitor is placed in the feedback path of an op-amp circuit, then the circuit can act as

- (A) Multiplier
- (B) Divider
- (C) Subtractor
- (D) Integrator

94. What is the unit of illumination?

- (A) Decibel
- (B) Lux
- (C) Henry
- (D) Coulomb

95. The lamina is as shown in the following Fig.-1. The centroid of lamina from the point O is

- (A) 120 mm.
- (B) 100 mm.
- (C) 140 mm.
- (D) 110 mm.



Fig.-1

96. The speed at which rotating magnetic field revolves is called

- (A) Induction speed
- (B) Synchronous speed
- (C) Relative speed
- (D) Rotating speed

97. When single phasing occurs in a three phase induction motor under running conditions, it

- (A) will stall.
- (B) will become noisy while it still runs.
- (C) may either stall or continue depending on the load carried by it.
- (D) will keep running through with slightly increased slip.

98. Distance relays are generally

- (A) split-phase relays
- (B) impedance relays
- (C) reactance relays
- (D) overcurrent relays

99. The equation $f(x)$ is given as $x^2 - 4 = 0$. Considering the initial approximation at $x = 6$ then the value of x_1 is given as _____.

- (A) $\frac{4}{3}$
- (B) $\frac{7}{3}$
- (C) $\frac{10}{3}$
- (D) $\frac{13}{3}$

100. Which of the following represents the CORRECT expression of Lorentz Force?

- (A) eE_H
- (B) $\frac{E_H}{b}$
- (C) $\frac{b}{eE_H}$
- (D) $\frac{eE_H}{b}$

Group-B
(Mechanical Engineering)

1. The calculation of heat transmission by convection is based on the determination of a Nusselt number or convective film coefficient. To that goal, which of the following strategies have been proposed?

(i) Non-dimensional analysis and experimental correlations

(ii) Hydrodynamic concept of velocity boundary layer

(iii) Reynolds similarity between the mechanism of fluid friction in the boundary layer and the transfer of heat by convection

Identify the correct one:

- (A) (ii) and (iii)
- (B) (i) and (iii)
- (C) (i), (ii) and (iii)
- (D) (i) and (ii)

2. Which of the following has the same combustion as HCCI (Homogeneous Charge Compression Ignition) engine?

- (A) SI engine
- (B) CI engine
- (C) Hybrid of both SI and CI engine
- (D) Wankel engine

3. Which of the following statements is wrong?

- (A) The difference between the maximum and minimum energies is called maximum fluctuation of energy.
- (B) The co-efficient of fluctuation of speed is the ratio of maximum fluctuation of speed to the mean speed.
- (C) The variations of energy above and below the mean resisting torque line is known as fluctuation of energy.
- (D) None of the mentioned

4. If spring index = 2.5, what can be concluded about stresses in the wire?

- (A) They are high.
- (B) They are negligible.
- (C) They are moderate.
- (D) Cannot be determined.

5. The enthalpy and internal energy are the function of temperature for

- (A) all gases
- (B) steam
- (C) water
- (D) ideal gas

6. What is the abbreviation of Laser?

- (A) Light allowed simple emission of radiation
- (B) Light amplification by stimulated emission of radiation
- (C) Light amplified simultaneous emission of rays
- (D) Light amplified stimulated emanation of rays

7. In Abrasive jet machining, what may be the size of the abrasive grains used?

- (A) 10 — 40 μm
- (B) 50 — 100 μm
- (C) 100 — 150 μm
- (D) 200 — 300 μm

8. Which of the following phase will be resulted when the transformation temperature of steel is more than 750°C?

- (A) Austenite
- (B) Pearlite
- (C) Bainite
- (D) Martensite

Please Turn Over

9. On a bending of a beam, which is the layer which is neither elongated nor shortened?

- (A) Axis of load
- (B) Neutral axis
- (C) Center of gravity
- (D) None of the mentioned

10. Heat flow into a system is _____, and heat flow out of the system is _____.

- (A) positive, positive
- (B) negative, negative
- (C) negative, positive
- (D) positive, negative

11. What is the brake power if the swept volume is 3.5 liters, brake mean effective pressure is 10 bars, and speed is 6000 rpm?

- (A) 175 kW
- (B) 17.5 kW
- (C) 1.75 kW
- (D) 1750 kW

12. Which of the following is the mathematical technique used to predict physical parameters?

- (A) Dimensional analysis
- (B) Temperature analysis
- (C) Pressure analysis
- (D) Combustion analysis

13. In which of the following casting process the sand is mixed with a thermosetting resin to form a mould?

- (A) Shell moulding
- (B) Squeeze casting
- (C) Centrifugal casting
- (D) Die casting

14. Which of the following in power screws is the correct equation for torque if the load is lowered while designing a machine? (W: Weight in N, θ : Angle of inclination, ϕ : Friction angle)

- (A) $W \tan (\theta / \phi)$
- (B) $W \tan (\theta \times \phi)$
- (C) $W \tan (\theta + \phi)$
- (D) $W \tan (\theta - \phi)$

15. Which of the following fields are not present for edge dislocation?

- (A) Tensile
- (B) Compressive
- (C) Shear stress
- (D) Strain

16. Which of the following expressions is not correct for designing a shaft according to rigidity?

- (A) $T = G\theta J/L$
- (B) $J = TL/G\theta$
- (C) $\theta = TL/GJ$
- (D) $L = G\theta T/J$

17. Which of the following is a cylinder head type of an IC engine?

- (A) U head
- (B) F head
- (C) C head
- (D) X head

18. _____ requires less proportion of binders.

- (A) Natural sand
- (B) Synthetic sand
- (C) Loam sand
- (D) Silica sand

19. Given the cross sectional area as 4 m^2 , what will be the gauge length?

- (A) 12.3 m
- (B) 13 m
- (C) 11.3 m
- (D) 12 m

20. What is the strain energy stored in a body due to gradually applied load?

- (A) $\sigma E/V$
- (B) $\sigma E^2/V$
- (C) $\sigma V^2/E$
- (D) $\sigma V^2/2E$

21. Drilling in Ultrasonic Machining is done, by which motion of the tool?
- Only rotation
 - Only oscillation
 - Oscillation and rotation
 - None of the above
22. If the spring is compressed completely and the adjacent coils touch each other, then the length of spring is called as
- Solid length
 - Compressed length
 - Free length
 - None of the above
23. A Hartnell governor is a
- pendulum type governor
 - spring loaded governor
 - dead weight governor
 - inertia governor
24. Up to which point on the stress-strain curve is Hooke's law valid?
- Elastic limit
 - Yield point
 - Proportionality limit
 - Fracture point
25. The Diesel cycle consists of
- two reversible isotherms and two reversible isobars.
 - one reversible isochore and two reversible adiabatics and one reversible isobar.
 - one reversible isotherm and two reversible isochores and one reversible isobar.
 - two reversible isobars and two reversible adiabatics.
26. Which of the following is defined as an upraised part on the hood which directs the airflow into the engine compartment?
- Hood scoop
 - Spoiler
 - Wings
 - Hotpipe
27. What are the relevant boundary conditions in case of heat transfer from a bar connected to two heat sources at different temperatures?
- $\alpha = \alpha_1$ at $x = 1$ and $\alpha = \alpha_2$ at $x = 2L$
 - $\alpha = \alpha_1$ at $x = 0$ and $\alpha = \alpha_2$ at $x = \text{infinity}$
 - $\alpha = \alpha_1$ at $x = 0$ and $\alpha = \alpha_2$ at $x = L$
 - $\alpha = \alpha_1$ at $x = \text{infinity}$ and $\alpha = \alpha_2$ at $x = 1$
28. What are the values of velocity maintained in the EBM process?
- 118×10^3 m/s
 - 228×10^3 m/s
 - 338×10^3 m/s
 - 448×10^3 m/s
29. Given the shear modulus (G) for aluminum as $2.4e^{10}$ N/m² and the shear strain is given as $6e^{-5}$. What is the value for shear stress?
- $13.4e^{+5}$ N/m²
 - $14.4e^{+5}$ N/m²
 - $12.4e^{+5}$ N/m²
 - $13.4e^{-5}$ N/m²
30. Armature reaction of an unsaturated D.C. machine is
- Cross-magnetizing
 - Magnetizing
 - De-magnetizing
 - None of the above

Please Turn Over

31. For a heat pump, coefficient of performance is given by (T_1 is the temperature of heat rejection and T_2 is the temperature of heat absorption)

- (A) $T_1/(T_1 - T_2)$
- (B) $T_2/(T_1 - T_2)$
- (C) $1 - (T_1/T_2)$
- (D) $1 - (T_2/T_1)$

32. What is the rate of heat transfer from the fin in case of fin insulated at the tip?

- (A) $(h P k)^{1/2} (t_0 - t_a) \tan h ml$
- (B) $(h P A)^{1/2} (t_0 - t_a) \tan h ml$
- (C) $(h P k A)^{1/2} (t_0 - t_a) \tan h ml$
- (D) $(h k A)^{1/2} (t_0 - t_a) \tan h ml$

33. The correct sequence of processes in CI engine is

- (A) intake < fuel injection and combustion < compression < expansion < exhaust
- (B) intake < compression < fuel injection and combustion < expansion < exhaust
- (C) intake < compression < expansion < fuel injection and combustion < exhaust
- (D) intake < compression < exhaust < fuel injection and combustion < expansion

34. In the manufacturing of hole and shaft, the maximum shaft diameter was 49.88 mm and the minimum hole diameter was found to be 49.94 mm. Which of the following is correct?

- (A) Interference fit
- (B) Transition fit
- (C) Clearance fit
- (D) None of the above

35. Which of the following processes is not used to remove the cores from the finished casting?

- (A) Blowing
- (B) Melting
- (C) Washing
- (D) Chemical Dipping

36. By first law of thermodynamics,

- (A) $Q = \Delta E - W$
- (B) $Q = \Delta E + W$
- (C) $Q = -\Delta E - W$
- (D) $Q = -\Delta E + W$

37. Which of the following statement is true?

- (A) Cast aluminium alloys are specified by a four digit system while wrought alloys by a five digit system.
- (B) Cast aluminium alloys are specified by a five digit system while wrought alloys by a four digit system.
- (C) Cast aluminium alloys are specified by a six digit system while wrought alloys by a five digit system.
- (D) Cast aluminium alloys are specified by a five digit system while wrought alloys by a six digit system.

38. A muff coupling is connecting two shafts. The torque involved is 650 N-m. The shaft diameter is 45 mm with length and breadth of the key being 14 mm and 80 mm respectively. Find the shear stress induced in the key.

- (A) 30.2 N/mm²
- (B) 25.8 N/mm²
- (C) 34.4 N/mm²
- (D) None of the listed

39. Major constituent of the gun metal is _____.

- (A) Copper
- (B) Nickel
- (C) Iron
- (D) Zinc

40. For two-stroke SI engine, the scavenging efficiency is 0.5, cylinder volume of 1200 cc and the scavenging density is 1.3 kg/m³. What is the mass flow rate of air per cycle?

- (A) 0.00072 kg/cycle
- (B) 0.00076 kg/cycle
- (C) 0.00074 kg/cycle
- (D) 0.00084 kg/cycle

41. Define Factor of safety.
- Ultimate stress/Permissible stress
 - Ultimate stress/Shear stress
 - Compressive stress/Ultimate stress
 - Tensile stress/Shear stress
42. Sum of enthalpy and kinetic energy remains a constant in _____.
- Polytropic flow
 - Isentropic flow
 - Adiabatic flow
 - Mechanical flow
43. What is the product of inertia of a circle of diameter 10 mm?
- 1862 mm⁴
 - 1945 mm⁴
 - 1963 mm⁴
 - 2014 mm⁴
44. The pressure at any given point of a non-moving fluid is called the _____.
- Gauge Pressure
 - Atmospheric Pressure
 - Differential Pressure
 - Hydrostatic Pressure
45. Which of the following forging operation is Heading?
- Embossing
 - Coining
 - Piercing
 - Upsetting
46. Which of the following parts does not include an automobile chassis?
- Differential
 - Brakes
 - Steering system
 - Shock absorbers
47. A beam is said to be of uniform strength, if—
- B.M. is same throughout the beam
 - Shear stress is the same through the beam
 - Deflection is the same throughout the beam
 - Bending stress is the same at every section along its longitudinal axis
48. In which of the following processes the ductility of material decreases?
- Hot working
 - Cold working
 - Warm working
 - Cannot say
49. A cube having each side of length p , is constrained in all directions and is heated uniformly so that the temperature is raised to T.C. What will be the stress developed in the cube?
- $\delta ET/\gamma$
 - $\delta TE/(1-2\gamma)$
 - $\delta TE/2\gamma$
 - $\delta TE/(1+2\gamma)$
50. At the interface of solid body, heat flows by conduction and is given by
- $A(t_s - t_{\text{infinity}})$
 - $hA(t_s - t_{\text{infinity}})$
 - $h(t_s - t_{\text{infinity}})$
 - hA

Please Turn Over

51. If $F = m \cdot \omega^2 \cdot r$ represents the centrifugal force then which of the following expressions represents controlling force?

- (A) F
- (B) 2F
- (C) - 2F
- (D) - F

52. Which of the following is a classification of automobiles based on Load?

- (A) Heavy transport vehicle (HTV)
- (B) Sedan Hatchback car
- (C) Four wheeler vehicle
- (D) Front-wheel drive

53. The final dimensions of the pattern are _____ the final dimensions of the casting required.

- (A) similar to
- (B) different from
- (C) equal to
- (D) approximate to

54. Which of the following methods is not used in measuring the velocity of a stream?

- (A) By floats
- (B) By rod float
- (C) By hydrograph
- (D) By colour

55. How is the material removed in Electropolishing process?

- (A) Anodic dissolution
- (B) Cathodic dissolution
- (C) Chemical corrosion
- (D) Mechanical erosion

56. Air injection processes can be used for _____.

- (A) Iron
- (B) Scandium
- (C) Zinc
- (D) Argon

57. The appropriate rate equation for convective heat transfer between a surface and adjacent fluid is prescribed by which law?

- (A) Newton's law of cooling
- (B) Kirchhoff's law
- (C) Newton's first law
- (D) Wein's displacement law

58. What causes an un-proportionally thin and high tooth in the toe region, and a short and thick tooth at the heel?

- (A) Difference in feed rates
- (B) Difference in PCDs of the generating gears
- (C) Error in indexing while manufacturing
- (D) Difference in outer and inner circumference of the generating gear

59. What is the unit of radius of gyration?

- (A) m^4
- (B) m
- (C) N
- (D) m^2

60. The work done in irreversible adiabatic expansion by the turbine is called

- (A) external work
- (B) internal work
- (C) zero work
- (D) useful work

61. Which of the following is having highest value of overall heat transfer coefficient?
- (A) Steam
 - (B) Steam condensers
 - (C) Feed water heaters
 - (D) Alcohol condensers
62. In simply supported beams, the _____ stress distribution is not uniform.
- (A) bending
 - (B) shearing
 - (C) tensile
 - (D) compressive
63. What type of flow can be taken for granted in a pipe of a uniform cross-section?
- (A) Steady
 - (B) Unsteady
 - (C) Uniform
 - (D) Non-uniform
64. In mechanical machining, material is removed by _____.
- (A) erosion
 - (B) corrosion
 - (C) abrasion
 - (D) vaporization
65. Which of the following mechanisms are used in the hybrid machining of ECH?
- (A) Electro chemical dissolution
 - (B) Mechanical abrasion
 - (C) Electro chemical dissolution & Mechanical abrasion
 - (D) None of the above
66. What is the factor of safety?
- (A) The ratio of stress to strain
 - (B) The ratio of permissible stress to the ultimate stress
 - (C) The ratio of ultimate stress to the permissible stress
 - (D) The ratio of longitudinal strain to stress
67. Find the discharge through a rectangular orifice 2.2 m wide and 1.3 m deep fitted to a easier tank. The water level in a team is 2.5 m above the top edge of orifice.
- (A) $13.9 \text{ m}^3/\text{s}$
 - (B) $11.5 \text{ m}^3/\text{s}$
 - (C) $16.9 \text{ m}^3/\text{s}$
 - (D) $8.7 \text{ m}^3/\text{s}$
68. The radiant heat transfer from a plate of 2.5 cm^2 area at 1250 K to a very cold enclosure is 5.0 W. Determine the emissivity of the plate at this temperature.
- (A) 0.544
 - (B) 0.144
 - (C) 0.044
 - (D) 0.244
69. Which point on the stress strain curve occurs after the ultimate point?
- (A) Last point
 - (B) Breaking point
 - (C) Elastic limit
 - (D) Material limit
70. Which of the following contribute to the reason behind the origin of surface tension?
- (A) Only cohesive forces
 - (B) Only adhesive forces
 - (C) Neither cohesive forces nor adhesive forces
 - (D) Both cohesive forces and adhesive forces
71. Which is not a possible type of failure in a riveted joint?
- (A) Crushing failure of the plate
 - (B) Shear failure of rivet
 - (C) Tensile failure of the plate between rivets
 - (D) Shear failure of plate

Please Turn Over

72. Which of the following is correct regarding one dimensional heat transfer?

- (A) Steady $-f(x, y, t)$, Unsteady $-f(x)$
- (B) Steady $-f(y, z)$, Unsteady $-f(y)$
- (C) Steady $-f(x, t)$, Unsteady $-f(x)$
- (D) Steady $-f(x)$, Unsteady $-f(x, t)$

73. For low and moderate speed engines, the cam follower should move with

- (A) uniform velocity
- (B) simple harmonic motion
- (C) uniform acceleration and retardation
- (D) cycloidal motion

74. What type of friction in cup design is recommended for the set screw?

- (A) Sliding
- (B) Rolling
- (C) Static
- (D) None of the above

75. Why do the pore characteristics of the resulting pSi Structures depend upon the doping type? Choose the most correct option.

- (A) The pore formation mechanism relies on doping.
- (B) Atomic size of doping atom affects the final structure.
- (C) Processing time depends on the doping.
- (D) The manufacturing process is selected on the basis of doping.

76. Which of the following is not correct about fixture?

- (A) It is used to hold the work.
- (B) It is used to position the work.
- (C) It assures high accuracy of parts.
- (D) It is used to guide the cutting tool.

77. Which of the following is/are the components of a brass alloy?

- (A) Brass, Copper, Zinc
- (B) Copper only
- (C) Zinc only
- (D) Both Copper and Zinc

78. If a piston/cylinder with a cross-sectional size of 0.01 m^2 is resting on the stops, what should the water pressure be to lift the piston with an outside pressure of 100 kPa?

- (A) 218 kPa
- (B) 168 kPa
- (C) 198 kPa
- (D) 318 kPa

79. Frenkel defect belongs to which of the following classes?

- (A) Point defect
- (B) Linear dislocation
- (C) Interfacial defect
- (D) Bulk defect

80. Which among these devices are the best suited for the measurement of high pressure liquids with high accuracy?

- (A) Dead Weight Gauge
- (B) Vacuum Gauge
- (C) Manganin wire pressure
- (D) Ionization Gauge

81. The engine of an aeroplane rotates in clockwise direction when seen from the tail end and the aeroplane takes a turn to the left. The effect of the gyroscopic couple on the aeroplane will be

- (A) to raise the nose and dip the tail
- (B) to dip the nose and raise the tail
- (C) to raise the nose and tail
- (D) to dip the nose and tail

82. For high speed engines, the cam follower should move with

- (A) uniform velocity
- (B) simple harmonic motion
- (C) uniform acceleration and retardation
- (D) cycloidal motion

83. Protons attract electrons. Then why do electrons not fall on the nucleus?

- (A) Neutrons repel the electrons
- (B) Electrons in ground state cannot radiate energy
- (C) At very small distances, protons repel electrons
- (D) Inner electrons repel those in outer orbitals

84. In an isothermal curve, which of the following is true when the temperature is increased?

- (A) The curve shifts rightward
- (B) The curve shifts leftward
- (C) The curve goes down
- (D) The curve goes up

85. In a CAD package, mirror image of a 2D point P(5, 10) is to be obtained about a line which passes through the origin and makes an angle of 45° counter clockwise with the X-axis. The coordinates of the transformed point will be

- (A) (7.5, 5)
- (B) (10, 5)
- (C) (7.5, -5)
- (D) (10, -5)

86. Wrought iron is a product of _____.

- (A) Cupola
- (B) Bessemer converter
- (C) Puddling furnace
- (D) Blast furnace

87. The essential condition for parallel operation of two D.C. generators is that they have

- (A) same kW rating
- (B) the same operation r.p.m.
- (C) the same drooping voltage characteristics
- (D) same percentage regulation

88. In Meyer's expansion valve, the main valve is driven by an eccentric having an angle of advance from

- (A) $10^\circ-15^\circ$
- (B) $15^\circ-25^\circ$
- (C) $25^\circ-30^\circ$
- (D) $30^\circ-40^\circ$

89. Why fins are provided on a heat transfer surface?

- (A) Pressure drop of the fluid should be minimized
- (B) Increase turbulence in flow for enhancing heat transfer
- (C) Surface area is maximum to promote the rate of heat transfer
- (D) Increase temperature gradient so as to enhance heat transfer

90. What are the accuracy levels that are obtained by using IBM?

- (A) $\pm 1.0\%$
- (B) $\pm 2.0\%$
- (C) $\pm 3.0\%$
- (D) $\pm 4.0\%$

91. The lowest practicable temperature of heat rejected is the

- (A) given temperature
- (B) 0K
- (C) temperature of surroundings
- (D) 273K

Please Turn Over

92. Radiation heat transfer is characterized by
- (A) Movement of discrete packets of energy as electromagnetic waves
 - (B) Due to bulk fluid motion, there is a transport of energy
 - (C) There is the circulation of fluid by buoyancy effects
 - (D) Thermal energy transfer as vibrational energy in the lattice structure of the material
93. Which of the following property cannot be determined by a tensile test?
- (A) Yield strain
 - (B) Yield stress
 - (C) Elastic limit
 - (D) Limit of proportionality
94. For manufacturing of a certain amount of hole, maximum hole size was found to be 50.14 mm and minimum hole size was found to be 49.98 mm. What will be the tolerance in mm?
- (A) 0.14
 - (B) 0.15
 - (C) 0.16
 - (D) 0.17
95. A circular solid disc of uniform thickness 20 mm, radius 200 mm and mass 20 kg, is used as flywheel. If it rotates at 600 rpm, the kinetic energy of the flywheel, in Joules is
- (A) 395
 - (B) 790
 - (C) 1580
 - (D) 3160
96. Turning is done on which type of surfaces?
- (A) Flat surfaces
 - (B) Cylindrical surfaces
 - (C) Irregular surfaces
 - (D) Spherical surfaces
97. Abrasive machining is used when _____ is needed.
- (A) cutting
 - (B) roughing
 - (C) finishing
 - (D) drilling
98. Determine the width of the cotter used in cotter joint connecting two rods subjected to axial load of 50 kN and permissible shear stress in cotter is $50 \text{ N}/(\text{mm}^2)$. Given thickness of cotter = 10 mm.
- (A) 50 mm
 - (B) 100 mm
 - (C) 150 mm
 - (D) 25 mm
99. Which type of lubrication system is used in two-stroke engine?
- (A) Mist lubrication system
 - (B) Wet sump lubrication system
 - (C) Dry sump lubrication system
 - (D) Splash lubrication system
100. Given that maximum fluctuation of energy is 2000 N-m/s and coefficient of fluctuation of speed is 0.02. What is the mean kinetic energy of flywheel?
- (A) 50 kN-m/s
 - (B) 40 kN-m/s
 - (C) 30 kN-m/s
 - (D) 20 kN-m/s