14/PD/M-2025-02

Candidate's Roll Number

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Booklet Series

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Serial No. 4121752

Question Booklet

MECHANICAL ENGINEERING

PAPER - II

Time Allowed : 2 Hours

Maximum Marks : 100

Read the following instructions carefully before you begin to answer the questions.

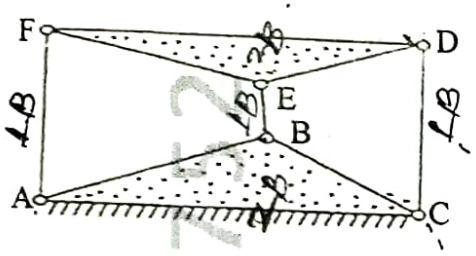
IMPORTANT INSTRUCTIONS

1. This Question Booklet contains 100 questions in all.
2. All questions carry equal marks.
3. An Answer Sheet has been supplied inside the Question Booklet to mark the answers. **You must write your Roll Number and encode it and write other particulars in the space provided in the Answer Sheet, failing which your Answer Sheet will not be evaluated.**
4. **Immediately after commencement of the examination, you should check up your Question Booklet and attached answer sheet and ensure that the Question Booklet Series is printed on the top right hand corner of the Booklet and the series encoded in answer sheet are same. Also please check that the Booklet contains 16 printed pages including two pages (Page Nos. 15 and 16) for Rough Work and no page or question is missing or unprinted or torn or repeated or question booklet and answer sheet have different series. If you find any defect in this Booklet and attached answer sheet, get it replaced Immediately by a complete Booklet with OMR sheet of the same series.**
5. You must write your Roll Number in the space provided on the top of this page. Do not write anything else on the Question Booklet.
6. Questions and their responses are printed in English version in this Booklet. Each question comprises of **four** responses - (A), (B), (C) and (D). You are to select ONLY ONE correct response and mark it in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case choose ONLY ONE response for each question.
7. In the Answer Sheet, there are **four** circles - Ⓐ, Ⓑ, Ⓒ and Ⓓ against each question. To answer the questions, you are to mark with **Black/Blue ink ballpoint pen ONLY ONE circle** of your choice for each question. Select only one response for each question and mark it in your Answer Sheet. If you mark more than one circle for one question, the answer will be treated as wrong. **Use Black/Blue ink ballpoint pen only to mark the answer in the Answer Sheet. Any erasure or change is not allowed.**
8. You should not remove or tear off any sheet from the Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. **After the examination has concluded, you must hand over your Answer Sheet to the Invigilator.** Thereafter, you are permitted to take away the Question Booklet with you.
9. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.
10. Candidates must assure before leaving the Examination Hall that their Answer Sheets will be kept in Self Adhesive LDPE Bag and completely packed/sealed in their presence.

1. The shapes of the bending moment diagram for a uniform cantilever beam carrying a uniformly distributed load over its length is:

(A) A parabola
(B) A hyperbola
(C) An ellipse
(D) A straight line

2. A linkage is shown below in the figure in which links ABC and DEF are ternary links whereas AF, BE and CD are binary links. The degrees of freedom of the linkage when link ABC is fixed are



(A) 3
(B) 1
(C) 2
(D) 0

3. Which of the following is an inversion of double slider crank chain?

(A) Oscillating cylinder engine
(B) Pendulum pump
(C) Elliptical trammels
(D) Coupling rod of a locomotive

4. The Coriolis component of acceleration is taken into account for

(A) Slider crank mechanism
(B) Four bar chain mechanism
(C) Quick return motion mechanism
(D) None of these

5. In a cone pulley, if the sum of radii of the pulleys on the driving and driven shafts is constant, then

(A) The drive is recommended depending upon the torque transmitted
(B) Cross belt drive is recommended
(C) Both open belt drive and cross belt drive are recommended
(D) Open belt drive is recommended

6. The product of the diametral pitch and circular pitch is equal to

(A) 2π
(B) $1/\pi$
(C) π
(D) 1

7. The module is the reciprocal of

(A) Diametral pitch
(B) Circular pitch
(C) Pitch diameter
(D) None of these

8. The train value of a gear train is

(A) $\frac{No.\ of\ teeth\ on\ driven}{Speed\ of\ driven}$

(B) $\frac{No.\ of\ teeth\ on\ driven}{No.\ of\ teeth\ on\ driver}$

(C) $\frac{No.\ of\ teeth\ on\ driver}{No.\ of\ teeth\ on\ driven}$

(D) $\frac{Speed\ of\ driver}{Speed\ of\ driven}$

9. The rotor of a ship rotates in clockwise direction when viewed from the stern and the ship takes a left turn. The effect of the gyroscopic couple acting on it will be

(A) To lower the bow and raise the stern

(B) To lower the bow and stern

(C) To raise the bow and lower the stern

(D) To raise the bow and stern

10. When the pitching of a ship is upward, the effect of gyroscopic couple acting on it will be

(A) To raise the stern and lower the bow

(B) To move the ship towards star-board

(C) To raise the bow and lower the stern

(D) To move the ship towards port side

11. Isochronism in a governor is desirable when

(A) one speed is desired under one load

(B) the engine operates at high speeds

(C) the engine operates at variable speeds

(D) the engine operates at low speeds

12. The tractive force is maximum or minimum when the angle of inclination of the crank to the line of stroke (θ) is equal to

(A) 135° and 315°

(B) 135° and 180°

(C) 180° and 225°

(D) 90° and 225°

13. Match List-I with List-II and select the correct answer using the codes given below the Lists:

List-I	List-II
P. Distortion energy theory	1. Coulomb, Tresca and Guest's theory
Q. Maximum shear stress theory	2. St. Venant's theory
R. Maximum total strain energy theory	3. Haigh's theory
S. Maximum strain theory	4. Huber von Mises and Hencky's theory

Code :

	P	Q	R	S
(A)	3	4	2	1
(B)	3	1	2	4
(C)	4	3	1	2
(D)	4	1	3	2

14. 'Overhauling' in power screw occur

(A) Friction angle $\leq$ Helix angle

(B) Friction angle $\geq$ Helix angle

(C) Friction angle $>$ Helix angle

(D) Friction angle $<$ Helix angle

15. The Wahl factor for helical spring is given by

(A) $\frac{4C-1}{4C-4}+\frac{0.615}{C}$

(B) $\frac{4C-4}{4C-1}-\frac{0.615}{C}$

(C) $\frac{4C-1}{4C-4}-\frac{0.615}{C}$

(D) $\frac{4C-4}{4C-1}+\frac{0.615}{C}$

16. Which of following is considered as thermodynamic displacement work?
(A) Shaft work
(B) Paddle wheel work
(C) Boundary work
(D) Electrical work

17. Consider the following properties :
1 Temperature
2 Viscosity
3 Specific entropy
4 Thermal conductivity
Which of the above properties of a system is/are intensive?
(A) 1, 2, 3 and 4
(B) 2 and 3 only
(C) 2, 3 and 4 only
(D) 1 only

18. Which of the following is/are reversible processes (es)?
1 Isentropic expansion
2 Slow heating of water from a hot source
3 Constant pressure heating of an ideal gas from a constant temperature source
4 Evaporation of a liquid at constant temperature
Select the correct answer using the code given below :
(A) 1 and 4
(B) 1 and 2
(C) 2 and 3
(D) 1 only

19. What is temperature of triple point of water?
(A) 0.01 C°
(B) 0.1 K
(C) 0.01 K
(D) 0.1 C°

20. Which of the following statement is not correct with regards to heat and work transfer?
(A) Heat transfer is the energy interaction due to temperature difference only where all other energy interactions may be termed as work transfer
(B) Both heat and work transfer are boundary phenomena
(C) Both heat and work are path functions and exact differential
(D) Heat and work transfer are the form of energy interactions

21. A new temperature scale in degrees N is to be defined. The boiling and freezing on this scale are 500° N and 200°N respectively. What will be the reading on new scale corresponding to 40°C?
(A) 320°N
(B) 420°N
(C) 220°N
(D) 120°N

22. For the expression pdv to represent the work, which of the following conditions should apply?
(A) If the system is open one, it should be non-reversible pdv
(B) The process is non-quasi static
(C) The boundary of the system should not move in order that work may be transferred
(D) The system is closed one and process takes place in non-flow system

23. When a gas is heated at constant pressure, the percentage of the energy supplied, which goes as the internal energy of the gas is :
(A) Less for triatomic gas than for a diatomic gas
(B) Same for monatomic, diatomic and triatomic gases but less than 100%
(C) 100% for all gases
(D) More for a diatomic gas than for triatomic gas

24. During a process with heat and work interactions, the internal energy of a system increases by 80 kJ. The amounts of heat and work interactions are respectively.

(A) 50 kJ and -130 kJ
(B) -50 kJ and 130 kJ
(C) 50 kJ and 130 kJ
(D) -50 kJ and - 130 kJ

25. Which one of the following is correct on basis of the second law of thermodynamics?

(A) $\Delta E = q + w$
(B) $\Delta S = q_{rev}/T$ at constant temperature
(C) Efficiency of the Stirling cycle is more than that of a Carnot cycle
(D) For any spontaneous process, the entropy of the universe increases

(The symbols have their usual meaning)

26. For a given heat flow and for the same thickness, the temperature drops across the material will be maximum for

(A) Refractory brick
(B) Steel
(C) Glass-wool
(D) Copper

27. A large concrete slab 1 m thick has a one-dimensional temperature distribution :

$T = 10 - 30x + 70x^2 + 10x^3$

Where T is temperature and x is distance from one face towards other face of wall. If the slab material has thermal diffusivity of 2×10^{-3} m^2/hr, what is the rate of change of temperature at the other face of the wall?

(A) 0.5 °C/h
(B) 0.4 °C/h
(C) 0.45 °C/h
(D) 0.3 °C/h

28. The use of fins is the most effectively in application justified?

(A) With higher overall heat transfer coefficient
(B) In liquid medium with forced convection
(C) In gas medium with natural convection
(D) With higher convection heat transfer coefficient

29. It is proposed to coat a 1 mm diameter wire with enamel paint ($k = 0.2$ W/mK) to increase heat transfer with air. If the air side heat transfer coefficient is 100 W/m^{2}K, then optimum thickness of enamel paint should be :

(A) 0.5 mm
(B) 1.5 mm
(C) 1 mm
(D) 2 mm

30. In current carrying conductors, if the radius of the conductor is less than the critical radius, then addition of electrical insulation is desirable, as

(A) It reduces the thermal resistance of the insulation and thereby enables the conductor to carry a higher current
(B) It increases the heat loss from the conductor and thereby enables the conductor to carry a higher current
(C) It increases the thermal resistance of the insulation and thereby enables the conductor to carry a higher current
(D) It reduces the heat loss from the conductor and thereby enables the conductor to carry a higher current

31. Efficiency of fin is considered, as
(A) Ratio of actual heat transfer rate from the fin to heat transfer rate from the surface area
(B) Ratio of actual heat transfer rate from the fin to ideal heat transfer rate from the fin
(C) Ratio of heat transfer rate from the fin base area to heat transfer rate from the surface area
(D) Ratio of actual heat transfer rate from the fin to heat transfer rate from the base area

32. Biot number is the ratio of?
(A) Conduction resistance within body to convection at the surface of the body
(B) Conduction within body to convection at the surface of the body
(C) Conduction resistance within body to convection resistance at the surface of the body
(D) Convection resistance within body to conduction within the body

33. For lumped system analysis it is assumed that:
(A) Conduction thermal resistance of the body is zero
(B) Convection thermal resistance of the body is zero
(C) Convection through surface is zero
(D) Conduction through the body is zero

34. The equation of effectiveness $\varepsilon = 1 - e^{NTU}$ for a heat exchanger is valid in the case of:
(A) Gas turbine for both parallel now and counter flow
(B) Boiler and condenser for counter flow
(C) Boiler and condenser for both parallel flow and counter flow
(D) Boiler and condenser for parallel flow

35. An oil of specific gravity 0.9 has viscosity of 0.28 Stokes at 380C°. What will be its viscosity in Ns/m^2?
(A) 0.0206
(B) 0.0311
(C) 0.0252
(D) 0.2520

36. Decrease in temperature, in general, results in
(A) A decrease in the viscosity of liquids and an increase in that of gases
(B) A decrease in the viscosities of both liquids and gases
(C) An increase in the viscosity of liquids and a decrease in that of gases
(D) An increase in viscosities of both gases and liquids

37. If the velocity potential (ϕ) satisfies the Laplace equation, represents that:
(A) rotational component of flow is not zero
(B) flow should be irrotational
(C) flow should be incompressible
(D) possible steady incompressible irrotational flow

38. A mercury-water manometer has a gauge difference of 500 mm (difference in elevation of menisci). What will be the difference in pressure?
(A) 7.3 m
(B) 6.3 m
(C) 6.8 m
(D) 0.5 m

39. The vertical component of the hydrostatic force on a submerged curved surface is the
(A) Product of pressure at the centroid and the surface area
(B) Weight of the liquid supported by the curved surface upto free surface of liquid
(C) Force on a vertical projection of the surface
(D) Mass of liquid vertically above it

40. A floating body is considered in unstable equilibrium under the condition of:

(A) When metacentre M is above centre of gravity G

(B) When metacentre M is coincided with centre of gravity G

(C) When metacentre M is below the centre of gravity G

(D) None of the above

41. A large metacentric height in a vessel

(A) Improves stability and makes the periodic time of oscillation shorter

(B) Impairs stability and makes periodic time of oscillation shorter

(C) Has no effect on stability or the periodic time of oscillation

(D) Improves stability and makes periodic time to oscillation longer

42. Irrotational flow occurs when :

(A) Fluid element does not undergo any change in size or shape

(B) Fluid particles while flowing along streamline also rotate about their mass centre

(C) There is no net rotation of the fluid element about its mass center

(D) Flow takes place in a duct of uniform cross-section at constant mass flow rate

43. For a forced vortex flow in a open tank:

(A) Fall of liquid level at centre is equal to rise of liquid level at the ends

(B) Fall of liquid level at centre is more than rise of liquid level at the ends

(C) Fall of liquid level at centre is half of rise of liquid level at the ends

(D) Fall of liquid level at centre is less than rise of liquid level at the ends

44. In a Rankine cycle, with the maximum steam temperature being fixed from metallurgical considerations, as the boiler pressure increases.

(A) The quality of turbine exhaust will remain unchanged

(B) The quality of turbine exhaust will decrease

(C) The quality of turbine exhaust will increase

(D) The condenser load will increase

45. Which one of the following statement is correct?

(A) Both cycles have the same efficiencies and work ratio

(B) Efficiency of the Carnot cycle is high and work ratio is low in comparison to the Rankine cycle

(C) Efficiency of the Carnot cycle is low and work ratio is also low in comparison to the Rankine cycle

(D) Efficiency of the Carnot cycle for thermal power plant is high and work ratio is also high in comparison to the Rankine cycle

46. Which of the following statement is incorrect for two stroke engines as compared with four stroke engines?

(A) These engines are used where low cost, compactness and light weight are important

(B) Volumetric efficiency is more due to more time for induction

(C) Two stroke engines have no valves but only ports

(D) Thermal efficiency is lower also part load efficiency is poor

47. For constant maximum pressure and heat input, the air standard efficiency of gas power cycles is in the order.

(A) Diesel cycle, Otto cycle, dual cycle

(B) Otto cycle, Diesel cycle, dual cycle

(C) Dual cycle, Otto cycle, Diesel cycle

(D) Diesel cycle, dual cycle, Otto cycle

48. Priming is necessary in

(A) Hydraulic turbine to-increase the speed of turbine and to generate more power

(B) Centrifugal pumps to remove air in the suction pipe and casing

(C) Hydraulic turbine to remove air in the turbine casing

(D) Centrifugal pumps to lift water from a greater depth

49. Brinell hardness number is expressed by the equation

(A) $BHN = \dfrac{L}{\pi D\left(D - \sqrt{D^2 - d^2}\right)}$

(B) $BHN = \dfrac{L}{\pi d\left(D - \sqrt{D^2 - d^2}\right)}$

(C) $BHN = \dfrac{2L}{\pi d\left(D - \sqrt{D^2 - d^2}\right)}$

(D) $BHN = \dfrac{2L}{\pi D\left(D - \sqrt{D^2 - d^2}\right)}$

(Where L = load in kg, D = dia. of ball in mm, d = dia. of indentation in mm.)

50. Match List-I with List-II and select the correct answer, using the codes given below the lists :

List-I (Heat Treatment)	List-II (Effect of the properties)
A Annealing	1. Refined grain structure
B Nitriding	2. Improves the hardness of the whole mass
C Martempering	3. Increases surface hardness
D Normalising	4. Improves ductility

Code :

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

51. Chemicals attack atoms within grain boundaries preferentially because they have

(A) Lower number of atoms than in the grains

(B) Higher energy than those in the grains

(C) Higher number of atoms than in the grains

(D) Lower energy than those in the grains

52. Atomic packing factor (APF) in the case of copper crystal is

(A) 1.63

(B) 0.68

(C) 0.74

(D) 0.52

53. Heating the hypoeutectoid steels to 30° C above the upper critical temperature line, soaking at that temperature and then cooling slowly to room temperature to form a pearlite and ferrite structure, is known as
(A) Annealing
(B) Normalizing
(C) Tempering
(D) Hardening

54. Arc blow occurs in
(A) Gas cutting
(B) Arc welding when straight polarity is used
(C) Arc welding when reverse polarity is used
(D) Gas welding

55. In coated electode in arc welding
(A) Rod melts first and then coating melts
(B) Coating melts first and then rod melts
(C) Which melts first depends on polarity used
(D) Both rod and coating melt simultaneously

56. In manual arc welding, the equipment should have drooping characteristics in order to maintain
(A) Weld pool red-hot
(B) Current constant when arc length changes
(C) Temperature in the arc contstant
(D) Voltage constant when arc length changes

57. In MIG welding, the metal is transferred into the form of which one of the following?
(A) Molecules
(B) Molten drops
(C) Weld pool
(D) A fine spray of metal

58. Fluidity is greatly influenced by
(A) Pouring temperature of molten metal
(B) Melting temperature of molten metal
(C) Inoculant addition
(D) Carbon content of molten metal

59. Freezing ratio or relative freezing time according to Caine's equation is
(A) $\frac{V_R/A_R}{V_C/A_C}$
(B) $\frac{A_R/V_R}{A_C/V_C}$
(C) $\frac{V_C/A_C}{V_R/A_R}$
(D) $\frac{A_C/V_C}{A_R/V_R}$

(Where A_C and A_R are areas of casting and risers and V_C and V_R are their volumes)

60. The ratio of surface area of volume for a unit volume of riser is minimum in case of
(A) Cuboids riser
(B) Spherical riser
(C) Hemispherical riser
(D) Cylindrical riser

61. In light metal casting, runner should be so designed that:
1 It avoids aspiration
2 It avoids turbulence
3 The path of runner is reduced in area so that unequal volume of flow through each gate takes place
(A) 1, 2 and 3
(B) 1 and 3 only
(C) 2 and 3 only
(D) 1 and 2 only

62. In gating system design, which one of the following is the correct sequence in which choke area, pouring time, pouring basin and sprue sizes are calculated?

(A) Pouring basin - Pouring time - Choke area - Sprue

(B) Pouring basin - Sprue - Choke area - Pouring time

(C) Choke area - Sprue - Pouring basin - Pouring - time

(D) Choke area - Pouring time - Pouring basin - Sprue

63. Plug rolling is used to

(A) Increase wall thickness of tubes

(B) Produce seamless tubes

(C) Reduce wall thickness and increase diameter of tubes

(D) Produce collapsible tubes

64. Lancing is the operation of

(A) Punching in which punch is stopped as soon as the metal fracture is complete and metal is not removed but held in hold

(B) Cutting of the excess metal at edge which was required for gripping purpose during press working operation

(C) Cutting in a single line across a part of the metal strip to allow bending or forming in progressive die operation while the part remains attached to the strip

(D) Removal of excess metal from the edge of a strip to make it suitable for drawing without wrinkling

65. Swaging is the operation

(A) Employed to expand a tubular or cylindrical part

(B) Of producing contours in sheet metal and of bending previously roll formed sections

(C) In which a series of impact blows are transferred on dies so that solid or tubular work changes in cross-section or geometric shape

(D) In which the edges of sheet are turned over to provide stiffness and smooth edge

66. Cold working produces the following effects :

1 Stresses are set up in the metal

2 Grain structure gets distorted

3 Strength and hardness of the metal are decreased

4 Surface finish is reduced

Which of these statement are correct?

(A) 1 and 4

(B) 1, 2 and 3

(C) 3 and 4

(D) 1 and 2

67. In orthogonal cutting test, the cutting force = 900 N, the thrust force = 600 N and chip shear angle is 30°. Then the chip shear force is

(A) 69.6 N

(B) 969.6 N

(C) 479.4 N

(D) 1079.4 N

68. Flank wear occurs mainly on which of the following?

(A) Face of the cutting tool at a short distance from the cutting edge

(B) Cutting edge only

(C) Nose part, front relief face and side relief face of the cutting tool

(D) Nose part and top face

69. Using the Taylor equation $VT^n = C$, calculate the percentage increase in tool life when the cutting speed is reduced by 50% ($n = 0.5$ and $c = 400$)

(A) 50%

(B) 400%

(C) 100%

(D) 300%

70. Electro - discharge machining uses the following dielectric fluid

(A) Kerosene

(B) Acqueous salt solution

(C) Sodium hydroxide

(D) Water

71. When machining a hard and brittle metal like cast iron, the type of chips produced is

(A) Fine chips

(B) Discontinuous chip

(C) Continuous chip with build-up edge

(D) Continuous chip

72. Among the conventional machining processes, maximum specific energy is consumed in

(A) Grinding

(B) Drilling

(C) Planning

(D) Turning

73. The strain hardening exponent n of stainless-steel SS 304 with distinct yield and UTS values undergoing plastic deformation is

(A) $n = 1$

(B) $n = 0$

(C) $0 < n < 1$

(D) $n < 0$

74. Plug gauges are used to

(A) Check the length of holes in the workpieces

(B) Measure the diameter of the holes in the workpieces

(C) Check the diameter of the holes in the workpieces

(D) Measure the diameter of the workpieces

75. In the tolerance specification 25 D 6, the letter D represents

(A) Type of fit

(B) Upper deviation

(C) Lower deviation

(D) Grade of tolerance

76. Interpolation in the controller refers to control of which one of the following in a CNC machine?

(A) Coolant and miscellaneous functions on machine

(B) Loading/unloading of tools from the tool changer

(C) Axes of machine for contouring

(D) Loading/unloading of jobs on machine

77. The demand for a product in the month of March turned out to be 20 units against an earlier made forecast of 20 units. The actual demand for April and May turned to be 25 and 26 units respectively. What will be the forecast for the month of June, using exponential smoothing method and taking constant α as 0.2?

(A) 28 units

(B) 22 units

(C) 26 units

(D) 20 units

78. A company has four work centres A,B,C and D, with per day capacities of 450 units, 390 units, 360 units and 400 units respectively. The machines are laid down in order A,B,C and D and product has to be operated on all these machines for getting converted into finished product. The actual output turns to be 306 units per day. What is the system efficiency?

(A) 85%
(B) 78%
(C) 80%
(D) 68%

79. Which of the following is the measure of forecast error?

(A) Price fluctuation
(B) Trend value
(C) Moving average
(D) Mean absolute deviation

80. For vibration isolation, the transmissibility ratio becomes less than unity if the ratio of forcing frequency to natural frequency is

(A) Between 0 and 1
(B) Equal to 1
(C) Greater than $\sqrt{2}$
(D) Less than 1

81. A rod of material with $E = 2.1 \times 10^5$ N/mm^2 and $\alpha = 1.2 \times 10^{-5}$ Per °C is fixed at both ends. It is uniformly heated such that the increase in temperature is 30 K. The stress developed in the rod is

(A) 763.56 N/mm^2 (compressive)
(B) 763.56 N/mm^2 (tensile)
(C) 75.6 N/mm^2 (compressive)
(D) 75.6 N/mm^2 (tensile)

82. In a particular material, if the modulus of rigidity is equal to the bulk modulus, then the Poisson's ratio will be

(A) 1
(B) 1/4
(C) 1/2
(D) 1/8

83. Mitre gears is

(A) Bevel gears in which the angle between the axes is 90° and the speed ratio of the gears is 1 : 1
(B) Skew gears connecting non-parallel and nonintersecting shafts
(C) Bevel gears transmitting power at more than or less than 90°
(D) Spur-gears with gear ratio 1 : 1

84. An external gear with 65 teeth meshes with a pinion of 15 teeth, module being 4 mm. What is the centre distance in mm?

(A) 100
(B) 180
(C) 160
(D) 120

85. A leaf spring is supported at the-

(A) Centre and loaded anywhere
(B) Centre and loaded at the ends
(C) Ends and loaded anywhere
(D) Ends and loaded at centre

86. A ladder is resting on a rough ground and leaning against a smooth vertical wall. The force of friction will act-

(A) Perpendicular to the wall at its upper end
(B) Upward at its upper end
(C) Zero at its upper end
(D) Downward at its upper end

87. The effective length 'L' of a column fixed at both ends as compared to its actual length 'l' is

(A) $L = 1/\sqrt{2}$

(B) $L = 1$

(C) $L = 2l$

(D) $L = l/2$

88. What is sunk key made in the form of a segment of a circular disc of uniform thickness, known as?

(A) Saddle key

(B) Kennedy key

(C) Woodruff key

(D) Feather key

89. Which one of the following is the value of helix angle for maximum efficiency of a square threaded screw?

(A) $45° + \varphi/2$

(B) $45° - \varphi$

(C) $45° - \varphi/2$

(D) $45° + \varphi$

90. Which of the following is a surface fatigue failure occurs when the load on the bearing part exceeds the surface endurance strength of the material?

(A) Pitting Wear

(B) Abrasive Wear

(C) Corrosive Wear

(D) Scoring Wear

91. Consider a long tube of 25 mm outside diameter (d_o) and of 20 mm inside diameter (d_i) twisted about its longitudinal axis with a torque T of 45 N-m. The polar moment of inertia of the hollow tube is

(A) 27271 mm^4

(B) 36980 mm^4

(C) 18933 mm^4

(D) 22641 mm^4

92. What is the relationship between the linear elastic properties Young's modulus (E), rigidity modulus (G) and bulk modulus (K)?

(A) $\frac{9KG}{K+3G}$

(B) $\frac{9KG}{K+G}$

(C) $\frac{9KG}{3K+G}$

(D) $\frac{KG}{9K+G}$

93. The number of elastic constants for a completely anisotropic elastic material which follows Hooke's law is :

(A) 25

(B) 4

(C) 21

(D) 3

94. Match List-I with List-II and select the correct answer using the codes given below the Lists:

List - I	List - II
A Bending moment is constant	1. Point of contraflexure
B Bending moment is maximum or minimum	2. Shear force changes sign
C Bending moment is zero	3. Slope of shear force diagram is zero over the portion of the beam
D Loading is constant	4. Shear force is zero over the portion of the beam

Code :

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

95. The minimum number of teeth on the pinion to operate without interference in standard full height involute teeth gear mechanism with 20° pressure angle is

(A) 32
(B) 12
(C) 18
(D) 14

96. For spur with gear ratio greater than one, the interference is most likely to occur near the

(A) Root of the tooth
(B) Point of beginning of contact
(C) Point of end of contact
(D) Pitch point

97. Cycloidal tooth is made of two curves,

(A) hypocycloid curve above the Base circle and epicycloid curve below the Base circle
(B) hypocycloid curve above the pitch circle and epicycloid curve below the pitch circle
(C) hypocycloid curve below the Base circle and epicycloid curve above the Base circle
(D) hypocycloid curve below the pitch circle and epicycloid curve above the pitch circle

98. The equation of motion for a damped viscous vibration is $3\ddot{X}+9\dot{X}+27X=0$. The damping factor is

(A) 1.00
(B) 0.50
(C) 0.75
(D) 0.25

99. In a clock mechanism, hour and minute hands are connected by

(A) Compound gear train
(B) Simple gear train
(C) Reverted gear train
(D) Epicyclic gear train

100. A thin-walled cyclindrical vessel of wall thickness, t and diameter d is fitted with gas to a gauge pressure of p. The maximum shear stress on the vessel wall will then be :

(A) $\frac{pd}{8t}$

(B) $\frac{pd}{2t}$

(C) $\frac{pd}{4t}$

(D) $\frac{pd}{t}$