Tribhuvan University

Institute of Science and Technology

M.A. / M.Sc. Entrance Examination with answer sheet (Mathematics)

2080

Time:.2 Hours | Full Marks: 100

Attempt 100 questions (from 1 to 90) and remaining 10 (from 91 to 100 either Mechanics or Linear Programming). 1×100

Tick (✓) the best alternatives.

1. What point is lie on the line $-3x + 7y = 21$?

   (a) $(-4, 3)$
   (b) $(7, 6)$
   (c) $(1, 3)$
   (d) $(-7, 6)$

   Ans: b

2. Which vector is the linear combination of the vectors $(4, 2, 7)$ and $(3, 1, 4)$?

   (a) $(-1, 3, 7)$
   (b) $(1, -3, 7)$
   (c) $(1, 3, -7)$
   (d) $(-1, -3, 7)$

   Ans: a

3. The span of the set consisting of standard unit vectors in $\mathbb{R}^2$ is

   (a) $((-1, 0), (0, 1)$
   (b) $(0, 1), (0, -1)$
   (c) $(1, 0), (0, 0)$
   (d) $(1, 0), (0, 1)$.

   Ans: d

4. If $T : \mathbb{R}^2 \to \mathbb{R}$ is a linear transformation for which $T(1, 1) = 3, T(0, 1) = -2$, then the value of $T(1, \frac{1}{2})$ is

   (a) -4
   (b) 3
   (c) 4
   (d) -3

   Ans: c

5. For square matrices A and B of same order n, and a scalar k, which is true?

   (a) tr(AB)= tr(AB)
   (b) tr(AB)= tr(BA)
   (c) tr(kAB)= 2tr(AB)

(d) $\text{tr}(kAB) = k\ \text{tr}(AB)$

Ans: b

6. What is the area of the triangle whose vertices are $(4,7), (-2,1)$ and $(12,-6)$?

   (a) 23
   (b) -23
   (c) 64
   (d) 46

   Ans: a

7. What is the coordinate of the vector $(1,0)$ in $\mathbb{R}^2$ with respect to the basis vectors $(1,2)$ and $(1,-1)$ are

   (a) $(\frac{1}{3}, \frac{2}{3})$
   (b) $(\frac{1}{2}, \frac{2}{3})$
   (c) $(\frac{1}{3}, 1)$
   (d) $(-\frac{1}{3}, \frac{2}{3})$

   Ans: a

8. Where is used the application of the eigenvalues and eigenvectors of a square matrix?

   (a) Electrical and mechanical engineering
   (b) Communication
   (c) Designing bridges
   (d) All of above

   Ans: d

9. Which is the correct formula if u and v are orthogonal?

   (a) $||u-v||^2 = ||u||^2 - 2 < u, v > + ||v||^2$
   (b) $||u-v||^2 = ||u||^2 + 2 < u, v > + ||v||^2$
   (c) $||u-v||^2 = ||u||^2 + ||v||^2$
   (d) $||u-v||^2 = ||u||^2 - ||v||^2$

   Ans: c

10. The LU factorization of the matrix $\begin{bmatrix} 2 & 5 \\ 6 & -7 \end{bmatrix}$ is

    (a) $\begin{bmatrix} 1 & 0 \\ 3 & 1 \end{bmatrix} \begin{bmatrix} -2 & 5 \\ 0 & -22 \end{bmatrix}$
    (b) $\begin{bmatrix} 1 & 0 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} 2 & 5 \\ 0 & -22 \end{bmatrix}$
    (c) $\begin{bmatrix} 1 & 0 \\ 3 & 1 \end{bmatrix} \begin{bmatrix} 2 & 5 \\ 0 & 22 \end{bmatrix}$
    (d) $\begin{bmatrix} 1 & 0 \\ 3 & 1 \end{bmatrix} \begin{bmatrix} 2 & 5 \\ 0 & -22 \end{bmatrix}$

Ans: d

11. Which map ϕ is an isomorphism?

    (a) $(\mathbb{Z}, +)$ with $(\mathbb{Z}, +)$ where $\phi(x) = 2x$ for $x \in \mathbb{Z}$
    (b) $(\mathbb{Q}, +)$ with $(\mathbb{Q}, +)$ where $\phi(x) = \frac{1}{2}x$ for $x \in \mathbb{Q}$
    (c) $(M_2\mathbb{R}, .)$ with $(\mathbb{R}, .)$ where $\phi(A)$ is the determinant of the matrix A.
    (d) $(\mathbb{Q}, .)$ with $(\mathbb{Q}, .)$ where $\phi(x) = x^2$ for $x \in \mathbb{Q}$

    Ans: b

12. What is the order of $(8, 4, 10)$ in the group $\mathbb{Z}_{12} \times \mathbb{Z}_{60} \times \mathbb{Z}_{24}$?

    (a) 60
    (b) 40
    (c) 20
    (d) 320

    Ans: a

13. What is the order of the group $\dfrac{\mathbb{Z}_3 \times \mathbb{Z}_5}{(\{0\} \times \mathbb{Z}_5)}$?

    (a) 7
    (b) 5
    (c) 3
    (d) 1

    Ans: c

14. Which of the following map $\phi : \mathbb{Z} \times \mathbb{Z} \to \mathbb{Z}$ is not a ring homomorphism?

    (a) $\phi_1(m, n) = 0$
    (b) $\phi_2(n, m) = n$
    (c) $\phi_3(n, m) = m$
    (d) $\phi_4(n, m) = n + m$

    Ans: d

15. Which is the kernel of the homomorphism $\phi : \mathbb{Z} \to \mathbb{Z}_6$ defined by $f(n) = [n]$

    (a) $\mathbb{Z}$
    (b) $5\mathbb{Z}$
    (c) $6\mathbb{Z}$
    (d) $[n]\mathbb{Z}$.

    Ans: c

16. What is the degree of $\sqrt{2 - \sqrt{-5}}$ over the rational number $\mathbb{Q}$ in the field ?

    (a) 2
    (b) 3
    (c) 4
    (d) 6.

Ans: c

17. From the following isomorphism which is the second isomorphism theorem in the group G where H, K and N are normal subgroup of G?

    (a) $\dfrac{G}{H} \cong \dfrac{\frac{G}{K}}{\frac{H}{K}}$
    (b) $\dfrac{G}{K} \cong G'$
    (c) $\dfrac{HN}{N} \cong \dfrac{H}{H \cap N}$
    (d) All of above.

    Ans: c

18. If the polynomial $p(x) = x^3 + 3x + 2$ is irreducible in $\mathbb{Z}[x]$, then $\dfrac{\mathbb{Z}_5}{< x^3 + 3x + 2 >}$ is a

    (a) Group
    (b) Ring
    (c) Field
    (d) Group and field.

    Ans: c

19. What is the equation of lowest degree with rational coefficient, one of the whose roots is $\sqrt{3} - \sqrt{2}$?

    (a) $x^4 - 10x^2 + 1 = 0$
    (b) $x^4 + 10x^2 + 1 = 0$
    (c) $x^4 + 10x^2 - 1 = 0$
    (d) $x^4 - 10x^2 - 1 = 0$.

    Ans: a

20. If α, β, γ be the roots of the equation $x^3 + qx + r = 0$, then which is the correct?

    (a) $(\beta - \gamma)(\gamma - \alpha)(\alpha - \beta)$
    (b) $(\beta - \gamma)^2(\gamma - \alpha)^2(\alpha - \beta)^2$
    (c) $(\beta + \gamma)(\gamma + \alpha)(\alpha + \beta)$
    (d) $(\beta + \gamma)^2(\gamma + \alpha)^2(\alpha + \beta)^2$

    Ans: b

21. $+\infty$ and $-\infty$ are

    (a) Numbers
    (b) Symbols
    (c) Both of them
    (d) None of them

    Ans: b

22. Every superset of an infinite set is

    (a) Infinite

(b) Finite
(c) Rational
(d) None of them

Ans: a

23. The subset $\{1, 2, 3, 4, 5, 6\}$ of $\mathbb{R}$ is

(a) Open
(b) Both open and closed
(c) Closed
(d) Empty

Ans: c

24. Let F be an open covering of closed and bounded set A in $\mathbb{R}^n$. Then there is a finite sub collection of F which also covers A is the statement of the theorem

(a) Bolzano Wierstrass theorem
(b) Cantor intersection theorem
(c) Lindelof covering theorem
(d) Heine Borel covering theorem

Ans: d

25. What is the limit points of the sequence $\{1, 2, 3, 4 \cdots\}$?

(a) 1
(b) 2
(c) 0
(d) No

Ans: d

26. What are the two roots of the function $g(x) = x^2 - 2x - 15$ in the interval (1,7) by using Intermediate value theorem ?

(a) $0, 1$
(b) $1, 2$
(c) $3, 5$
(d) $2, 4$

Ans: b

27. Let f and g are each function of bounded variation on $[a, b]$ then $V_{f.g}$ is equals to

(a) $> AV_f + BV_g$
(b) $\leq AV_f + BV_g$
(c) $\geq V_f + V_g$
(d) $< AV_f + BV_g$

Ans: b

28. The value of $\int_0^{\pi} x \, d(\sin x) \, dx$ is

(a) 1
(b) -3
(c) -2
(d) -1

Ans: c

29. If $P = \{0, \frac{1}{3}, \frac{1}{2}, \frac{3}{4}, 1\}$ is the partition of $[0, 1]$ then what is the value of Δx_3 ?

(a) $\frac{1}{4}$
(b) $\frac{1}{3}$
(c) $\frac{1}{4}$
(d) $\frac{1}{6}$

Ans: c

30. Let $\{a_n\}$ be a sequence of real numbers then which one is true ?

(a) $\lim\limits_{n\to\infty} \inf\{a_n\} \geq \lim\limits_{n\to\infty} \sup\{a_n\}$
(b) $\lim\limits_{n\to\infty} \inf\{a_n\} \geq \lim\limits_{n\to\infty} \inf\{a_n\}$
(c) $\lim\limits_{n\to\infty} \inf\{a_n\} \leq \lim\limits_{n\to\infty} \sup\{a_n\}$
(d) $\lim\limits_{n\to\infty} \inf\{a_n\} \leq \lim\limits_{n\to\infty} \sup\{a_n\}$

Ans: c

31. A sequence of continuous functions with a discontinuous limit function is defined by $f_n(x) = \dfrac{x^{2n}}{1 + x^{2n}}$, $x \in \mathbb{R},\ n = 1, 2, 3, \cdots$. If $|x_n| < 1$, the value of $\lim\limits_{n\to\infty} f_n(x)$ is

(a) $\dfrac{1}{4}$
(b) $\dfrac{1}{2}$
(c) 1
(d) 0

Ans: d

32. $\displaystyle\int_a^\infty \frac{\sin x}{x^p}\, dx$is convergent for all $x \geq a > 0$ and p is

(a) < 0
(b) > 0
(c) > 1
(d) < 1

Ans: b

33. A statement "I wear my running shoes if and only if I am exercising" is an

(a) Conditional
(b) Tautology
(c) Bi-conditional
(d) Contradiction

Ans: c

34. Let $f : S \to T$ be a function, where S and T are two sets. If $X \subseteq S$ and $Y \subseteq T$, then $X = f^{-1}(Y)$ implies

    (a) $f(X) \subseteq Y$
    (b) $f(Y) \subseteq X$
    (c) $f^{-1}(X) = Y$
    (d) None of them

    Ans: a

35. The value of $\lim_{x \to 0} (\sin x + \cos x)^{\cot x}$ is

    (a) e^{-1}
    (b) 1
    (c) ∞
    (d) e

    Ans: d

36. If a function f is continuous on $[a, b]$then there exist a number $c \in [a, b]$such that $\int_a^b f(x)\, dx = f(c)(b - a)$ is the statement of

    (a) Second mean value theorem of integral calculus
    (b) First mean value theorem of integral calculus
    (c) Fundamental theorem of integral calculus
    (d) Generalized mean value theorem of integral calculus

    Ans: b

37. Let f be a continuous function on $[a, b]$. If $f(a)$ and $f(b)$have opposite signs, then there exist $c \in (a, b) : f(c) = 0$ is the statement of

    (a) Heine theorem
    (b) Intermediate value theorem
    (c) Bolzano theorem
    (d) None of them

    Ans: c

38. If $\sum |a_n|$ converges and $\{b_n\}$ bounded then $\sum a_n b_n$ is

    (a) Bounded
    (b) Divergent
    (c) Oscillatory
    (d) Convergent

    Ans: d

39. If an increasing sequence is bounded above, then it converges to the

    (a) Supremum
    (b) Infimum

(c) Neither suprimum nor infimum
(d) Monotonically increasing function

Ans: a

40. If $0 < a < 1$ and $A = \{a^n : n \in \mathbb{N}\}$,then A has infimum and inf A equals to
    (a) 3
    (b) 2
    (c) 1
    (d) 0

    Ans: d

41. The value of $\lim_{x \to 0} \dfrac{\ln(\tan x)}{\ln x}$ is
    (a) 0
    (b) 1
    (c) 3
    (d) -1

    Ans: b

42. The maximum value of $\sin x + \cos x$ is
    (a) 1
    (b) 2
    (c) $\sqrt{2}$
    (d) 0

    Ans: c

43. If $f(x) = x^2 - 1$ and $g(x) = \sqrt{x}$ then the value of $(fog)(x)$ is
    (a) $x + 1$
    (b) $x - 1$
    (c) $\sqrt{x^2 - 1}$
    (d) $x^4 - 2x^2$.

    Ans: b

44. Given that $1 - \frac{x^2}{4} \leq f(x) \leq 1 + \frac{x^2}{2}$ for all $x \neq 0$. The value of $\lim_{x \to 0} f(x)$ is equal to
    (a) 0
    (b) -1
    (c) 1
    (d) Does not exist.

    Ans: c

45. If $y = x^n$, where n is a positive integer then the value of $(n + 1)^{th}$ derivative of y is
    (a) nx^{n-1}
    (b) $n!$

(c) $(n+1)!$
(d) 0

Ans: d

46. The domain of the function $f(x) = \dfrac{x^2}{\sqrt{x+1}}$ is

(a) $(-\infty, \infty)$
(b) $(0, \infty)$
(c) $(-1, 1)$
(d) $(-1, \infty)$

Ans: d

47. The horizontal asymptote to the curve $y = \dfrac{x^2}{x^2+1}$ is

(a) $y = -1$
(b) $x = -1$
(c) $y = 1$
(d) $x = 1$

Ans: c

48. If $f(x, y) = x^2 + 3xy + y - 1$ then the value of $f_x(4, -5)$ is

(a) -7
(b) 13
(c) 7
(d) -13

Ans: a

49. The equation of tangent to the curve $x^2 + y^2 = 25$ at the point $(3, -4)$ is

(a) $3x - 4y = 5$
(b) $3x - 4y = 25$
(c) $4x + 3y = 0$
(d) $4x - 3y = 0$

Ans: b

50. The derivative of x^x with respect to x is

(a) $x^x(1 + \ln x)$
(b) x^x
(c) $x^x \ln x$
(d) 0

Ans: a

51. $\int_{-a}^{a} f(x)dx = 0$

(a) For every function $f(x)$

(b) When $f(x)$ is an even function

(c) When $f(x)$ is an odd function

(d) When $f(x)$ is continuous

Ans: c

52. The value of $\int_{-1}^{1} \frac{1}{x^2}\, dx$ is

(a) -2

(b) 2

(c) 0

(d) The integral doesn't exist

Ans: d

53. Which of the following is not true?

(a) $\Gamma(\frac{1}{2}) = \frac{\sqrt{\pi}}{2}$

(b) $\Gamma(1) = 1$

(c) $\Gamma(n+1) = n\Gamma(n)$

(d) $\Gamma(n+1) = n!$, when n is a positive integer

Ans: a

54. The value of $\int_{0}^{\frac{\pi}{4}} \sin^2 x\, dx$ is

(a) $-\frac{1}{2}$

(b) $\frac{1}{2}$

(c) $\frac{\pi}{4} - \frac{1}{4}$

(d) $\frac{\pi}{8} - \frac{1}{4}$

Ans: d

55. The value of $\int_{0}^{\infty} e^{-x^2}\, dx$ is

(a) $\sqrt{\pi}$

(b) $\frac{\sqrt{\pi}}{2}$

(c) 1

(d) $\frac{1}{2}$

Ans: b

56. The plane area bounded by the curve $r = f(\theta)$, vectorial angles $\theta = \alpha$ and $\theta = \beta$ is

(a) $\int_{\alpha}^{\beta} \int_{0}^{f(\theta)} r^2\, dr\, d\theta$

(b) $\frac{1}{2} \int_{\alpha}^{\beta} \int_{0}^{f(\theta)} r\, dr\, d\theta$

(c) $\int_{\alpha}^{\beta} \int_{0}^{f(\theta)} r \; dr \; d\theta$

(d) $\frac{1}{2} \int_{\alpha}^{\beta} \int_{0}^{f(\theta)} r^2 \; dr \; d\theta$

Ans: c

57. The value of $\Gamma(\frac{1}{4})\Gamma(\frac{3}{4})$

(a) $\sqrt{2}\pi$

(b) $\sqrt{\pi}$

(c) $\sqrt{2}$

(d) $\frac{\sqrt{\pi}}{2}$

Ans: a

58. The value of $\int_{1}^{\infty} \frac{1}{\sqrt{x}} \; dx$ is

(a) -2

(b) 2

(c) 0

(d) The integral doesn't exist

Ans: d

59. The value of $\int_{0}^{\pi} \int_{0}^{x} \sin y \; dy \; dx$ is

(a) π

(b) 2π

(c) $-\pi$

(d) 0

Ans: b

60. The integral $\int_{0}^{a} f(a-x)dx$ is equivalent to

(a) $\int_{0}^{a} f(a-t) \; dt$

(b) $\int_{0}^{a} f(x) \; dx$

(c) $-\int_{a}^{0} f(x) \; dx$

(d) All of the above

Ans: d

61. The general solution of the ODE $y\,dy = -x\,dx$ represents

(a) Family of ellipses

(b) Family of intersecting circles

(c) Family of concentric circles

(d) Family of parabolas

Ans: c

62. A solution of the differential equation $\dfrac{dy}{dx} = -y$ can not be

(a) A polynomial function
(b) A trigonometric function
(c) A logarithmic function
(d) All of the above

Ans: d

63. The Direction field is also known as

(a) Slope field
(b) Vector field
(c) Both (a) and (b)
(d) Scalar field

Ans: c

64. The process of describing or translating physical phenomenon (Real world situation) into the mathematical formulations is known as

(a) Numerical method
(b) Mathematical Modeling
(c) Mathematical Solution
(d) Physical interpretation

Ans: b

65. For the ODE, $\dfrac{dy}{dt} = y(y-1)(y-2), y \geq 0$, the equilibrium solution $y = 1$ is

(a) Asymptotically stable
(b) Stable but not asymptotically stable
(c) Semi-stable
(d) Unstable

Ans: a

66. In the Runge-Kutta method, the operations on linear and non-linear ODEs are

(a) Different
(b) Identical
(c) Differ by mean $1, 2$
(d) Differ by weight $2, 4$

Ans: b

67. Sufficient condition for the existence and uniqueness of the IVP: $y' = f(t, y), y(t_0) = y_0$ is

(a) Only f continuous
(b) Only $\dfrac{\partial f}{\partial y}$ continuous

(c) Both f and $\dfrac{\partial f}{\partial y}$ continuous

(d) Both f and $\dfrac{\partial f}{\partial y}$ discontinuous

Ans: c

68. If the damped system is described by ODE $m\,u'' + \gamma\,u' + k\,u = 0$, and $\gamma^2 = 4m\,k$, then the motion is

(a) Underdamped

(b) Undamped

(c) Overdamped

(d) Critically damped

Ans: d

69. Laplace's equation $u_{xx} + u_{yy} = 0$ is

(a) Quadratic equation

(b) Parabolic equation

(c) Elliptic equation

(d) Hyperbolic equation

Ans: c

70. The longest interval in which the given IVP: $(x-3)\,y''+x\,y'+(\ln|x|)\,y = 0,\ y(1) = 0, y'(1) = 1$ is certain to have a unique twice-differentiable solution.

(a) $(-\infty, \infty)$

(b) $(0, 3)$

(c) $(-\infty, 3) \cup (0, \infty)$

(d) $(0, \infty)$

Ans: b

71. The equation of a straight line which cuts off an intercept 3 form the y- axis and makes an angle of 60^0 with x-axis is

(a) $y + \sqrt{3}x = 3$

(b) $y - \sqrt{3}x = 3$

(c) $y + \sqrt{3}x = 4$

(d) $y - \sqrt{3}x = 4$

Ans: a

72. The condition of three points (x_1, y_1), (x_2, y_2), and (x_3, y_3) lie on the locus of the straight line is

(a) $x_1y_2 + x_2y_1 + x_2y_3 + x_3y_2 + x_3y_1 + x_1y_3 = 0$

(b) $x_1y_2 + x_2y_1 - x_2y_3 + x_3y_2 + x_3y_1 - x_1y_3 = 0$

(c) $x_1y_2 - x_2y_1 + x_2y_3 - x_3y_2 + x_3y_1 - x_1y_3 = 0$

(d) $x_1y_2 + x_2y_1 - x_2y_3 - x_3y_2 + x_3y_1 - x_1y_3 = 0$

Ans: c

73. The slope of the line passing through the point (x_1, y_1) and (x_2, y_2) is

(a) $\dfrac{y_2 + y_1}{x_2 + x_1}$
(b) $\dfrac{y_2 + y_1}{x_2 - x_1}$
(c) $\dfrac{y_2 - y_1}{x_2 + x_1}$
(d) $\dfrac{y_2 - y_1}{x_2 - x_1}$

Ans: d

74. The acute angle between the lines $2x + 3y = 4$ and $x + 2y = 3$ is

(a) $\tan^{-1}\dfrac{1}{4}$
(b) $\tan^{-1}\dfrac{1}{5}$
(c) $\tan^{-1}\dfrac{1}{6}$
(d) $\tan^{-1}\dfrac{1}{8}$

Ans: d

75. The length of perpendicular drawn from the point $(4, -7)$ upon the straight line passing through the origin and the point of intersection of the lines $2x - 3y + 14 = 0$ and $5x + 4y - 7 = 0$ is

(a) 5
(b) 1
(c) 3
(d) 4

Ans: b

76. The equation of the tangent at the point (x_1, y_1) of the parabola $y^2 = 4ax$ is

(a) $yy_1 = 4a(x + x_1)$
(b) $yy_1 = 2a(x + x_1)$
(c) $yy_1 = 3a(x + x_1)$
(d) $yy_1 = a(x + x_1)$

Ans: b

77. The equation of the tangent at a given (x_1, y_1) of the hyperbola $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$ is

(a) $\dfrac{x^2 x_1}{a^2} - \dfrac{y_2 y_1}{b^2} = 1$
(b) $\dfrac{xx_1}{a^2} + \dfrac{yy_1}{b^2} = 1$
(c) $\dfrac{xx_1}{a^2} - \dfrac{yy_1}{b^2} = 1$
(d) $\dfrac{xx_1}{a^2} - \dfrac{yy_1}{b^2} = 2ab$

Ans: c

78. If $\cos\alpha, \cos\beta, \cos\gamma$ are the direction cosines of a straight line then which one of the following is true?

(a) $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$
(b) $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 0$
(c) $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 1$
(d) $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = 0$

Ans: a

79. The equation of the plane passing through the points $(0, 1, 1), (1, 1, 2)$ and $(-1, 2, -2)$ is

(a) $4x + 2y - 3z + 16 = 0$
(b) $5x - 2y - 3z - 20 = 0$
(c) $6x + 5y - 3z - 19 = 0$
(d) $x - 2y - z + 3 = 0$

Ans: d

80. The equation of the plane, which is at a distance 7 units from the origin and the direction ratios of the normal to the plane being $(1, 2, -1)$ is

(a) $2x + 2y - 3z = 7$
(b) $3x + 2y + z = 7\sqrt{3}$
(c) $x + 2y - z = 7\sqrt{6}$
(d) $5x + 2y + 3z = 7\sqrt{5}$

Ans: c

81. The equation of the plane passing through the points $(-1, 1, 1)(1, -1, 1)$ and the perpendicular to the plane is $x + 2y + 2z = 0$ is

(a) $8x + 2y + 2z + 4 = 0 or x - 6y - z + 2 = 0$
(b) $14x - 7y + 7z = 0 or 2x - y + x = 0$
(c) $9x + 12y - 2z + 4 = 0 or 2x - y + x = 0$
(d) $4x + 6y - z + 2 = 0$

Ans: b

82. The equation of the tangent plane at $(-1, 4, -2)$ of the sphere is

(a) $2x + 2y - 3z = 7$
(b) $2x - 2y + z + 12 = 0$
(c) $x + 2y - z = 8\sqrt{6}$
(d) $5x + 2y + 3z = 10$

Ans: b

83. The equation of the plane of contact of a point $P(x_1, y_1, z_1)$ with respect to sphere $x^2 + y^2 + z^2 = r^2$ is

(a) $xx_1 - yy_1 - zz_1 = r^2$
(b) $xx_1 + yy_1 + zz_1 + r^2 = 0$
(c) $xx_1 + yy_1 + zz_1 = r^2$

(d) $xx_1 + yy_1 + zz_1 = 0$

Ans: c

84. The Equation of the cylinder whose generators are $x = -\frac{y}{2} = \frac{z}{3}$ and whose guiding curve is the ellipse $x^2 + 2y^2 = 1, z = 0$ is

(a) $xy \pm yx \pm zx = 0$
(b) $xx_1 \pm yy_1 \pm zz_1 = r^2$
(c) $xx_1 + yy_1 + zz_1 + r^2 = 0$
(d) $xy \pm yx \pm zx = xyz$

Ans: b

85. If one considers only the magnitude and direction of a vector, such a vector is said to be a

(a) Position vector.
(b) Sliding vector.
(c) Free vector.
(d) Localised vector.

Ans: c

86. A cube has four diagonals, connecting opposite vertices. The angle between an adjacent pair is

(a) $\cos \frac{1}{3}$.
(b) $\sin^{-1} \frac{1}{3}$.
(c) $\cos^{-1} \frac{1}{\sqrt{3}}$.
(d) $\cos^{-1} \frac{1}{3}$.

Ans: d

87. The equation of a vector line is given by $\vec{r} = \vec{a} + \lambda \vec{b}$. The vector $\vec{b}$ is termed as

(a) The direction vector.
(b) The position vector.
(c) The localised vector.
(d) The free vector.

Ans: a

88. For the path $y = x^n$, the integral $\int_{(0,0)}^{(1,1)} (y^2\, x\, dx + y\, x^2\, dy)$ equals

(a) $\frac{n}{2}$.
(b) $\frac{1}{n}$.
(c) $\frac{1}{4}$.
(d) $\frac{1}{2}$.

Ans: d

89. The value of the integral $\int_S \vec{a}.\, d\vec{S}$, where $\vec{a} = z^3\,\hat{k}$ and S is the sphere of radius r with the centre origin is

 (a) $\dfrac{\pi r^5}{5}$.
 (b) $\dfrac{2\pi r^5}{5}$.
 (c) $\dfrac{3\pi r^5}{5}$.
 (d) $\dfrac{4\pi r^5}{5}$.

Ans: d

90. Let $U = r^2, r^2 = x^2 + y^2 + z^2$, the Laplacian of U, $\nabla^2 U$ is

 (a) 2
 (b) 4
 (c) 6
 (d) 8

Ans: c

Attempt either from Mechanics or Linear Programming.

Mechanics

91. The force in a string connecting two particles has a tendency to bring the particles together is called

 (a) Tension.
 (b) Thrust.
 (c) Buoyancy.
 (d) Reaction.

Ans a

92. The magnitude of the resultant force R of the two perpendicular forces P and Q is

 (a) $\sqrt{P^2 - Q^2}$.
 (b) $\sqrt{P + Q}$.
 (c) $\sqrt{P^2 + Q^2}$.
 (d) $P^2 + Q^2$.

Ans c

93. The necessary and sufficient conditions for the equilibrium of coplanar and concurrent forces are

 (a) The resultant or their resolved parts along two perpendicular directions are zero.
 (b) The resultant and their resolved parts along two non-perpendicular directions are zero.

(c) The resultant but not their resolved parts along two perpendicular directions are zero.
(d) The resultant and their resolved parts along two perpendicular directions are zero.

Ans d

94. The virtual work done by the tension of an inextensible string is

(a) Negative.
(b) Positive.
(c) Zero.
(d) Not fixed.

Ans c

95. The centre of gravity of a uniform triangular area lies at

(a) The point where the medians meet.
(b) One vertex.
(c) The mid point of a side.
(d) The incentre.

Ans a

96. If a point moves along a circle, its angular velocity about any point on the circle is ... of that about the centre.

(a) $\frac{2}{3}$
(b) $\frac{1}{3}$
(c) $\frac{3}{2}$
(d) $\frac{1}{2}$

Ans b

97. The number n of complete oscillations in one second is given by

(a) $\frac{1}{T-1}$.
(b) $\frac{1}{T}$.
(c) $\frac{1}{\sqrt{T}}$.
(d) $\frac{1}{T+1}$.

Ans b

98. The force exerted due to the surface of contact of an object perpendicular to the surface is said to be

(a) Normal contact force.
(b) Total contact force.
(c) Resolved force.
(d) Component force.

Ans a

99. An object is said to be in-extensible which

  (a) Varies with time.
  (b) Varies with length.
  (c) Does not vary with time.
  (d) Does not vary with length.

  Ans d

100. Which is not an equation of catenary?

  (a) $s = c \tan \psi$
  (b) $y^2 = c^2 + s^2$
  (c) $y = c \cos \psi$
  (d) $y = c \cosh \frac{x}{c}$

  Ans c

Linear Programming

91 A linear programming formulation requires

  (a) The objective function should be linear
  (b) The constraints should be linear
  (c) Ether (a) or (b) holds
  (d) Both (a) and (b) must hold

  Ans: d

92 Consider the linear programming problem $\min\{c'x \mid Ax = b, x \geq 0, x \in R^n\}$. Then

  (a) Every basic solution to this problem is a basic feasible solution
  (b) Every basic feasible solution to this problem is a basic solution
  (c) There is no relation between basic feasible solution and basic solution
  (d) Every basic solution is an optimal solution

  Ans: b

93 The simplex algorithm is efficient to solve

  (a) A linear programming problem
  (b) A non-linear programming problem
  (c) Neither of (a) and (b)
  (d) Both cases (a) and (b)

  Ans: a

94 Let a primal linear programming problem P and its dual D be given. Then

  (a) The dual problem D is also linear
  (b) Dual of D is a linear programming problem P

(c) Both statements (a) and (b) are correct
(d) Both statements (a) and (b) are false

Ans: c

95 An optimal solution to a linear programming problem is guaranteed

(a) In the set of its all extreme vertices
(b) In the complement set of its all extreme vertices
(c) Outside of the bounded polytope
(d) None of the (a-c) is a correct statement

Ans: a

96 While forming a linear programming problem, the free variable $x \in R^n$ may appear in the type of formulation

(a) The general form of LP
(b) The canonical form of LP
(c) The standard form of LP
(d) In all of the above (a-c)

Ans: a

97 Let a linear programming problem LP: $\max\{c'x \mid Ax = b, x \geq 0, x \in R^n\}$ be restricted to the integer programming problem IP: $\max\{c'x \mid Ax = b, x \geq 0, x \in Z^n\}$. Then it holds

(a) The optimal solution of IP is greater than or equal to the optimal solution of LP
(b) The optimal solution of LP is greater than or equal to the optimal solution of IP
(c) The optimal solution of LP must be equal to the optimal solution of IP
(d) The optimal solution of LP must not be equal to the optimal solution of IP

Ans: b

98 Consider the general linear programming problem to be minimized where the equality constraints appear. Then the correct statement is

(a) In the dual formulation the corresponding variable must be negative
(b) In the dual formulation the corresponding variable must be positive
(c) In the dual formulation the corresponding variable is free
(d) In the dual formulation the corresponding variable does not exist

Ans: c

99 Given a single-source s single-sink d network $N = (s, d, V, A, b)$, where V and A represent the nodes and arcs, respectively, and b capacity on arcs, the maximum flow problem with flow function $f : A \rightarrow R^{\geq 0}$ does not fulfill the condition

(a) The flow conservation constraints
(b) The capacity constraints
(c) Flow non-negativity constraint
(d) Flow negativity constraint

Ans: d

100 Given a $s-d$ network $N=(s,d,V,A,b,c)$ with flow bound $b \geq 0$ and the cost $c \geq 0$ on the arcs, then the min-cost flow problem requires

(a) To find a feasible $s-d$ flow of variable value v_o that has minimum cost

(b) To find a feasible $s-d$ flow of fixed value v_o that has maximum cost

(c) To find a feasible $s-d$ flow of variable value v that has maximum cost

(d) To find a feasible $s-d$ flow of fixed value v_o that has minimum cost

Ans: d