HALL TICKET NO. | | | | | | | |

NAME OF THE CANDIDATE

SIGNATURE OF THE CANDIDATE

SET CODE : **T2**

BOOKLET SL. NO. **313134**

BOOKLET CODE : **B**

INVIGILATOR'S SIGNATURE:

(MEC) **MECHANICAL ENGINEERING**

INSTRUCTIONS TO CANDIDATES

1. Candidates should write their Hall Ticket Number only in the space provided at the top left hand corner of this page, on the leaflet attached to this booklet and also in the space provided on the OMR Response Sheet. **BESIDES WRITING, THE CANDIDATE SHOULD ENSURE THAT THE APPROPRIATE CIRCLES PROVIDED FOR THE HALL TICKET NUMBERS ARE SHADED USING BALL POINT PEN (BLUE/BLACK) ONLY ON THE OMR RESPONSE SHEET. DO NOT WRITE HALL TICKET NUMBER ANY WHERE ELSE.**
2. Immediately on opening this Question Paper Booklet, check.
   (a) Whether **200** multiple choice questions are printed (**50** questions in Mathematics, **25** questions in Physics, **25** questions in Chemistry and **100** questions in Engineering)
   (b) In case of any discrepancy immediately exchange the Question paper Booklet of same code by bringing the error to the notice of invigilator.
3. Use of Calculators, Mathematical Tables and Log books is not permitted.
4. **Candidate must ensure that he/she has received the Correct Question Booklet, corresponding to his/her branch of Engineering.**
5. **Candidate should ensure that the booklet Code and the Booklet Serial Number, as it appears on this page is entered at the appropriate place on the OMR Response Sheet by shading the appropriate circles provided therein using Ball Point Pen (Blue/Black) only. Candidate should note that if they fail to enter the Booklet Serial Number and the Booklet Code on the OMR Response Sheet, their Answer Sheet will not be valued.**
6. **Candidate shall shade one of the circles 1, 2, 3 or 4 corresponding question on the OMR Response Sheet using Ball Point Pen (Blue/Black) only. Candidate should note that their OMR Response Sheet will be invalidated if the circles against the question are shaded using pencil or if more than one circle is shaded against any question.**
7. One mark will be awarded for every correct answer. **There are no negative marks.**
8. The OMR Response Sheet will not be valued if the candidate :
   (a) Writes the Hall Ticket Number in any part of the OMR Response Sheet except in the space provided for the purpose.
   (b) Writes any irrelevant matter including religious symbols, words, prayers or any communication whatsoever in any part of the OMR Response Sheet.
   (c) Adopts any other malpractice.
9. Rough work should be done only in the space provided in the Question Paper Booklet.
10. No loose sheets or papers will be allowed in the examination hall.
11. Timings of Test: 10.00 A.M. to 1.00 P.M.
12. Candidate should ensure that he / she enters his / her name and appends signature on the Question paper booklet, leaflet attached to this question paper booklet and also on the OMR Response Sheet in the space provided. Candidate should ensure that the invigilator puts his signature on this question paper booklet, leaflet attached to the question paper booklet and also on the OMR Response Sheet.
13. Before leaving the examination hall candidate should **return both the OMR Response Sheet and the leaflet attached to this question paper booklet** to the invigilator. Failure to return any of the above shall be construed as malpractice in the examination. **Question paper booklet may be retained by the candidate.**
14. This booklet contains a total of **32** pages including Cover page and the pages for Rough Work.

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SPACE FOR ROUGH WORK

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Note: *(1) Answer **all** questions.*

*(2) Each question carries **1** mark. There are no negative marks.*

*(3) Answer to the questions must be entered only on OMR Response Sheet provided separately by completely shading with **Ball Point Pen (Blue/Black)**, only one of the circles 1, 2, 3 or 4 provided against each question, and which is most appropriate to the question.*

(4) The OMR Response Sheet will be invalidated if the circle is shaded using pencil or if more than one circle is shaded against each question.

MATHEMATICS

1. $\int\left(\frac{x+2}{x+1}\right)dx =$

(1) $x\log(x+1)+c$ (2) $x\log(x+1)+2\log(x+1)+c$

(3) $x+\log(x+1)+c$ (4) $\frac{1}{x}\log(x+1)+c$

2. $\int\frac{x^2}{\sqrt{1+x^6}}dx =$

(1) $\frac{1}{2}\sin^{-1}(x^3)+c$ (2) $2\cos^{-1}(x^3)+c$

(3) $\frac{1}{2}\cos h^{-1}(x^3)+c$ (4) $\frac{1}{3}\sin h^{-1}(x^3)+c$

3. $\int 8x^3 e^{2x}\,dx =$

(1) $(4x^3-6x^2+6x-3)\,e^{2x}+c$ (2) $4x^3+6x^2+6x+3e^{2x}+c$

(3) $\left(\frac{4x^2}{3}-\frac{2}{3}x+\frac{1}{3}\right)e^{2x}+c$ (4) $\left(\frac{4x^2}{3}+\frac{2}{3}x-\frac{1}{3}\right)e^{2x}+c$

4. $\lim_{n\to\infty}\left[\frac{1}{n}+\frac{1}{n+1}+\frac{1}{n+2}+\ldots+\frac{1}{3n}\right]=$

(1) $\frac{\pi}{3}$ (2) $\frac{\pi}{4}$ (3) $\log 2$ (4) $\log 3$

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5. $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\sin x}}{\sqrt{\cos x}+\sqrt{\sin x}}\,dx =$

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$ (3) 0 (4) 2

6. The area of the region in the first quadrant enclosed by x–axis, y–axis, $y = 3x-2$ and $y = 4$ is

(1) 16 (2) 8 (3) $\frac{16}{3}$ (4) $\frac{8}{3}$

7. The root mean square (RMS) value of $\log x$ over the range $x = 1$ to $x = e$ is

(1) $\frac{\sqrt{(e+1)}}{\sqrt{(e-2)}}$ (2) $\frac{\sqrt{(e-2)}}{\sqrt{(e-1)}}$ (3) $\frac{\sqrt{(e+2)}}{\sqrt{(e+1)}}$ (4) $\frac{\sqrt{(e+2)}}{\sqrt{(e-1)}}$

8. The differential equation formed by eliminating the arbitrary constants a and b in the relation $y = a\cos(nx+b)$ is

(1) $\frac{d^2y}{dx^2}+n^2y=0$ (2) $\frac{d^3y}{dx^3}-x^3y=0$

(3) $\frac{dy}{dx}+ny=0$ (4) $\frac{d^2y}{dx^2}-y=0$

9. The solution of $\frac{dy}{dx} = e^{x-y}$

(1) $e^x-e^{-y}+c=0$ (2) $e^{x-y}+c$

(3) $e^x+e^{-y}+c=0$ (4) $e^x-e^y+e^c=0$

10. The solution of the differential equation $\tan x\frac{dy}{dx}+y=\sec x$ is

(1) $y\sin x - x = c$ (2) $y\cot x + x = c$

(3) $y = \tan x + c$ (4) $y.\ \text{cosec}\, x = x + c$

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11. The solution of the linear third order equation $\frac{d^3y}{dx^3} - 7\frac{d^2y}{dx^2} + 16\frac{dy}{dx} - 12y = 0$ is

(1) $y = c_1 e^{3x} + c_2 e^{x} + c_3 e^{4x}$

(2) $y = c_1 e^{3x} + c_2 x e^{x} + c_3 e^{4x}$

(3) $y = c_1 e^{2x} + c_2 x e^{3x} + c_3 e^{4x}$

(4) $y = c_1 e^{3x} + (c_2 + c_3 x)\, e^{2x}$

12. If $y_1 = e^{x}$ and $y_2 = e^{-x}$ are two solutions of the homogeneous differential equation; then

(1) $y_3 = e^{2x}$ and $y_4 = e^{-2x}$ are also solutions of the equation

(2) $y_3 = xe^{x}$ and $y_4 = xe^{-x}$ are also solutions of the equation

(3) $y_3 = \cosh x$ and $y_4 = \sinh x$ are also solutions of the equation

(4) $y_3 = \cos x$ and $y_4 = \sin x$ are also solutions of the equation

13. The particular integral (P.I) of the equation $(D^2+D-6)y = 5e^{2x} + 6$ is

(1) $xe^{2x} - 1$

(2) $e^{2x} + 1$

(3) $5xe^{2x} + 1$

(4) $e^{2x} - 1$

14. The particular integral of $(D^2+16)\, y = 8 \cos 4x$ is

(1) $\cos 4x$

(2) $x \sin 4x$

(3) $-\frac{1}{4}\sin 4x$

(4) $-\frac{1}{4}\cos 4x$

15. If $A = \begin{bmatrix} 2 & 4 & 3 \\ 1 & 0 & 2 \\ -3 & 5 & 1 \end{bmatrix}$ then,

(1) $A = A^T$

(2) A is a diagonal matrix

(3) A is a singular matrix

(4) A is a nonsingular matrix

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16. If $A=\begin{bmatrix}2 & 5 & 3\\ 3 & 1 & 2\\ 1 & 2 & 1\end{bmatrix}$ then

(1) The minors of first row elements are respectively $-3, -1, 5$
(2) The cofactors of second row elements respectively are $1, -1, 1$
(3) The cofactors of first row elements respectively are $-3, -1, -5$
(4) The minors of second row elements respectively are $7, 5, -13$

17. If A, B, C are non singular matrices of order 3 then
(1) $A(BC) \neq (AB)C$ (2) $(ABC)^T = A^T B^T C^T$
(3) $(ABC)^{-1} = C^{-1} B^{-1} A^{-1}$ (4) $(ABC)^{-1} = 1/(ABC)$

18. If $\begin{bmatrix}3 & 2\\ 2 & -3\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}4\\ 7\end{bmatrix}$, then
(1) $x=-1, y=4$ (2) $x=2, y=-1$
(3) $x=4, y=-1$ (4) $x=-1, y=2$

19. If w is the cube root of unity then $\begin{bmatrix}1 & w & w^2\\ w & w^2 & 1\\ w^2 & 1 & w\end{bmatrix}=$

(1) 0 (2) 1 (3) -1 (4) 2

20. If $\frac{x^2+13x+15}{(2x+3)(x+3)^2}=\frac{A}{2x+3}+\frac{B}{x+3}+\frac{C}{(x+3)^2}$ then C =

(1) 10 (2) 5 (3) 3 (4) 1

21. If $\frac{2x+1}{(x^2+1)(x-1)}=\frac{Ax+B}{x^2+1}+\frac{C}{x-1}$ then $A=$

(1) -1 (2) $\frac{2}{3}$ (3) $-\frac{3}{2}$ (4) $-\frac{2}{3}$

22. Which of the following statement is TRUE
(A) The period of $\sin x$ is π and the period of $\operatorname{cosec} x$ is 2π
(B) The period of $\cos x$ is 2π and the period of $\sec x$ is 2π
(C) The period of $\tan x$ is 2π and the period of $\cot x$ is π
(D) The period of $\operatorname{cosec} x$ is π and the period of $\sec x$ is 3π
(1) A (2) B (3) C (4) D

23. The range of $3\cos\theta - 4\sin\theta$ is
(1) $[-1, 1]$ (2) $[0, 4]$ (3) $[-5, 5]$ (4) $[-4, 0]$

24. If $A+B=45°$, then $(1+\tan A)(1+\tan B) =$
(1) 0 (2) 1 (3) $\frac{1}{2}$ (4) 2

25. $\left(\frac{\sin 2A}{1-\cos 2A}\right)\left(\frac{1-\cos A}{\cos A}\right) =$
(1) $\tan\frac{A}{2}$ (2) $\cos\frac{A}{2}$ (3) $\sec\frac{A}{2}$ (4) $\operatorname{cosec}\frac{A}{2}$

26. The value of $\frac{\sin 70° - \cos 40°}{\cos 50° - \sin 20°} =$
(1) 1 (2) $\frac{1}{\sqrt{2}}$ (3) $\frac{1}{\sqrt{3}}$ (4) 0

27. $4\sin\frac{11\theta}{2}\cos\frac{11}{2}\theta\cos 5\theta$ expressed as sum or difference is
(1) $\sin 15\theta - \sin 6\theta$ (2) $\sin 16\theta + \sin 6\theta$
(3) $\sin 11\theta + \sin 8\theta$ (4) $\sin 11\theta - \sin 8\theta$

28. If $2\cos^2\theta + 11\sin\theta = 7$, the principal value of θ is
(1) $60°$ (2) $45°$ (3) $30°$ (4) $22\frac{1}{2}°$

29. Which one of the following equation is FALSE

(1) $\cos^{-1}(-x) = \pi - \cos^{-1} x$ (2) $\sin^{-1}(-x) = \pi - \sin^{-1} x$

(3) If $-1 \le x \le 1$, then $\cos^{-1}x + \sin^{-1} x = \frac{\pi}{2}$ (4) $\sin^{-1}x \ne \frac{1}{\sin x}$

30. In any triangle ABC, $\Sigma (b+c)\cos A =$

(1) $a+b+c$ (2) $2(a+b+c)$ (3) $3(a+b+c)$ (4) 0

31. With the usual notation, in a triangle ABC

$$s\left[\frac{r_1 - r}{a} + \frac{r_2 - r}{b} + \frac{r_3 - r}{c}\right] =$$

(1) $2(r_1+r_2+r_3)$ (2) $3(r_1+r_2+r_3)$ (3) $r_1+r_2+r_3$ (4) 0

32. The modulus amplitude form of $-\sqrt{3} + i$ is

(1) $2 \text{ cis } \frac{5\pi}{6}$ (2) $2 \text{ cis } \frac{3\pi}{6}$ (3) $2 \text{ cis } \frac{\pi}{3}$ (4) $2 \text{ cis } \frac{\pi}{6}$

33. If $x = \cos\theta + i \sin\theta$, then the value of $x^6 + \left(\frac{1}{x^6}\right)$

(1) 0 (2) $2i \sin 6\theta$ (3) $2 \cos 6\theta$ (4) $2(\cos 6\theta + \sin 6\theta)$

34. The most general second degree equation $ax^2+2hxy+by^2+2gx+2fy+c = 0$ represents a circle if

(1) $a+b = 0, h = 0$ (2) $a-b = 0, h = 0$

(3) $a-b = 0, h \ne 0$ (4) $a+b \ne 0, h \ne 0$

35. The equation of the circle whose radius is $\sqrt{(a^2 - b^2)}$ and whose center is (–a, –b) is

(1) $x^2+y^2+2ax+2by+2a^2 = 0$ (2) $x^2+y^2-2ax+2(a^2+b^2) = 0$

(3) $x^2+y^2+2ax+2by+2(a^2-b^2) = 0$ (4) $x^2+y^2+2ax+2bx+2b^2 = 0$

36. The coordinates of the parabola $y^2 = 18x$ such that the ordinate equals to three times of the abscissa is

(1) (3, 9) (2) (2, 6) (3) (1, 3) (4) (162, 54)

37. With respect to the ellipse $5x^2+7y^2 = 11$, the point $(4, -3)$
(1) Is a focus
(2) lies with in the ellipse
(3) lies outside the ellipse
(4) lies on the ellipse

38. For the Hyperbola $4x^2-9y^2 = 36$, the coordinates of the foci are
(1) $(\pm\sqrt{13},0)$ (2) $(\pm\sqrt{31},0)$ (3) $(\pm 6,0)$ (4) $(0,\pm 6)$

39. Which of the following statements are FALSE
(A) The equation of the tangent at the point (x', y') of the circle $x^2+y^2 = a^2$ is $xx' + yy' = a^2$
(B) The eccentricity of a parabola is unity
(C) The eccentricity of an ellipse is greater than unity
(D) The eccentricity of a hyperbola is less than unity
(1) A, B (2) A, D (3) B, C (4) C, D

40. $\lim_{x \to \infty} \frac{3^{x+1}+4}{3^{x+2}+4} =$
(1) 1 (2) 0 (3) $\frac{3}{4}$ (4) $\frac{1}{3}$

41. Derivative of $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ with reference to x is
(1) $\frac{2}{1+x^2}$ (2) $\frac{1}{1-x^2}$ (3) $2x$ (4) $\sqrt{(1+x^2)}$

42. If $y=x^{3x}.(x>0)$ then $\frac{dy}{dx} =$
(1) $3.x^{3x-1}$ (2) $3x^{2x}$ (3) $3y(1+\log x)$ (4) $\frac{3y}{\log x}$

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43. If $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ then $\frac{dy}{dx} =$

(1) $\left(\frac{x}{y}\right)^{\frac{1}{3}}$ (2) $-\left(\frac{y}{x}\right)^{\frac{1}{3}}$ (3) $-\left(\frac{x}{y}\right)^{\frac{1}{3}}$ (4) $\left(\frac{y}{x}\right)^{\frac{1}{3}}$

44. The derivative of log sec x with respect to tan x is

(1) sec x . tan x (2) cos x . cot x (3) cos x . sin x (4) sec x . cot x

45. The coordinates of the point $P(x, y)$ on the curve of $y = x^2 - 4x + 5$ such that the tangent at P is parallel to $y = 2x + 4$ are

(1) (3, 2) (2) (1, 2) (3) (2, 1) (4) (5, 4)

46. The function $f(x) = x \log^2 x$ has

(1) Maximum value occurs when $x = \frac{1}{e}$ (2) Maximum value occurs when $x = e$

(3) Maximum value occurs when $x = e^{-2}$ (4) Maximum value occurs when $x = e^2$

47. In a cube the percentage increase in side is 2 units. The percentage increases in the volume of the cube is

(1) 3 (2) 6 (3) 8 (4) 16

48. The curves $x = y^2$ and $xy = m$ cut at right angle if

(1) $m = 0$ (2) $m^2 = 8$ (3) $8m^2 = 1$ (4) $m = -1$

49. If $u = e^{ax} \sin by$. then $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} =$

(1) $(a^2 - b^2)\, u$ (2) $a^2 + b^2$ (3) $(a^2 + b^2)\, u$ (4) $(a + b)\, u$

50. $\int \frac{\cos \sqrt{x}}{\sqrt{x}}\, dx =$

(1) $\sqrt{x} \sin \sqrt{x} + c$ (2) $2 \sin \sqrt{x} + c$ (3) $\sqrt{\cos x} + c$ (4) $\frac{\sin \sqrt{x}}{\sqrt{x}} + c$

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PHYSICS

51. In thermodynamics, $dQ = 0$ and $dU = -dW$ is true for
(1) Isothermal process
(2) Adiabatic process
(3) Isochoric process
(4) Isobaric process

52. A sample of an ideal gas has volume V, pressure P and temperature T. The mass of each molecule of the gas is m. The density of the gas is _____
(1) P/kVT (2) mkT (3) mP/kT (4) P/kT

53. A gas does 4.5 J of external work during adiabatic expansion. Its temperature falls by 2 K. Its internal energy will be _____
(1) increase by 4.5 J
(2) increase by 9.0 J
(3) decrease by 4.5 J
(4) decrease by 2.25 J

54. One mole of an ideal gas ($\gamma = 5/3$) is mixed with one mole of diatomic gas ($\gamma=7/5$). The value of γ of the mixture
(1) 3/2 (2) 4/3 (3) 23/15 (4) 35/23

55. In a given process on an ideal gas, $dW = 0$ and $dQ < 0$. Then for the gas _____
(1) the temperature will decrease
(2) the volume will increase
(3) the pressure will remain constant
(4) the temperature will increase

56. The threshold wavelength for a metal whose work function is W_0 is λ_0. The threshold wavelength for a metal whose work function is $W_0/2$ _____
(1) $\lambda_0/4$ (2) $\lambda_0/2$ (3) $4\lambda_0$ (4) $2\lambda_0$

57. The propagation of light through an optical fiber goes by the principle _____
(1) Refraction
(2) Total internal reflection
(3) Interference
(4) Diffraction

58. The dimensions of angular momentum are _____
(1) ML^2T^{-1} (2) $ML^{-1}T$ (3) ML^0T^{-2} (4) ML^2T^{-1}

59. The SI unit of universal gas constant R is _____
(1) Newton K^{-1} mol^{-1}
(2) Joule K^{-1} mol^{-1}
(3) Watt K^{-1} mol^{-1}
(4) erg K^{-1} mol^{-1}

60. The magnitude of the resultant of $(A+B)$ and $(A-B)$ is _____

(1) $2A$ (2) $\sqrt{(A^2+B^2)}$

(3) $2B$ (4) $\sqrt{(A^2-B^2)}$

61. Given A.B = 0 and A×C = 0, the angle between B and C is _____

(1) 135° (2) 90° (3) 180° (4) 45°

62. A projectile has a maximum range of 200m. The maximum height attained by it is _____

(1) 75 m (2) 100 m

(3) 25 m (4) 50 m

63. A block of mass M is lying on a horizontal frictionless surface. One end of a rope mass m is fixed to the block and a force F is applied at the free end parallel to the surface. The force acting on the block will be _____

(1) FM/(M-m) (2) Fm/(M+m)

(3) FM/(M+m) (4) F

64. A block of weight 200 N is pulled along a rough horizontal surface at a constant speed by a force of 100 N acting at an angle of 30°. The coefficient of friction between the block and the surface is _____

(1) 0.58 (2) 0.75 (3) 0.45 (4) 0.65

65. A boy wants to climb down a rope. The rope can withstand a maximum tension equal to two-thirds the weight of the boy. If g is the acceleration due to gravity, the minimum acceleration with which the boy should climb down the rope is _____

(1) g/3 (2) 2g/3 (3) 3g/2 (4) g

66. N bullets each of mass m kg are fired with a velocity v m/s, at the rate of n bullets per second, upon a wall. The reaction offered by the wall to the bullets is given by _____

(1) nNv/m (2) $nNmv$

(3) Nmv/n (4) nNm/v

67. A machine gun fires a bullet of mass 40 g with a velocity of 1200 m/s. The man holding it can exert a maximum force of 144 N on the gun. The number of bullets he can fire per second is _____

(1) 4 (2) 1 (3) 3 (4) 8

68. A horizontal force F pulls a 20 kg box at a constant speed along a horizontal floor. If the coefficient of friction between the box and the floor is 0.25. The work done by the force F in moving the box through a distance of 2 m _____
(1) 49 J (2) 147 J
(3) 196 J (4) 98 J

69. A uniform rod of mass m and length l is made to stand vertically on one end. The potential energy of the rod in this position is _____
(1) mgl/4 (2) mgl/2 (3) mgl (4) mgl/3

70. If momentum is increased by 20%, then kinetic energy increases by _____
(1) 44% (2) 77% (3) 55% (4) 66%

71. A particle is executing linear SHM of amplitude A. When the displacement is half the amplitude the fraction of kinetic energy is _____
(1) 1/5 (2) 3/4 (3) 1/2 (4) 1/4

72. For a particle executing S.H.M starting from equilibrium position the phase is $\pi/2$ when it has
(1) maximum displacement (2) maximum energy
(3) half the displacement (4) maximum velocity

73. A particle executes SHM between $x = -A$ and $x = +A$. The time taken for it to go from 0 to A/2 is T_1 and to go from A/2 to A is T_2. Then
(1) $T_1 = 2T_2$ (2) $T_1 = T_2$
(3) $T_1 < T_2$ (4) $T_1 > T_2$

74. Two sounds of wavelengths 5 m and 6 m, travelling in a medium produce 10 beats per second. The speed of sound in the medium _____
(1) 300 m/s (2) 320 m/s (3) 350 m/s (4) 1200 m/s

75. An observer moves towards a stationary source of sound with a velocity one tenth the velocity of sound. The apparent increase in frequency _____.
(1) 3% (2) 0.1% (3) 5% (4) 10%

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CHEMISTRY

76. Glass is corroded by
(1) Fluorine (dry or wet)
(2) Sulphuric acid (concentrated)
(3) Phosphoric acid
(4) Carbonic acid

77. The most resistant material to alkaline corrosion is
(1) Cast iron
(2) Nickel
(3) Aluminium
(4) Brass

78. The monomer of polyvinyl chloride is
(1) Chloro ethene
(2) Ethylene dichloride
(3) Ethyl chloride
(4) Chloroform

79. Polythene is
(1) An addition polymerization product
(2) A condensation polymerization product
(3) Thermosetting
(4) Polymer of amylopectin

80. Teflon is
(1) Phenol formaldehyde
(2) An inorganic polymer
(3) Poly tetrafluoroethylene
(4) A monomer

81. Water gas constitutes mainly of
(1) CO and H_2
(2) CO and N_2
(3) CO_2 and H_2
(4) CH_4 and H_2

82. The lightest particle is
(1) Positron
(2) Neutron
(3) Proton
(4) α-particle

83. If an electron has spin quantum number of +1/2 and magnetic quantum number of –1, it cannot be present in
(1) *d* orbital (2) *f* orbital (3) *p* orbital (4) *s* orbital

84. The ion that is iso electronic with CO is
(1) NO^+ (2) O_2^+ (3) O_2^- (4) N_2^+

85. The hydrogen bond is strongest in
(1) O-H-- --S (2) S-H---O (3) F-H---F (4) F-H---O

86. The molecule having pyramidal shape
(1) PCl_3 (2) SO_3 (3) CO_3^{2-} (4) NO_3^-

87. Crystals of a sodium chloride belong to the system
(1) Orthorhombic (2) Cubic (3) Trigonal (4) Monoclinic

88. The pH of 0.05 M acetic acid is ($K_a = 2\times10^{-5}$)
(1) 2 (2) 11 (3) 10^{-3} (4) 3

89. The volume in ml. of 0.1 M solution of NaOH required to completely neutralize 100 ml of 0.3 M solution of H_3PO_3 is
(1) 60 (2) 600 (3) 300 (4) 30

90. The P^{ka} values of four carboxylic acids are 4.76, 4.19, 0.23 and 3.41 respectively. The strongest carboxylic acid among them is the one having P^{ka} value of
(1) 4.19 (2) 3.41 (3) 0.23 (4) 4.76

91. If pH value of a solution is 8, then its pOH value will be
(1) 7 (2) 1 (3) 6 (4) 10

92. The standard reduction potential for Li^+/Li, Zn^{+2}/Zn; H^+/H_2 and Ag^+/Ag are –3.05, –0.762, 0.000 and +0.80 V respectivcly. Which is the strongest reducing agent?
(1) Ag (2) H_2 (3) Zn (4) Li

93. The standard reduction potential for the following half-cell reactions are
$Zn = Zn^{+2} + 2e^-$ $E^\circ = -0.76V$
$Fe = Fe^{+2} + 2e^-$ $E^\circ = -0.44V$
The E.M.F. for the cell reaction $Fe^{+2} + Zn \rightarrow Zn^{+2} + Fe$ will be
(1) 0.32 V (2) +0.32 V (3) +1.20 V (4) –1.20 V

94. In salt bridge, KCl is used because
(1) KCl is present in calomel electrode
(2) K^+ and Cl^- ions are not iso electronic
(3) K^+ and Cl^- ions have the same transport number
(4) KCl is an electrolyte

95. The metal that cannot be obtained by electrolysis of aqueous solution of its salt is
(1) Ag (2) Au (3) Cu (4) Al

96. BOD of raw municipal sewage may be about
(1) 2-5 mg/lit (2) 5-10 mg/lit
(3) 150-300 mg/lit (4) 2000-3000 mg/lit

97. The pH value of potable water should be between
(1) 1 to 1.5 (2) 6.5 to 8
(3) 13 to 14 (4) 4 to 5

98. Deaeration of high pressure boiler feed water is done to reduce
(1) Foaming from boilers (2) Its dissolved oxygen content
(3) Its silica content (4) Caustic embrittlement

99. Presence of non-biodegradable substances like alkyl benzene sulphonate from detergents in polluted water stream causes
(1) Fire hazards (2) Explosion hazards
(3) Persistent foam (4) Depletion of dissolved oxygen

100. Presence of soluble organics in polluted water causes
(1) Undesirable plants growth (2) Depletion of oxygen
(3) Fire hazards (4) Explosion hazards

Set Code : T2
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MECHANICAL ENGINEERING

101. The hydraulic efficiency of an impulse turbine is maximum when velocity of wheel is _____ of the jet velocity

(1) 1/4 (2) 1/2
(3) 3/4 (4) double

102. The speed ratio in case of Francis turbine varies from

(1) 0.15 to 0.3 (2) 0.4 to 0.5
(3) 0.6 to 0.9 (4) 1 to 1.5

103. In a centrifugal pump, the regulating valve is provided on the

(1) Casing (2) Delivery pipe
(3) Suction pipe (4) Impeller

104. In a reciprocating pump, air vessels are used to

(1) Smoothen the flow (2) Reduce suction head
(3) Increase delivery head (4) Reduce acceleration head

105. Which of the following hydraulic unit is used for transmitting increased or decreased torque to the driven shaft?

(1) Hydraulic ram (2) Hydraulic intensifier
(3) Hydraulic torque converter (4) Hydraulic accumulator

106. The best suited boiler for meeting the fluctuating demand of steam is

(1) Cornish boiler (2) Lancashire boiler
(3) Babcock and Wilcox boiler (4) Locomotive boiler

107. In order to compare the capacity of boilers, the feed water temperature and working pressure are taken as
(1) 100°C and normal atmospheric pressure
(2) 100°C and 1.1 bar pressure
(3) 50°C and normal atmospheric pressure
(4) 50°C and 1.1 bar pressure

108. The power of a boiler may be defined as
(1) The evaporation of 15.653 kg of water per hour from and at 100°C
(2) The ratio of heat actually used in producing the steam to the heat liberated in the furnace
(3) The amount of water evaporated or steam produced in kg per kg of fuel burnt
(4) The amount of water evaporated from and at 100°C to produce dry and saturated steam

109. The shape of the nozzle used for obtaining supersonic velocities is
(1) Short length convergent nozzle
(2) Long length convergent nozzle
(3) Divergnet nozzle
(4) Convergent - Divergent nozzle

110. Generally the limit of super saturation is upto a dryness fraction of about
(1) 98% - 100%
(2) 96% - 98%
(3) 94% - 96%
(4) 92% - 94%

111. A single stage impulse turbine with diameter of 2m runs at 3600 rpm. If the blade speed ratio is 0.4, then the inlet velocity of the steam will be
(1) 120.9 m/s
(2) 150.8 m/s
(3) 942.6 m/s
(4) 1440.4 m/s

112. The efficiency of reaction turbine is maximum when
(1) $V_b = 0.5\ V \cos\alpha$
(2) $V_b = V \cos\alpha$
(3) $V_b = 0.5\ V^2 \cos\alpha$
(4) $V_b = V^2 \cos\alpha$
Where, V_b = blade speed, V = absolute velocity of steam, α = nozzle angle

113. A steam turbine, in which a part of the steam after partial expansion is used for process heating and the remaining steam is further expanded for power generation is known as

(1) Impulse turbine
(2) Back pressure turbine
(3) Low pressure turbine
(4) Pass out turbine

114. The capacity of domestic refrigerator is in the range of

(1) 0.1 to 0.3 TR
(2) 1 to 3 TR
(3) 3 to 5 TR
(4) 5 to 7 TR

115. A condenser of refrigerator rejects heat at the rate of 150 kW, while its compressor consumes a power of 50 kW. The coefficient of performance of the system will be

(1) 1/3 (2) 1/2 (3) 2 (4) 3

116. The material of pipe lines for a system using Freon as a refrigerant should be

(1) Copper
(2) Steel
(3) Brass
(4) Aluminium

117. In a vapour compression refrigeration system, a throttle valve is used in place of an expander because

(1) Reduces mass of the system
(2) Improves COP as the condenser is small
(3) Positive work in isentropic expansion of liquid is very small
(4) Leads to significant reduction

118. In break-even chart the expenditure on publicity to promote sales is shown below the

(1) Fixed cost line
(2) Variable cost line
(3) Total cost line
(4) Sales revenue line

119. Service time in queuing theory is usually assumed to follow

(1) Poisons distribution
(2) Normal distribution
(3) Erlang distribution
(4) Exponential law

120. PERT requires

(1) Single time estimate
(2) Double time estimate
(3) Triple time estimate
(4) Quatraple time estimate

121. The type of organization preferred for a steel industry

(1) Line organization
(2) Functional organization
(3) Line and staff organization
(4) Line, staff and functional organization

122. If A is the total items consumed per year, P is the procurement cost per order and C is the annual inventory carrying cost per item, then the most economic ordering quantity is given by

(1) (AP/C)
(2) $(AP/C)^2$
(3) $\sqrt{2(AP/C)}$
(4) $(2AP/C)$

123. The type of layout suitable for manufacturing tools and gauges

(1) Product layout
(2) Process layout
(3) Combination of product and process layout
(4) Fixed position layout

124. The mathematical technique for finding the best use of limited resources of a company in the maximum manner is

(1) Queuing theory
(2) Value analysis
(3) Network analysis
(4) Linear programming

125. ISO 9000 is a common quality language among the suppliers and the

(1) Manufactures
(2) Customer
(3) Consumer
(4) Manager

126. Six sigma level of quality control means

(1) 2.1 defects per million opportunites
(2) 3.4 defects per million opportunites
(3) 4.3 defects per million opportunites
(4) 5.7 defects per million opportunites

127. The transportation technique belongs to one of the following mathematical models in operations research
(1) Allocation model
(2) Sequencing model
(3) Queuing model
(4) Inventory model

128. The tilting of the front wheels away from the vertical, when viewed from the front of the car is called
(1) Camber
(2) Caster
(3) Toe-in
(4) Toe-out

129. The starter motor is driven by
(1) Chain drive
(2) Gear drive
(3) Flat belt drive
(4) V-belt drive

130. The parking brake generally acts on
(1) Front wheels
(2) Rear wheels
(3) Front and rear wheels
(4) Propeller shaft

131. The gear shift lever requires two separate motions to shift gears, the first moment
(1) Selects the synchronizer
(2) Moves the synchronizer
(3) Meshes the gears
(4) Operates the clutch

132. The maximum torque multiplication ratio in a torque converter is about
(1) 2.5 (2) 4.5 (3) 6.5 (4) 8.5

133. Two speed reverse gear arrangement is generally provided in case of
(1) Passenger cars
(2) Metadors
(3) Tractors
(4) Trucks

134. The component that connects the steering rack to the knuckles is
(1) Tie-rod
(2) Sector gear
(3) Pivot
(4) Spline

135. The operation of cutting of a flat sheet to the desired shape is called
(1) Shearing
(2) Piercing
(3) Punching
(4) Blanking

136. A hacksaw blade is specified by its
(1) Length
(2) Material
(3) Width
(4) Number of teeth

137. The accuracy of micrometers, calipers and dial indicators can be checked by
(1) Feeler gauge
(2) Slip gauge
(3) Ring gauge
(4) Plug gauge

138. A sine bar is specified by
(1) Centre to centre distance between the rollers
(2) Total length
(3) Diameter of the rollers
(4) Its weight

139. In a carpentry shop, rebating is the process of making
(1) Convex surfaces
(2) Circular holes
(3) A recess on the edge of work piece
(4) A recess in the middle of work piece

140. Continuous chips with built up edge are formed during machining of
(1) Brittle metals
(2) Ductile metals
(3) Hard metals
(4) Soft metals

141. Tumbler gears in lathe are used to
(1) Cut gears
(2) Drill a hole in work piece
(3) Reduce the spindle speed
(4) Give desired direction of movement to the lathe carriage

... which of the following machine, the work is usually rotated while the drill is fed into Work

(1) Radial drilling machine
(2) Sensitive drilling machine
(3) Gang drilling machine
(4) Deep hole drilling machine

143. In lapping operation, the amount of thickness of metal removed is

(1) 0.005 to 0.01 mm
(2) 0.01 to 0.1 mm
(3) 0.05 to 0.1 mm
(4) 0.5 to 1 mm

144. Internal or external threads of different pitches can be produced by

(1) Pantograph milling machine
(2) Profiling machine
(3) Plano miller
(4) Planetary milling machine

145. Gear finishing operation is called

(1) Shaping
(2) Milling
(3) Hobbing
(4) Burnishing

146. FMS is possible for products

(1) High volume, low variety, continuous flow
(2) Low volume, low variety, continuous flow
(3) Low volume, high variety, intermittent flow
(4) High volume, high variety, intermittent flow

147. CNC drilling machine is considered to be

(1) P.T.P. controlled machine
(2) Continuous path controlled machine
(3) Servo controlled machine
(4) Adaptive controlled machine

148. Seam welding is best adopted for metal thickness ranging from

(1) 0.025 to 3mm
(2) 3 to 5mm
(3) 5 to 8mm
(4) 8 to 10mm

149. In submerged arc welding, an arc is produced between a
(1) Metal electrode and the work
(2) Bare metal electrode and the work
(3) Carbon electrode and the work
(4) Two tungsten electrodes and the work

150. The commonly used gases in tungsten arc welding arc
(1) Hydrogen and oxygen
(2) Hydrogen and organ
(3) Hydrogen and helium
(4) Helium and argon

151. Linde welding uses
(1) Neutral flame and rightward technique
(2) Carburizing flame and rightward technique
(3) Neutral flame and leftward technique
(4) Oxidizing flame and leftward technique

152. Welding of glass is done by
(1) Ultrasonic welding
(2) Electron beam welding
(3) Laser beam welding
(4) Explosive welding

153. The cold chisels are made by
(1) Drawing
(2) Rolling
(3) Forging
(4) Piercing

154. The process extensively used for making bolts and nuts is
(1) Hot piercing
(2) Extrusion
(3) Cold peening
(4) Cold heading

155. Structural sections such as rails, angles, I-beams are made by
(1) Hot rolling
(2) Hot drawing
(3) Hot piercing
(4) Hot extrusion

156. The mode of deformation of the metal during spinning is

(1) Bending (2) Stretching

(3) Bending and stretching (4) Rolling and stretching

157. In die casting, machining allowance is

(1) Small (2) Large

(3) Very large (4) Not provided

158. The property of sand due to which the sand grains stick together, is called

(1) Collapsibility (2) Permeability

(3) Cohesiveness (4) Adhesiveness

159. A casting defect which occurs near the ingates as rough lumps on the surface of a casting is known as

(1) Shift (2) Sand wash (3) Swell (4) Scab

160. The symbol used for butt resistance weld is

(1) ∩ (2) | (3) ⌂ (4) □

161. In the drawing of bolted joints, the radius of chamber arc for the bolt nominal diameter of D is

(1) D (2) 1.2D (3) 1.5D (4) (1.5D + 3) mm

162. A material is said to be ductile if the elongation is

(1) less than 5% (2) 5 to 10%

(3) 10 to 15% (4) more than 15%

163. The property of the material which enables it to be twisted, bent or stretched under a high stress before rupture is known as

(1) Hardness (2) Toughness

(3) resilience (4) Strength

164. The shock resistance of steel is increased by adding
(1) Nickel (2) Chromium
(3) Nickel and chromium (4) Cobalt and molybdenum

165. For hardening alloy steels and high speed steels, they are heated to
(1) 500 to 600°C (2) 700 to 900°C
(3) 1100 to 1300°C (4) 1300 to 1500°C

166. The heat treatment process used for castings is
(1) Carburizing (2) Normalizing
(3) Annealing (4) Tempering

167. The percentage of phosphorus in phosphor bronze is
(1) 0.3 (2) 1 (3) 11.1 (4) 95.3

168. In powder metallurgy the range of pressures to which powdered metals in desired proportions are compressed in moulds is
(1) 10 to 50 bar (2) 50 to 300 bar
(3) 310 to 650 bar (4) 690 to 13750 bar

169. The angle between two forces to make their resultant a minimum and a maximum respectively are
(1) 0° and 90° (2) 180° and 90°
(3) 90° and 180° (4) 180° and 0°

170. The Poisson's ratio for cast iron varies from
(1) 0.23 to 0.27 (2) 0.25 to 0.33 (3) 0.31 to 0.34 (4) 0.34 to 0.42

171. The point of contraflexure occurs in
(1) Simply supported beams (2) Cantilever beams
(3) Fixed beams (4) Overhanging beams

172. A simply supported beam A of length 1 breadth b and depth d carries a central load W. Another beam of the same dimensions carries a central load equal to 2W. The deflection of beam B will be _____ as that of A.

(1) One fourth (2) Half
(3) Double (4) Four times

173. The strain energy stored in a spring, when subjected to maximum load, without suffering permanent distortion, is known as

(1) Impact energy (2) Proof stress
(3) Proof resilience (4) Modulus of resilience

174. In a flat belt drive, if the slip between the driver and belt is 1%, between the belt and follower is 3% and driver and follower pulley diameters are equal, then velocity ratio of the drive will be

(1) 0.96 (2) 0.97 (3) 0.98 (4) 0.99

175. The effective stress in wire ropes during normal working is equal to the stress due to

(1) Sum of axial load and stress due to bending
(2) Sum of acceleration or retardation of masses and stress due to bending
(3) Sum of axial load and stress due to acceleration or retardation
(4) Sum of bending and stress due to acceleration or retardation

176. The centrifugal tension in the belt

(1) Increases the power transmitted
(2) Decreases the power transmitted
(3) Has no effect on the power transmitted
(4) Is equal to maximum tension on the belt

177. In roller chain the roller diameter is approximately _____ of the pitch

(1) 5/8 (2) 6/8 (3) 7/8 (4) same as that

178. Which one of the following springs is used in mechanical wrist watch?

(1) Spiral spring (2) Torsion spring
(3) Bevel spring (4) Helical compression spring

179. When two non intersecting and non-coplanar shafts are connected by gears. the arrangement is known as

(1) Spur gearing (2) Helical gearing

(3) Bevel gearing (4) Spiral gearing

180. The cam follower extensively used in aircraft engines is

(1) Flat faced follower (2) Knife edge follower

(3) Roller follower (4) Spherical faced follower

181. The ratio of circumferential stress to longitudinal stress in a thin cylinder subjected to an internal pressure is

(1) 1/2 (2) 1 (3) 2 (4) 4

182. The bending moment M and a torque T is applied on a solid circular shaft. If the maximum bending stress equals to maximum shear stress developed, then M is equal to

(1) T/2 (2) T (3) 2T (4) 4T

183. In designing a key, it is assumed that the distribution of forces along the length of key

(1) Varies linearly

(2) Is uniform through out

(3) Varies exponentially, being more at the torque input end

(4) Varies exponentially, being less at the torque input end

184. The sleeve or muff coupling is designed as a

(1) Thin cylinder (2) Thick cylinder

(3) Hollow shaft (4) Solid shaft

185. Charles' law states that all perfect gases change in volume by _____ of its original volume at 0°C for every 1°C change in temperature, when pressure remains constant

(1) 1/27 (2) 1/93 (3) 1/173 (4) 1/273

186. The isentropic process means
(1) Reversible process
(2) Adiabatic process
(3) Reversible adiabatic process
(4) Irreversible adiabatic process

187. The hyperbolic law is governed by
(1) Gay-Lussac law
(2) Avogadro's law
(3) Boyle's law
(4) Chales's law

188. A thermodynamic cycle consisting of two constant pressure and two isentropic processes is known as
(1) Carnot cycle
(2) Joule cycle
(3) Otto cycle
(4) Stirling cycle

189. Alpha-methyl-naphthalene has a cetane number of
(1) 0 (2) 50 (3) 100 (4) 120

190. The inlet valve of a four stroke cycle internal combustion engine remains open for
(1) 150° (2) 180° (3) 230° (4) 280°

191. In air standard diesel cycle as the cut of ratio increases keeping the compression ratio same, the efficiency will be
(1) Increasing
(2) Decreasing
(3) Remains same
(4) Tending to the efficiency of Otto cycle

192. The aim of providing masked inlet valve in the air passage of compression ignition engines is to
(1) Control air flow
(2) Enhance flow rate
(3) Induce primary swirl
(4) Induce secondary turbulence

193. A turbo-prop is preferred to turbo-jet because of
(1) It's high propulsive efficiency at high speeds
(2) It can fly at super sonic speeds
(3) It can fly at high elevations
(4) It can have high power for take off

194. Separators are generally used in air compressor installations
(1) Before the first stage of ompression (2) Before the inter cooler
(3) After the inter cooler (4) Between the after cooler and receiver

195. In a jet engine the air-fuel ratio is
(1) 20:1 (2) 40:1 (3) 60:1 (4) 80:1

196. The type of compressor used in gas turbines
(1) Reciprocating (2) Axial
(3) Centrifugal (4) Radial

197. The variation in the volume of a liquid with the variation of pressure is called its
(1) Capillarity (2) Compressibility
(3) Surface tension (4) Viscosity

198. The mercury does not wet the glass. This is due to property of liquid known as
(1) Cohesion (2) Adhesion
(3) Viscocity (4) Surface tension

199. The loss of head at exit of a pipe is
(1) $v^2/2g$ (2) $0.5\ v^2/2g$ (3) $0.375\ v^2/2g$ (4) $0.75\ v^2/2g$

200. A jet of water is striking at the centre of a curved vane moving with a uniform velocity in the direction of jet. For the maximum efficiency, the vane velocity is _____ of the jet velocity
(1) 1/2 (2) 1/3
(3) 2/3 (4) 3/4

Set Code : T2

Booklet Code : B

SPACE FOR ROUGH WORK

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SPACE FOR ROUGH WORK