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A

SET-X

PG-EE-2021

SUBJECT : Mathematics

Sr. No. 10333

Time : **1¼ Hours**

Max. Marks : **100**

Total Questions : **100**

Roll No. (in figures)__________ (in words)__________

Name__________ Date of Birth__________

Father's Name__________ Mother's Name__________

Date of Examination__________

(Signature of the Candidate)

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SEAL

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1. The rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ is :

(1) Less than 2

(2) Less than 3

(3) Greater than 2

(4) Greater than 3

2. Which one of the following statement is ***not*** true ?

(1) A set containing only the zero vector is linearly independent.

(2) A set containing only a non-zero vector is linearly independent.

(3) Every super set of a linearly dependent set is linearly dependent.

(4) None of these

3. If $A = \begin{bmatrix} 1 & \sqrt{2} \\ -\sqrt{2} & -1 \end{bmatrix}$, then by Cayley Hamilton theorem :

(1) $A^2 = \sqrt{2}I$ (2) $A^2 = -\sqrt{2}I$

(3) $A^2 = -I$ (4) $A^2 = I$

4. If 1, α, β, γ, ... are roots of the equation $x^n - 1 = 0$, then $(1-\alpha)(1-\beta)(1-\gamma)$ ...... is equal to :

(1) n (2) $-n$

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

5. If α, β, γ are the roots of the equation $x^3 + px^2 + qx + r = 0$, then $\sum \frac{1}{\alpha}$ is equal to :

(1) $\frac{r}{q}$ (2) $\frac{q}{r}$

(3) $-\frac{r}{q}$ (4) $-\frac{q}{r}$

6. The equation of curve having $x+y-1=0$ and $x-y+2=0$ as its asymptotes and passing through origin is :

(1) $(x-y+2)(x+y-1)-2=0$ (2) $(x+y-1)(x-y+2)+2=0$

(3) $(x+y-1)(x-y+2)-4=0$ (4) None of these

7. For the curve $r^n = a^n \cos n\theta$, the angle ϕ is given by :

(1) $\frac{\pi}{2} - n\theta$ (2) $\pi + n\theta$

(3) $\frac{\pi}{2} + n\theta$ (4) $\pi - n\theta$

8. The double point (2, 0) of the curve $y^2 = (x-2)^2(x-1)$ is a :

(1) Node (2) Cusp

(3) Conjugate point (4) Point of inflexion

9. For the curve $r = a(1-\sin\theta)$, the tangent to the curve at the origin is :

(1) $\theta = \pi$ (2) $\theta = \frac{\pi}{3}$

(3) $\theta = \frac{\pi}{2}$ (4) $\theta = \frac{\pi}{4}$

10. $\int_0^1 \frac{x^3}{\sqrt{1-x^2}} dx$ is equal to :

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

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

11. The equation $36x^2 + 24xy + 29y^2 - 72x + 126y + 81 = 0$ represents a :

(1) Parabola (2) Ellipse

(3) Hyperbola (4) Circle

12. The centre of conic $8x^2 - 4xy + 5y^2 - 16x - 14y + 17 = 0$ is :

(1) $\left(\frac{3}{2}, 2\right)$ (2) $\left(2, \frac{3}{2}\right)$

(3) $\left(\frac{2}{3}, 2\right)$ (4) $\left(2, \frac{2}{3}\right)$

13. The equation of sphere which passes through the origin and meets the axes in $A(a, 0, 0)$, $B(0, b, 0)$ and $C(0, 0, c)$ is :

(1) $ax^2 + by^2 + cz^2 - ax - by - cz = 0$ (2) $x^2 + y^2 + z^2 + ax + by - cz = 0$

(3) $x^2 + y^2 + z^2 - ax - by - cz = 0$ (4) $x^2 + y^2 + z^2 + ax - by + cz = 0$

14. The pole of the plane $lx + my + nz = p$ w.r.t. the conicoid $ax^2 + by^2 + cz^2 = 1$ is :

(1) $\left(\frac{ap}{l}, \frac{bp}{m}, \frac{cp}{n}\right)$ (2) (lap, mbp, ncp)

(3) (ap, bp, cp) (4) $\left(\frac{l}{ap}, \frac{m}{bp}, \frac{n}{cp}\right)$

15. The discriminating cubic to reduce $2x^2 - 7y^2 + 2z^2 - 10yz - 8zx - 10xy + 6x + 12y - 6z + 5 = 0$ to the standard form is :

(1) $\lambda^3 + 3\lambda^2 - 90\lambda + 216 = 0$

(2) $\lambda^3 - 3\lambda^2 + 90\lambda + 216 = 0$

(3) $\lambda^3 + 3\lambda^2 + 90\lambda + 216 = 0$

(4) $\lambda^3 + 3\lambda^2 - 90\lambda - 216 = 0$

16. Which of the following statement is ***not*** true ?

(1) If p is a prime number and p/ab, then either p/a or p/b.

(2) If $a \equiv b \pmod{m}$, then a and b leave the same remainder when divided by m.

(3) If p is a prime number, then by Wilson theorem, $\underline{|p} + 1 \equiv 0 \pmod{p}$.

(4) None of these

17. $\tan\frac{\theta}{7} + \tan\frac{\theta+\pi}{7} + \dots\dots\dots + \tan\frac{\theta+6\pi}{7}$ is equal to :

(1) $\tan 7\theta$

(2) $\tan\frac{\theta}{7}$

(3) $7\tan\theta$

(4) $\frac{\tan\theta}{7}$

18. The principal value of $\log(-5)$ is :

(1) $\frac{\log 5}{\pi i}$

(2) $\log 5 + i\pi$

(3) $\log 5 - i\pi$

(4) $\log 5$

19. $\tan^{-1}\frac{x}{\sqrt{a^2 - x^2}}$ is equal to :

(1) $\sin^{-1}(ax)$

(2) $\sin^{-1}\left(\frac{a}{x}\right)$

(3) $\sin^{-1}\left(\frac{x}{a}\right)$

(4) $\sin^{-1}\left(\frac{x}{\sqrt{a}}\right)$

20. The real part of $\sin h\,(x + iy)$ is :

(1) $\sin h\,x \cos y$

(2) $\sin x \cos h\,y$

(3) $\sin h\,x \cos h\,y$

(4) $\cos h\,x \sin h\,y$

21. The integrating factor of the differential equation $(y^2 + 2x + x^2)dx + 2y\,dy = 0$ is :

(1) e^{y}

(2) e^{-x}

(3) e^{-y}

(4) e^{x}

22. The particular integral of the differential equation $(D^2 - 6D + 9)y = e^{3x}$ is :

(1) $\frac{x^2}{2}e^{3x}$

(2) x^2e^{3x}

(3) xe^{3x}

(4) $x^2 e^{3x}$

23. The complementary function of the differential equation $x^2\frac{d^2y}{dx^2}-x\frac{dy}{dx}-3y=x^2\log x$ is :

(1) $\frac{c_1}{x^3}+c_2x$ (2) $c_1x^3+\frac{c_2}{x}$

(3) $c_1x^3+c_2x$ (4) $(c_1+c_2x)x^3$

24. The value of determinant used for solving the differential equation $\frac{d^2y}{dx^2}+4y=\tan 2x$ by the method of variation of parameters is :

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

(3) 2 (4) 3

25. Using 1, y and z as multipliers, one part of the complete solution of $\frac{xdx}{z^2-2yz-y^2}=\frac{dy}{y+z}=\frac{dz}{y-z}$ is :

(1) $x^2+y^2+z^2=c$ (2) $x^2-y^2+z^2=c$

(3) $x^2+y^2-z^2=c$ (4) $-x^2+y^2+z^2=c$

26. The necessary and sufficient condition for the vector function $\vec{f}$ of a scalar variable t to have constant direction is :

(1) $\vec{f}.\frac{d\vec{f}}{dt}=0$ (2) $\vec{f}\times\frac{d\vec{f}}{dt}=\vec{0}$

(3) $\vec{f}+\frac{d\vec{f}}{dt}=\vec{0}$ (4) $\vec{f}-\frac{d\vec{f}}{dt}=\vec{0}$

27. If $r=|\vec{r}|$, where $\vec{r}=x\hat{i}+y\hat{j}+z\hat{k}$, then $\nabla\log|\vec{r}|$ is equal to :

(1) $\vec{r}+r^2$ (2) $\vec{r}\times\log\vec{r}$

(3) $\frac{\vec{r}}{r^2}$ (4) $-\frac{\vec{r}}{r^3}$

28. If $\vec{f}$ and $\vec{g}$ are irrotational, then which of the following is solenoidal ?

(1) $\vec{f} + \vec{g}$ (2) $\vec{f} - \vec{g}$

(3) $\vec{f} . \vec{g}$ (4) $\vec{f} \times \vec{g}$

29. If a vector $\vec{r}$ satisfies the equation $\frac{d^2\vec{r}}{dt^2} = t\vec{a} + \vec{b}$, where $\vec{a}$ and $\vec{b}$ are constant vectors, then $\vec{r}$ is given by :

(1) $\frac{t^3}{6}\vec{a} + \vec{c}_1 t$ (2) $\frac{t^3}{6}\vec{a} + \frac{t^2}{2}\vec{b} + \vec{c}_1 t + \vec{c}_2$

(3) $\frac{t^3}{2}\vec{a} + \frac{t^2}{6}\vec{b} + \vec{c}_1 t + \vec{c}_2$ (4) $\frac{t^2}{3}\vec{a} + \frac{t^2}{2}\vec{b} + \vec{c}_1 t$

where $\vec{c}_1$ and $\vec{c}_2$ are constant vectors.

30. If S represents the surface of a sphere $x^2 + y^2 + z^2 = a^2$, then $\iint_S (x\,dy\,dz + y\,dz\,dx + z\,dx\,dy)$ is equal to :

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

(3) $\frac{4}{\pi}a^3$ (4) $\frac{4\pi}{a^3}$

31. $\lim_{x \to 0} \frac{(\tan^{-1} x)^2}{\log(1+x^2)}$ is equal to :

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

(3) 2 (4) 1

32. If $u = \tan^{-1}\frac{x^3 + y^3}{x - y}$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(1) $\sin u$ (2) $\sin 2u$

(3) $\cos u$ (4) $\tan u$

33. The magnitude of screw curvature is given by :

(1) $\sqrt{k^2 - \tau^2}$ (2) $\sqrt{\tau^2 - k^2}$

(3) $\sqrt{\frac{k^3}{\tau^5}}$ (4) $\sqrt{k^2 + \tau^2}$

34. The necessary and sufficient condition for a given curve to be a plane curve is that :

(1) $\tau = \infty$ at all points of the curve (2) $\tau = -\infty$ at all points of the curve

(3) $\tau = 1$ at all points of the curve (4) $\tau = 0$ at all points of the curve

35. The normal which is perpendicular to the osculating plane at a point is called :

(1) Principal Normal (2) Right Normal

(3) Left Normal (4) Bi-Normal

36. The complementary function of the differential equation $\frac{\partial^3 z}{\partial x^3} - 3\frac{\partial^3 z}{\partial x^2 \partial y} + 4\frac{\partial^3 z}{\partial y^3} = e^{x+2y}$ is :

(1) $\phi_1(y-x) + \phi_2(y+2x) + x\phi_3(y+2x)$ (2) $\phi_1(y-x) + \phi_2(y+2x) + \phi_3(y+2x)$

(3) $\phi_1(y+2x) + \phi_2(y-x) + \phi_3(y+2x)$ (4) None of these

37. The particular integral of the differential equation $x^2\frac{\partial^2 z}{\partial x^2} + 2xy\frac{\partial^2 z}{\partial x \partial y} - x\frac{\partial z}{\partial x} = \frac{x^3}{y^2}$ is :

(1) $-\frac{1}{9}x^{-2}y^3$

(2) $-\frac{1}{9}.\frac{x^3}{y^2}$

(3) $-\frac{1}{9}\frac{y^2}{x^3}$

(4) $-\frac{1}{9}\frac{x^3}{y^3}$

38. The equation $\frac{\partial^2 z}{\partial y^2} - \frac{\partial^2 z}{\partial x \partial y} + \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\left(1+\frac{1}{x}\right) + \frac{z}{x} = 0$ is :

(1) Elliptic (2) Parabolic

(3) Hyperbolic (4) None of these

39. For the partial differential equation $r = a^2 t$, the Monge's subsidiary equations are :

(1) $dp\,dy + a^2 dq\,dx = 0,\ (dy)^2 - a^2 (dx)^2 = 0$

(2) $dp\,dy - a^2 dq\,dx = 0,\ (dy)^2 + a^2 (dx)^2 = 0$

(3) $dp\,dy - a^2 dq\,dx = 0,\ (dy)^2 - a^2 (dx)^2 = 0$

(4) $dp\,dy + a^2 dq\,dx = 0,\ (dy)^2 + a^2 (dx)^2 = 0$

40. The two dimensional wave equation is given by :

(1) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(2) $\frac{\partial^2 u}{\partial x^2} + \left(\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}\right) = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(3) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(4) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2}\frac{\partial u}{\partial t}$

41. Which of the following is converse of Lami's theorem ?

(1) If three coplanar forces acting at a point be such that each is proportional to the sine of the angle between the directions of other two, then the forces are in equilibrium

(2) Every given system of forces acting on a rigid body can be reduced to a wrench

(3) A system of coplanar forces acting on a rigid body can be reduced to either a single force or single couple

(4) None of these

42. If AB = 40 cm and two unlike parallel forces 40 N and 5 N act at A and B respectively, then the resultant of these forces acts at a distance from A given by :

(1) 40 cm

(2) $\frac{40}{7}$ cm

(3) 7 cm

(4) 40.7 cm

43. Three forces 3P, 7P, 5P act along the sides AB, BC, CA of an equilateral triangle ABC. Then the magnitude of the resultant is given by :

(1) $2\sqrt{3}\,P$

(2) $3\sqrt{2}\,P$

(3) $\frac{\sqrt{3}}{2}P$

(4) $\frac{\sqrt{2}}{3}P$

44. Which of the following statement is ***not*** true ?

(1) Two couples in the same plane of equal moments and acting in the same sense are equivalent.

(2) Two couples of equal and opposite moments in parallel planes don't balance each other.

(3) The resultant of a number of coplanar couples is equivalent to a single couple whose moment is equal to the algebraic sum of the moments of the given couples.

(4) None of these

45. The equations of the central axis of any given system of forces acting on a rigid body is :

(1) $\frac{X - yZ + zY}{L} = \frac{Y - zX + xZ}{M} = \frac{Z - xY + yX}{N} = p$

(2) $\frac{L - yZ + zY}{X} = \frac{M - zX + xZ}{Y} = \frac{N - xY + yX}{Z} = p$

(3) $\frac{L + yZ + zY}{X} = \frac{M + zX - xZ}{Y} = \frac{N + xY - yX}{Z} = p$

(4) None of these

46. Which of the following statement is ***not*** true ?

(1) Interior of a set is an open set.

(2) The interior of a set A is the largest open subset of A.

(3) A point p is a limit point of a set A if and only if every neighbourhood of p contains one point of A.

(4) None of these

47. Which of the following statement is ***not*** true ?

(1) If a sequence $<a_n>$ diverges to ∞, then $<a_n>$ is bounded below but unbounded above.

(2) If a sequence $<a_n>$ diverges to $-\infty$, then $<a_n>$ is unbounded below but bounded above.

(3) Every monotonically increasing sequence unbounded above diverges to $-\infty$.

(4) Every monotonically decreasing sequence unbounded below diverges to $-\infty$.

48. A geometrical series $a + ar + ar^2 + \dots\dots\dots + \infty$ oscillates infinitely, if :

(1) $|r| < 1$

(2) $r \geq 1$

(3) $r = -1$

(4) $r < -1$

49. Which of the following is ***not*** true ?

(1) Every absolutely convergent infinite product is convergent.

(2) A series $\sum_{n=1}^{\infty} a_n$ is said to be absolutely convergent, if the series $\sum_{n=1}^{\infty} |a_n|$ converges.

(3) If $a_n \geq 0$, then the infinite series $\sum_{n=1}^{\infty} a_n$ and the infinite product $\prod_{n=1}^{\infty}(1+a_n)$ converge or diverge together.

(4) Every absolutely convergent infinite product may not be always convergent.

50. The series $\sum_{n=1}^{\infty}\left(1+\frac{1}{n}\right)^n x^n$, $x > 0$ is divergent, if :

(1) $x \geq 1$

(2) $x < 1$

(3) $x \leq \frac{1}{2}$

(4) None of these

51. $\frac{d}{dx}(x^n J_n(x))$ is equal to :

(1) $x^{n-1}J_n(x)$

(2) $x^n J_{n-1}(x)$

(3) $nx^{n-1}J_n(x)$

(4) $nx^n J_{n-1}(x)$

52. Rodrigue's formula for Legendre polynomial is :

(1) $P_n(x) = \frac{1}{\lfloor n\, 2^n} \frac{d^n}{dx^n}(x^2-1)^{n+1}$

(2) $P_n(x) = \frac{1}{\lfloor n\, 2^n} \frac{d^n}{dx^n}(x^2-1)^n$

(3) $P_n(x) = \frac{1}{\lfloor n-1\; 2^n} \frac{d^{n-1}}{dx^{n-1}}(x^2-1)^n$

(4) None of these

53. $H_n'(x)$ is equal to :

(1) $\frac{n}{2}H_{n-1}(x),\ n \geq 1$

(2) $n^2 H_{n-1}(x),\ n \geq 1$

(3) $2nH_{n-1}(x),\ n \geq 1$

(4) None of these

54. If $L(t^2) = \frac{2}{s^3}$, then $L(t^3)$ is :

(1) $\frac{6}{s^4}$

(2) $\frac{3}{s^4}$

(3) $\frac{4}{s^4}$

(4) $\frac{8}{s^4}$

55. If $\vec{f}(s)$ is the Fourier transform of $f(x)$, then the Fourier transform of $f(x-a)$ is :

(1) $e^{ias}\vec{f}(s)$

(2) $\frac{e^{ias}}{\vec{f}(s)}$

(3) $e^{-ias}\vec{f}(s)$

(4) $\frac{e^{-ias}}{\vec{f}(s)}$

56. Which of the following is ***not*** derived data type ?

(1) Functions (2) Pointers

(3) Arrays (4) Character

57. Which of the following is ***not*** a relational operator ?

(1) == (2) >=

(3) ! (4) !=

58. Which of the following is ***not*** related to function implementation ?

(1) Parameter list

(2) Statement block

(3) Declaration of local variables

(4) ROM

59. Pointers are :

(1) A data type in C

(2) Not related to C

(3) Called reading strings

(4) Called reading and Copying strings

60. The structure definition is specified by the keyword :

(1) stru (2) struct

(3) strct (4) struc

61. For the function f defined by $f(x) = x, x \in [0, 1]$ $L(f, P)$ is given by :

(1) $\dfrac{\left(1-\dfrac{1}{n}\right)}{2}$ (2) $\dfrac{\left(1-\dfrac{1}{n}\right)^2}{2}$

(3) $\dfrac{2}{\left(1-\dfrac{1}{n}\right)}$ (4) $\left(1-\dfrac{1}{n^2}\right)$

62. Which of the following is ***not*** true ?

(1) The improper integral $\int_a^b \frac{dx}{(x-a)^n}$ is convergent if and only if $n < 1$.

(2) The improper integral $\int_a^b \frac{dx}{(b-x)^n}$ is convergent if and only if $n > 1$.

(3) If f and g are two positive functions an $[a, \infty)$ such that $\lim_{x\to\infty} \frac{f(x)}{g(x)} = 0$ and $\int_a^\infty g\, dx$ converges, then $\int_a^\infty f\, dx$ converges.

(4) None of these

63. If (X, d) is a metric space and x, y, z are points of X, then which of the following is ***not*** true ?

(1) $d(x, y) \leq | d(x, z) - d(z, y) |$

(2) $d(x, z) - d(z, y) \leq d(x, y)$

(3) $d(x, y) \geq | d(x, z) - d(z, y) |$

(4) None of these

64. If d is the usual metric, $d(x, y) = | x - y |$ for $x, y \in [0, 1]$, then $S_{1/8}(0)$ is described by :

(1) $\left[-1, \frac{1}{8}\right]$

(2) $[-1, -8]$

(3) $\left[0, \frac{1}{8}\right)$

(4) $[-1, 0]$

65. Let (R, d) be the usual metric space. Then the derived set of $[0, 1)$ is :

(1) $[-1, 1]$

(2) $[-1, 0]$

(3) $(0, 1)$

(4) $[0, 1]$

66. Which of the following statement is ***not*** true ?

(1) Every convergent sequence in a metric space has a unique limit.

(2) Every convergent sequence in a metric space is a Cauchy sequence but converse need not be true.

(3) A Cauchy sequence in a metric space is convergent iff it has at least one convergent and one divergent subsequence.

(4) None of these

67. Which of the following statement is ***false*** ?

(1) Every closed subset of a compact metric space is compact.

(2) A metric space is sequentially compact iff it has no BWP.

(3) Every countably compact metric space has BWP.

(4) None of these

68. Let $(G, \bullet)$ be a group such that $a^2 = e$ for all $a \in G$. Then G is :

(1) Abelian (2) Not Abelian

(3) May or may not be abelian (4) None of these

69. If G is a cyclic group of order 8, then the number of generators of G is :

(1) 2 (2) 4

(3) 8 (4) 1

70. If $O(\text{Aut } G) > 1$, then $O(G)$ is :

(1) 2 (2) 3

(3) >2 (4) <2

71. A division ring has :

(1) At least one zero divisors (2) Infinite number of zero divisors

(3) No zero divisors (4) None of these

72. An ideal S of a ring R is called a prime ideal of R, if :

(1) $ab \in S \Rightarrow a \in S, b \notin S$

(2) $ab \in S \Rightarrow a \notin S, b \in S$

(3) $ab \in S \Rightarrow a \notin S, b \notin S$

(4) $ab \in S \Rightarrow a \in S$ or $b \in S$

73. If p is a irreducible element of a commutative ring R with unity, then which of the following is ***not*** true ?

(1) p has no proper factors

(2) $p \neq 0$ and p is not a unit

(3) For every $a, b \in R$ if $p/ab \Rightarrow p/a$ or p/b

(4) None of these

74. Which of the following statement is ***not*** true ?

(1) In a UFD, every pair of non-zero elements have a *g.c.d.* and *l.c.m.*

(2) Every principal ideal domain is a unique factorization domain.

(3) Every Euclidean ring is a unique factorization domain.

(4) If R is a UFD, then the product of two primitive polynomials in $R[x]$ is not a primitive polynomial.

75. If a particle describes the cycloid $s = 4a \sin \psi$ with uniform speed v, then the normal acceleration is given by :

(1) $\dfrac{v^2}{4a \sin \psi}$

(2) $\dfrac{v^2}{4a \cos \psi}$

(3) $\dfrac{v^2}{4a}$

(4) $\dfrac{v^2}{\sin \psi \cos \psi}$

76. A particle moving with S.H.M. of period 12 seconds travels 10 cm from the position of rest in 2 seconds. Then the amplitude at the end of a 2 seconds is :

(1) 20 cm

(2) 10 cm

(3) 30 cm

(4) 40 cm

77. A force of 150 Newtons acts on a body of mass 15 kg for 5 minutes and then ceases. The force required to bring the body to rest in 2 minutes is given by :

(1) 375 N
(2) 275 N
(3) 175 N
(4) 475 N

78. Horizontal range of a projectile is given by :

(1) $\frac{u^2 \sin 2\alpha}{2g}$
(2) $\frac{u^2 \sin \alpha}{2g}$
(3) $\frac{u^2 \sin \alpha}{g^2}$
(4) $\frac{u^2 \sin 2\alpha}{g}$

79. If the time of flight of a bullet over a horizontal range R is T seconds, then the inclination of the direction of projection to the horizontal is :

(1) $\tan^{-1}\left(\frac{gT}{2R}\right)$
(2) $\tan^{-1}\left(\frac{gT^2}{2R}\right)$
(3) $\tan^{-1}\left(\frac{g^2T}{2R}\right)$
(4) $\tan^{-1}\left(\frac{gT^3}{2R}\right)$

80. If a particle moves in an ellipse given by $\frac{l}{r} = 1 + e\cos\theta$ under a force which is always directed towards its focus, then the periodic time is :

(1) $2\pi\sqrt{\frac{a}{\lambda}}$
(2) $2\pi\frac{a^{3/2}}{\sqrt{\lambda}}$
(3) $\pi^2\sqrt{\frac{a}{\lambda}}$
(4) $\pi\frac{a^{3/2}}{\sqrt{\lambda}}$

Where a is the length of semi-major axis, $\frac{h}{2}$ is the rate of description of the sectorial area and $\lambda = \frac{h^2}{l}$.

81. Which of the following is a duplication formula ?

(1) $\Gamma(m)\,\Gamma(m+\frac{1}{2}) = \frac{\sqrt{\pi}}{2^{2m-1}}\Gamma(2m)$

(2) $\Gamma(m)\,\Gamma(m+1) = \frac{\sqrt{\pi}}{2^{2m-1}}\Gamma(2m)$

(3) $\Gamma(m)\,\Gamma(m+\frac{1}{2}) = \frac{\sqrt{\pi}}{2^{2m}}\Gamma(2m)$

(4) None of these

82. On changing the order of integration, the integral $\int_0^1\int_{4y}^4 e^{x^2}\,dx\,dy$ becomes :

(1) $\int_1^4\int_0^{x/4} e^{x^2}\,dy\,dx$

(2) $\int_0^4\int_0^{x/4} e^{x^2}\,dy\,dx$

(3) $\int_0^{1/4}\int_0^{x/4} e^{x^2}\,dy\,dx$

(4) None of these

83. In the Fourier expansion of $f(x)=\frac{1}{4}(\pi-x)^2$, $0<x<2\pi$, the Fourier co-efficient a_0 is equal to :

(1) π^2

(2) $\frac{\pi^2}{3}$

(3) $\frac{\pi^2}{6}$

(4) $\frac{\pi^2}{12}$

84. If a function $f(x)=x\sin x$ is represented by a series of cosines of multiples of x in the interval $(0, \pi)$, then a_0 for the series is :

(1) 4

(2) 1

(3) 6

(4) 2

85. The image of the point $1+i$ on the sphere of radius 1 and centre (0, 0, 0) is :

(1) $\left(\frac{2}{3}, \frac{1}{3}, \frac{2}{3}\right)$

(2) $\left(\frac{1}{3}, \frac{2}{3}, \frac{1}{3}\right)$

(3) $\left(\frac{2}{3}, \frac{1}{3}, \frac{1}{3}\right)$

(4) $\left(\frac{2}{3}, \frac{2}{3}, \frac{1}{3}\right)$

86. The co-efficient of magnification at $z = 2 + i$ for the transformation $w = z^2$ is :

(1) $2\sqrt{5}$ (2) $5\sqrt{2}$

(3) $\dfrac{2}{\sqrt{5}}$ (4) $\dfrac{\sqrt{5}}{2}$

87. The function $z = \sinh u \cos v + i \cos h u \sin v$ ceases to be analytic at :

(1) $z = i$ (2) $z = -i$

(3) $z = \pm i$ (4) $z = 0$

88. Which of the following statement is ***not*** true ?

(1) A set containing the null vector 0 is linearly independent.

(2) Every superset of a linearly dependent set of vectors is linearly dependent.

(3) Every subset of a linearly independent set is linearly independent.

(4) The non-zero rows in an echelon matrix form a linearly independent set.

89. Which of the following statement is ***not*** true ?

(1) There exists a basis for each finitely generated vector space.

(2) If $S = \{v_1, v_2, v_3, \ldots\ldots\ldots, v_n\}$ spans V(F), then any $n + 1$ vectors in V are linearly independent.

(3) If S is linearly independent and $v \notin < S >$, then the set $S\ U\{v\}$ is linearly independent.

(4) If V is finitely generated vector space, then any two bases of V have the same number of elements.

90. A function $T : R^2 \to R^2$ defined by $T(x, y) = (x, -y)$ is linear transformation and is called :

(1) Contraction (2) Dilatation

(3) Reflection (4) None of these

91. If $T : U(F) \to V(F)$ is a linear transformation, then Rank T + Nullity T is equal to :

(1) dim V (2) dim $(U + V)$

(3) dim $(U - V)$ (4) dim U

92. The linear transformation $T : R^2 \to R^2$ defined by $T(x, y) = (x + y, x - y, y)$ is a :

(1) Singular transformation

(2) Non-singular transformation

(3) Symmetric transformation

(4) None of these

93. The co-ordinates of vector (1, 1, 1) relative to basis (1, 1, 2), (2, 2, 1), (1, 2, 2) are :

(1) $\left(\frac{1}{3}, \frac{1}{3}, 0\right)$

(2) $\left(\frac{1}{3}, 0, \frac{1}{3}\right)$

(3) $\left(0, \frac{1}{3}, \frac{1}{3}\right)$

(4) None of these

94. If u is an eigen vector of A, then the number of eigen values of λ for which u is the eigen vector is :

(1) At least one

(2) Only one

(3) Infinite

(4) None of these

95. The order of convergence of Regula Falsi method is :

(1) 2

(2) 1

(3) 1.618

(4) None of these

96. The missing term in the table

x	0	1	2	3	4	5
y	1	2	4	8	–	32

is :

(1) 16

(2) 16.4

(3) 16.2

(4) 15.8

97. For the following table

Wages (in Rs.)	Frequency
0-10	9
10-20	30
20-30	35
30-40	42

the third forward difference is :

(1) 0

(2) 40

(3) 5

(4) 2

98. The binomial distribution whose mean is 3 and variance 2 is given by :

(1) ${}^9C_r\left(\frac{1}{3}\right)^r$

(2) ${}^9C_r\left(\frac{1}{3}\right)^r\cdot\left(\frac{2}{3}\right)^{9-r}$

(3) ${}^9C_r\left(\frac{1}{3}\right)^{9-r}\left(\frac{2}{3}\right)^r$

(4) None of these

99. If $A=\begin{bmatrix}4 & 2\\ 1 & 3\end{bmatrix}$ and the initial eigen vector is $X_0=\begin{bmatrix}1\\0\end{bmatrix}$, then by power method the smallest eigen value is :

(1) 2

(2) 4

(3) 1

(4) 3

100. $\int\limits_{x_0}^{x_0+nh} f(x)\,dx=\frac{h}{2}$ [(sum of first and last ordinates) + 2 (sum of all the intermediates ordinates)] is called :

(1) Trapezoidal rule

(2) Simpson's $\frac{1}{3}$rd rule

(3) Simpson's $\frac{3}{8}$th rule

(4) None of these

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B

SET-X

PG-EE-2021

SUBJECT : Mathematics

10318

Sr. No. ....

Time : 1¼ **Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)____________________(in words)______________________________

Name______________________________________Date of Birth____________________

Father's Name___________________________Mother's Name_______________________

Date of Examination____________________

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(Signature of the Candidate) (Signature of the Invigilator)

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2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
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4. Question Booklet along with answer key of all the A, B, C & D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University website. The complaint be sent by the students to the Controller of Examinations by hand or through email. Thereafter, no complaint in any case will be considered.
5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

SEAL

1. The equation $36x^2 + 24xy + 29y^2 - 72x + 126y + 81 = 0$ represents a :

(1) Parabola (2) Ellipse

(3) Hyperbola (4) Circle

2. The centre of conic $8x^2 - 4xy + 5y^2 - 16x - 14y + 17 = 0$ is :

(1) $\left(\frac{3}{2}, 2\right)$ (2) $\left(2, \frac{3}{2}\right)$

(3) $\left(\frac{2}{3}, 2\right)$ (4) $\left(2, \frac{2}{3}\right)$

3. The equation of sphere which passes through the origin and meets the axes in $A(a, 0, 0)$, $B(0, b, 0)$ and $C(0, 0, c)$ is :

(1) $ax^2 + by^2 + cz^2 - ax - by - cz = 0$ (2) $x^2 + y^2 + z^2 + ax + by - cz = 0$

(3) $x^2 + y^2 + z^2 - ax - by - cz = 0$ (4) $x^2 + y^2 + z^2 + ax - by + cz = 0$

4. The pole of the plane $lx + my + nz = p$ w.r.t. the conicoid $ax^2 + by^2 + cz^2 = 1$ is :

(1) $\left(\frac{ap}{l}, \frac{bp}{m}, \frac{cp}{n}\right)$ (2) (lap, mbp, ncp)

(3) (ap, bp, cp) (4) $\left(\frac{l}{ap}, \frac{m}{bp}, \frac{n}{cp}\right)$

5. The discriminating cubic to reduce $2x^2 - 7y^2 + 2z^2 - 10yz - 8zx - 10xy + 6x + 12y - 6z + 5 = 0$ to the standard form is :

(1) $\lambda^3 + 3\lambda^2 - 90\lambda + 216 = 0$ (2) $\lambda^3 - 3\lambda^2 + 90\lambda + 216 = 0$

(3) $\lambda^3 + 3\lambda^2 + 90\lambda + 216 = 0$ (4) $\lambda^3 + 3\lambda^2 - 90\lambda - 216 = 0$

6. Which of the following statement is ***not*** true ?

(1) If p is a prime number and p/ab, then either p/a or p/b.

(2) If $a \equiv b \pmod{m}$, then a and b leave the same remainder when divided by m.

(3) If p is a prime number, then by Wilson theorem, $\underline{|p} + 1 \equiv 0 \pmod{p}$.

(4) None of these

7. $\tan\frac{\theta}{7} + \tan\frac{\theta+\pi}{7} + \ldots\ldots\ldots + \tan\frac{\theta+6\pi}{7}$ is equal to :

(1) $\tan 7\theta$ (2) $\tan\frac{\theta}{7}$

(3) $7\tan\theta$ (4) $\frac{\tan\theta}{7}$

8. The principal value of $\log(-5)$ is :

(1) $\frac{\log 5}{\pi i}$ (2) $\log 5 + i\pi$

(3) $\log 5 - i\pi$ (4) $\log 5$

9. $\tan^{-1}\frac{x}{\sqrt{a^2 - x^2}}$ is equal to :

(1) $\sin^{-1}(ax)$ (2) $\sin^{-1}\left(\frac{a}{x}\right)$

(3) $\sin^{-1}\left(\frac{x}{a}\right)$ (4) $\sin^{-1}\left(\frac{x}{\sqrt{a}}\right)$

10. The real part of $\sin h\,(x + iy)$ is :

(1) $\sin h\, x \cos y$ (2) $\sin x \cos h\, y$

(3) $\sin h\, x \cos h\, y$ (4) $\cos h\, x \sin h\, y$

11. If $T : U(F) \to V(F)$ is a linear transformation, then Rank T + Nullity T is equal to :

(1) $\dim V$ (2) $\dim (U + V)$

(3) $\dim (U - V)$ (4) $\dim U$

12. The linear transformation $T : R^2 \to R^2$ defined by $T(x, y) = (x + y, x - y, y)$ is a :

(1) Singular transformation

(2) Non-singular transformation

(3) Symmetric transformation

(4) None of these

13. The co-ordinates of vector (1, 1, 1) relative to basis (1, 1, 2), (2, 2, 1), (1, 2, 2) are :

(1) $\left(\frac{1}{3}, \frac{1}{3}, 0\right)$ (2) $\left(\frac{1}{3}, 0, \frac{1}{3}\right)$

(3) $\left(0, \frac{1}{3}, \frac{1}{3}\right)$ (4) None of these

14. If u is an eigen vector of A, then the number of eigen values of λ for which u is the eigen vector is :

(1) At least one (2) Only one

(3) Infinite (4) None of these

15. The order of convergence of Regula Falsi method is :

(1) 2 (2) 1

(3) 1.618 (4) None of these

16. The missing term in the table

x	0	1	2	3	4	5
y	1	2	4	8	–	32

is :

(1) 16 (2) 16.4

(3) 16.2 (4) 15.8

17. For the following table

Wages (in Rs.)	Frequency
0-10	9
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20-30	35
30-40	42

the third forward difference is :

(1) 0 (2) 40

(3) 5 (4) 2

18. The binomial distribution whose mean is 3 and variance 2 is given by :

(1) $^9C_r\left(\frac{1}{3}\right)^r$

(2) $^9C_r\left(\frac{1}{3}\right)^r\left(\frac{2}{3}\right)^{9-r}$

(3) $^9C_r\left(\frac{1}{3}\right)^{9-r}\left(\frac{2}{3}\right)^r$

(4) None of these

19. If $A=\begin{bmatrix}4 & 2\\ 1 & 3\end{bmatrix}$ and the initial eigen vector is $X_0=\begin{bmatrix}1\\ 0\end{bmatrix}$, then by power method the smallest eigen value is :

(1) 2

(2) 4

(3) 1

(4) 3

20. $\int_{x_0}^{x_0+nh} f(x)\,dx=\frac{h}{2}$ [(sum of first and last ordinates) + 2 (sum of all the intermediates ordinates)] is called :

(1) Trapezoidal rule

(2) Simpson's $\frac{1}{3}$rd rule

(3) Simpson's $\frac{3}{8}$th rule

(4) None of these

21. A division ring has :

(1) At least one zero divisors

(2) Infinite number of zero divisors

(3) No zero divisors

(4) None of these

22. An ideal S of a ring R is called a prime ideal of R, if :

(1) $ab \in S \Rightarrow a \in S, b \notin S$

(2) $ab \in S \Rightarrow a \notin S, b \in S$

(3) $ab \in S \Rightarrow a \notin S, b \notin S$

(4) $ab \in S \Rightarrow a \in S$ or $b \in S$

23. If p is a irreducible element of a commutative ring R with unity, then which of the following is ***not*** true ?

(1) p has no proper factors

(2) $p \neq 0$ and p is not a unit

(3) For every $a, b \in R$ if $p/ab \Rightarrow p/a$ or p/b

(4) None of these

24. Which of the following statement is ***not*** true ?

(1) In a UFD, every pair of non-zero elements have a *g.c.d.* and *l.c.m.*

(2) Every principal ideal domain is a unique factorization domain.

(3) Every Euclidean ring is a unique factorization domain.

(4) If R is a UFD, then the product of two primitive polynomials in $R[x]$ is not a primitive polynomial.

25. If a particle describes the cycloid $s = 4a \sin \psi$ with uniform speed v, then the normal acceleration is given by :

(1) $\frac{v^2}{4a \sin \psi}$ (2) $\frac{v^2}{4a \cos \psi}$

(3) $\frac{v^2}{4a}$ (4) $\frac{v^2}{\sin \psi \cos \psi}$

26. A particle moving with S.H.M. of period 12 seconds travels 10 cm from the position of rest in 2 seconds. Then the amplitude at the end of a 2 seconds is :

(1) 20 cm (2) 10 cm

(3) 30 cm (4) 40 cm

27. A force of 150 Newtons acts on a body of mass 15 kg for 5 minutes and then ceases. The force required to bring the body to rest in 2 minutes is given by :

(1) 375 N (2) 275 N

(3) 175 N (4) 475 N

28. Horizontal range of a projectile is given by :

(1) $\dfrac{u^2 \sin 2\alpha}{2g}$ (2) $\dfrac{u^2 \sin \alpha}{2g}$

(3) $\dfrac{u^2 \sin \alpha}{g^2}$ (4) $\dfrac{u^2 \sin 2\alpha}{g}$

29. If the time of flight of a bullet over a horizontal range R is T seconds, then the inclination of the direction of projection to the horizontal is :

(1) $\tan^{-1}\left(\dfrac{gT}{2R}\right)$ (2) $\tan^{-1}\left(\dfrac{gT^2}{2R}\right)$

(3) $\tan^{-1}\left(\dfrac{g^2T}{2R}\right)$ (4) $\tan^{-1}\left(\dfrac{gT^3}{2R}\right)$

30. If a particle moves in an ellipse given by $\dfrac{l}{r} = 1 + e\cos\theta$ under a force which is always directed towards its focus, then the periodic time is :

(1) $2\pi\sqrt{\dfrac{a}{\lambda}}$ (2) $2\pi\dfrac{a^{3/2}}{\sqrt{\lambda}}$

(3) $\pi^2\sqrt{\dfrac{a}{\lambda}}$ (4) $\pi\dfrac{a^{3/2}}{\sqrt{\lambda}}$

Where a is the length of semi-major axis, $\dfrac{h}{2}$ is the rate of description of the sectorial area and $\lambda = \dfrac{h^2}{l}$.

31. $\dfrac{d}{dx}(x^n J_n(x))$ is equal to :

(1) $x^{n-1}J_n(x)$ (2) $x^n J_{n-1}(x)$

(3) $nx^{n-1}J_n(x)$ (4) $nx^n J_{n-1}(x)$

32. Rodrigue's formula for Legendre polynomial is :

(1) $P_n(x) = \dfrac{1}{\lfloor n \, 2^n} \dfrac{d^n}{dx^n}(x^2-1)^{n+1}$

(2) $P_n(x) = \dfrac{1}{\lfloor n \, 2^n} \dfrac{d^n}{dx^n}(x^2-1)^{n}$

(3) $P_n(x) = \dfrac{1}{\lfloor n-1 \, 2^n} \dfrac{d^{n-1}}{dx^{n-1}}(x^2-1)^{n}$

(4) None of these

33. $H_n'(x)$ is equal to :

(1) $\dfrac{n}{2} H_{n-1}(x), n \geq 1$

(2) $n^2 H_{n-1}(x), n \geq 1$

(3) $2n H_{n-1}(x), n \geq 1$

(4) None of these

34. If $L(t^2) = \dfrac{2}{s^3}$, then $L(t^3)$ is :

(1) $\dfrac{6}{s^4}$

(2) $\dfrac{3}{s^4}$

(3) $\dfrac{4}{s^4}$

(4) $\dfrac{8}{s^4}$

35. If $\vec{f}(s)$ is the Fourier transform of $f(x)$, then the Fourier transform of $f(x-a)$ is :

(1) $e^{ias}\vec{f}(s)$

(2) $\dfrac{e^{ias}}{\vec{f}(s)}$

(3) $e^{-ias}\vec{f}(s)$

(4) $\dfrac{e^{-ias}}{\vec{f}(s)}$

36. Which of the following is ***not*** derived data type ?

(1) Functions

(2) Pointers

(3) Arrays

(4) Character

37. Which of the following is ***not*** a relational operator ?

(1) = =
(2) > =
(3) !
(4) ! =

38. Which of the following is ***not*** related to function implementation ?

(1) Parameter list
(2) Statement block
(3) Declaration of local variables
(4) ROM

39. Pointers are :

(1) A data type in C
(2) Not related to C
(3) Called reading strings
(4) Called reading and Copying strings

40. The structure definition is specified by the keyword :

(1) stru
(2) struct
(3) strct
(4) struc

41. $\lim_{x \to 0} \frac{(\tan^{-1} x)^2}{\log(1+x^2)}$ is equal to :

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

42. If $u = \tan^{-1} \frac{x^3 + y^3}{x - y}$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(1) $\sin u$
(2) $\sin 2u$
(3) $\cos u$
(4) $\tan u$

43. The magnitude of screw curvature is given by :

(1) $\sqrt{k^2 - \tau^2}$ (2) $\sqrt{\tau^2 - k^2}$

(3) $\sqrt{\frac{k^3}{\tau^5}}$ (4) $\sqrt{k^2 + \tau^2}$

44. The necessary and sufficient condition for a given curve to be a plane curve is that :

(1) $\tau = \infty$ at all points of the curve (2) $\tau = -\infty$ at all points of the curve

(3) $\tau = 1$ at all points of the curve (4) $\tau = 0$ at all points of the curve

45. The normal which is perpendicular to the osculating plane at a point is called :

(1) Principal Normal (2) Right Normal

(3) Left Normal (4) Bi-Normal

46. The complementary function of the differential equation $\frac{\partial^3 z}{\partial x^3} - 3\frac{\partial^3 z}{\partial x^2 \partial y} + 4\frac{\partial^3 z}{\partial y^3} = e^{x+2y}$ is :

(1) $\phi_1(y-x) + \phi_2(y+2x) + x\phi_3(y+2x)$ (2) $\phi_1(y-x) + \phi_2(y+2x) + \phi_3(y+2x)$

(3) $\phi_1(y+2x) + \phi_2(y-x) + \phi_3(y+2x)$ (4) None of these

47. The particular integral of the differential equation $x^2\frac{\partial^2 z}{\partial x^2} + 2xy\frac{\partial^2 z}{\partial x \partial y} - x\frac{\partial z}{\partial x} = \frac{x^3}{y^2}$ is :

(1) $-\frac{1}{9}x^{-2}y^3$

(2) $-\frac{1}{9}.\frac{x^3}{y^2}$

(3) $-\frac{1}{9}\frac{y^2}{x^3}$

(4) $-\frac{1}{9}\frac{x^3}{y^3}$

48. The equation $\frac{\partial^2 z}{\partial y^2} - \frac{\partial^2 z}{\partial x \partial y} + \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\left(1+\frac{1}{x}\right) + \frac{z}{x} = 0$ is :

(1) Elliptic

(2) Parabolic

(3) Hyperbolic

(4) None of these

49. For the partial differential equation $r = a^2 t$, the Monge's subsidiary equations are :

(1) $dp\,dy + a^2 dq\,dx = 0, (dy)^2 - a^2(dx)^2 = 0$

(2) $dp\,dy - a^2 dq\,dx = 0, (dy)^2 + a^2(dx)^2 = 0$

(3) $dp\,dy - a^2 dq\,dx = 0, (dy)^2 - a^2(dx)^2 = 0$

(4) $dp\,dy + a^2 dq\,dx = 0, (dy)^2 + a^2(dx)^2 = 0$

50. The two dimensional wave equation is given by :

(1) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(2) $\frac{\partial^2 u}{\partial x^2} + \left(\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}\right) = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(3) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(4) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2}\frac{\partial u}{\partial t}$

51. The integrating factor of the differential equation $(y^2 + 2x + x^2)\,dx + 2y\,dy = 0$ is :

(1) e^y

(2) e^{-x}

(3) e^{-y}

(4) e^x

52. The particular integral of the differential equation $(D^2 - 6D + 9)y = e^{3x}$ is :

(1) $\frac{x^2}{2}e^{3x}$

(2) $x^2 e^{3x}$

(3) $x e^{3x}$

(4) $x^2 e^{3x}$

53. The complementary function of the differential equation $x^2\frac{d^2y}{dx^2}-x\frac{dy}{dx}-3y=x^2\log x$ is :

(1) $\frac{c_1}{x^3}+c_2x$ (2) $c_1x^3+\frac{c_2}{x}$

(3) $c_1x^3+c_2x$ (4) $(c_1+c_2x)x^3$

54. The value of determinant used for solving the differential equation $\frac{d^2y}{dx^2}+4y=\tan 2x$ by the method of variation of parameters is :

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

(3) 2 (4) 3

55. Using 1, y and z as multipliers, one part of the complete solution of $\frac{xdx}{z^2-2yz-y^2}=\frac{dy}{y+z}=\frac{dz}{y-z}$ is :

(1) $x^2+y^2+z^2=c$ (2) $x^2-y^2+z^2=c$

(3) $x^2+y^2-z^2=c$ (4) $-x^2+y^2+z^2=c$

56. The necessary and sufficient condition for the vector function $\vec{f}$ of a scalar variable t to have constant direction is :

(1) $\vec{f}.\frac{d\vec{f}}{dt}=0$ (2) $\vec{f}\times\frac{d\vec{f}}{dt}=\vec{0}$

(3) $\vec{f}+\frac{d\vec{f}}{dt}=\vec{0}$ (4) $\vec{f}-\frac{d\vec{f}}{dt}=\vec{0}$

57. If $r=|\vec{r}|$, where $\vec{r}=x\hat{i}+y\hat{j}+z\hat{k}$, then $\nabla\log|\vec{r}|$ is equal to :

(1) $\vec{r}+r^2$ (2) $\vec{r}\times\log\vec{r}$

(3) $\frac{\vec{r}}{r^2}$ (4) $-\frac{\vec{r}}{r^3}$

58. If $\vec{f}$ and $\vec{g}$ are irrotational, then which of the following is solenoidal ?

(1) $\vec{f} + \vec{g}$ (2) $\vec{f} - \vec{g}$

(3) $\vec{f} \cdot \vec{g}$ (4) $\vec{f} \times \vec{g}$

59. If a vector $\vec{r}$ satisfies the equation $\frac{d^2\vec{r}}{dt^2} = t\vec{a} + \vec{b}$, where $\vec{a}$ and $\vec{b}$ are constant vectors, then $\vec{r}$ is given by :

(1) $\frac{t^3}{6}\vec{a} + \vec{c}_1 t$ (2) $\frac{t^3}{6}\vec{a} + \frac{t^2}{2}\vec{b} + \vec{c}_1 t + \vec{c}_2$

(3) $\frac{t^3}{2}\vec{a} + \frac{t^2}{6}\vec{b} + \vec{c}_1 t + \vec{c}_2$ (4) $\frac{t^2}{3}\vec{a} + \frac{t^2}{2}\vec{b} + \vec{c}_1 t$

where $\vec{c}_1$ and $\vec{c}_2$ are constant vectors.

60. If S represents the surface of a sphere $x^2 + y^2 + z^2 = a^2$, then $\iint_S (x\,dy\,dz + y\,dz\,dx + z\,dx\,dy)$ is equal to :

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

(3) $\frac{4}{\pi}a^3$ (4) $\frac{4\pi}{a^3}$

61. Which of the following is converse of Lami's theorem ?

(1) If three coplanar forces acting at a point be such that each is proportional to the sine of the angle between the directions of other two, then the forces are in equilibrium

(2) Every given system of forces acting on a rigid body can be reduced to a wrench

(3) A system of coplanar forces acting on a rigid body can be reduced to either a single force or single couple

(4) None of these

62. If AB = 40 cm and two unlike parallel forces 40 N and 5 N act at A and B respectively, then the resultant of these forces acts at a distance from A given by :

(1) 40 cm
(2) $\frac{40}{7}$ cm
(3) 7 cm
(4) 40.7 cm

63. Three forces 3P, 7P, 5P act along the sides AB, BC, CA of an equilateral triangle ABC. Then the magnitude of the resultant is given by :

(1) $2\sqrt{3}\,P$
(2) $3\sqrt{2}\,P$
(3) $\frac{\sqrt{3}}{2}P$
(4) $\frac{\sqrt{2}}{3}P$

64. Which of the following statement is ***not*** true ?

(1) Two couples in the same plane of equal moments and acting in the same sense are equivalent.

(2) Two couples of equal and opposite moments in parallel planes don't balance each other.

(3) The resultant of a number of coplanar couples is equivalent to a single couple whose moment is equal to the algebraic sum of the moments of the given couples.

(4) None of these

65. The equations of the central axis of any given system of forces acting on a rigid body is :

(1) $\frac{X - yZ + zY}{L} = \frac{Y - zX + xZ}{M} = \frac{Z - xY + yX}{N} = p$

(2) $\frac{L - yZ + zY}{X} = \frac{M - zX + xZ}{Y} = \frac{N - xY + yX}{Z} = p$

(3) $\frac{L + yZ + zY}{X} = \frac{M + zX - xZ}{Y} = \frac{N + xY - yX}{Z} = p$

(4) None of these

66. Which of the following statement is ***not*** true ?

(1) Interior of a set is an open set.

(2) The interior of a set A is the largest open subset of A.

(3) A point p is a limit point of a set A if and only if every neighbourhood of p contains one point of A.

(4) None of these

67. Which of the following statement is ***not*** true ?

(1) If a sequence $<a_n>$ diverges to ∞, then $<a_n>$ is bounded below but unbounded above.

(2) If a sequence $<a_n>$ diverges to $-\infty$, then $<a_n>$ is unbounded below but bounded above.

(3) Every monotonically increasing sequence unbounded above diverges to $-\infty$.

(4) Every monotonically decreasing sequence unbounded below diverges to $-\infty$.

68. A geometrical series $a + ar + ar^2 + \ldots\ldots\ldots + \infty$ oscillates infinitely, if :

(1) $|r| < 1$

(2) $r \geq 1$

(3) $r = -1$

(4) $r < -1$

69. Which of the following is ***not*** true ?

(1) Every absolutely convergent infinite product is convergent.

(2) A series $\sum_{n=1}^{\infty} a_n$ is said to be absolutely convergent, if the series $\sum_{n=1}^{\infty} |a_n|$ converges.

(3) If $a_n \geq 0$, then the infinite series $\sum_{n=1}^{\infty} a_n$ and the infinite product $\prod_{n=1}^{\infty} (1 + a_n)$ converge or diverge together.

(4) Every absolutely convergent infinite product may not be always convergent.

70. The series $\sum_{n=1}^{\infty} \left(1 + \frac{1}{n}\right)^n x^n$, $x > 0$ is divergent, if :

(1) $x \geq 1$

(2) $x < 1$

(3) $x \leq \frac{1}{2}$

(4) None of these

71. For the function f defined by $f(x) = x, x \in [0, 1]$ $L(f, P)$ is given by :

(1) $\dfrac{\left(1-\frac{1}{n}\right)}{2}$

(2) $\dfrac{\left(1-\frac{1}{n}\right)^2}{2}$

(3) $\dfrac{2}{\left(1-\frac{1}{n}\right)}$

(4) $\left(1-\frac{1}{n^2}\right)$

72. Which of the following is ***not*** true ?

(1) The improper integral $\int_a^b \frac{dx}{(x-a)^n}$ is convergent if and only if $n < 1$.

(2) The improper integral $\int_a^b \frac{dx}{(b-x)^n}$ is convergent if and only if $n > 1$.

(3) If f and g are two positive functions an $[a, \infty)$ such that $\lim_{x\to\infty} \frac{f(x)}{g(x)} = 0$ and $\int_a^\infty g\,dx$ converges, then $\int_a^\infty f\,dx$ converges.

(4) None of these

73. If (X, d) is a metric space and x, y, z are points of X, then which of the following is ***not*** true ?

(1) $d(x, y) \le |\,d(x, z) - d(z, y)\,|$

(2) $d(x, z) - d(z, y) \le d(x, y)$

(3) $d(x, y) \ge |\,d(x, z) - d(z, y)\,|$

(4) None of these

74. If d is the usual metric, $d(x, y) = |x - y|$ for $x, y \in [0, 1]$, then $S_{1/8}(0)$ is described by :

(1) $\left[-1, \frac{1}{8}\right]$

(2) $[-1, -8]$

(3) $\left[0, \frac{1}{8}\right)$

(4) $[-1, 0]$

75. Let (R, d) be the usual metric space. Then the derived set of $[0, 1)$ is :

(1) $[-1, 1]$

(2) $[-1, 0]$

(3) $(0, 1)$

(4) $[0, 1]$

76. Which of the following statement is ***not*** true ?

(1) Every convergent sequence in a metric space has a unique limit.

(2) Every convergent sequence in a metric space is a Cauchy sequence but converse need not be true.

(3) A Cauchy sequence in a metric space is convergent iff it has at least one convergent and one divergent subsequence.

(4) None of these

77. Which of the following statement is ***false*** ?

(1) Every closed subset of a compact metric space is compact.

(2) A metric space is sequentially compact iff it has no BWP.

(3) Every countably compact metric space has BWP.

(4) None of these

78. Let $(G, \bullet)$ be a group such that $a^2 = e$ for all $a \in G$. Then G is :

(1) Abelian

(2) Not Abelian

(3) May or may not be abelian

(4) None of these

79. If G is a cyclic group of order 8, then the number of generators of G is :

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

80. If $O(\text{Aut } G) > 1$, then $O(G)$ is :

(1) 2
(2) 3
(3) >2
(4) <2

81. The rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ is :

(1) Less than 2
(2) Less than 3
(3) Greater than 2
(4) Greater than 3

82. Which one of the following statement is ***not*** true ?

(1) A set containing only the zero vector is linearly independent.
(2) A set containing only a non-zero vector is linearly independent.
(3) Every super set of a linearly dependent set is linearly dependent.
(4) None of these

83. If $A = \begin{bmatrix} 1 & \sqrt{2} \\ -\sqrt{2} & -1 \end{bmatrix}$, then by Cayley Hamilton theorem :

(1) $A^2 = \sqrt{2}I$
(2) $A^2 = -\sqrt{2}I$
(3) $A^2 = -I$
(4) $A^2 = I$

84. If 1, α, β, γ, …….. are roots of the equation $x^n - 1 = 0$, then $(1-\alpha)(1-\beta)(1-\gamma)$ …… is equal to :

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

85. If α, β, γ are the roots of the equation $x^3 + px^2 + qx + r = 0$, then $\sum \frac{1}{\alpha}$ is equal to :

(1) $\frac{r}{q}$ (2) $\frac{q}{r}$

(3) $-\frac{r}{q}$ (4) $-\frac{q}{r}$

86. The equation of curve having $x+y-1=0$ and $x-y+2=0$ as its asymptotes and passing through origin is :

(1) $(x-y+2)(x+y-1)-2=0$ (2) $(x+y-1)(x-y+2)+2=0$

(3) $(x+y-1)(x-y+2)-4=0$ (4) None of these

87. For the curve $r^n = a^n \cos n\theta$, the angle ϕ is given by :

(1) $\frac{\pi}{2} - n\theta$ (2) $\pi + n\theta$

(3) $\frac{\pi}{2} + n\theta$ (4) $\pi - n\theta$

88. The double point (2, 0) of the curve $y^2 = (x-2)^2(x-1)$ is a :

(1) Node (2) Cusp

(3) Conjugate point (4) Point of inflexion

89. For the curve $r = a(1-\sin\theta)$, the tangent to the curve at the origin is :

(1) $\theta = \pi$ (2) $\theta = \frac{\pi}{3}$

(3) $\theta = \frac{\pi}{2}$ (4) $\theta = \frac{\pi}{4}$

90. $\int_0^1 \frac{x^3}{\sqrt{1-x^2}} dx$ is equal to :

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

91. Which of the following is a duplication formula ?

(1) $\Gamma(m)\,\Gamma\left(m+\frac{1}{2}\right) = \frac{\sqrt{\pi}}{2^{2m-1}}\Gamma(2m)$

(2) $\Gamma(m)\,\Gamma(m+1) = \frac{\sqrt{\pi}}{2^{2m-1}}\Gamma(2m)$

(3) $\Gamma(m)\,\Gamma\left(m+\frac{1}{2}\right) = \frac{\sqrt{\pi}}{2^{2m}}\Gamma(2m)$

(4) None of these

92. On changing the order of integration, the integral $\int_0^1 \int_{4y}^4 e^{x^2}\,dx\,dy$ becomes :

(1) $\int_1^4 \int_0^{x/4} e^{x^2}\,dy\,dx$

(2) $\int_0^4 \int_0^{x/4} e^{x^2}\,dy\,dx$

(3) $\int_0^{1/4} \int_0^{x/4} e^{x^2}\,dy\,dx$

(4) None of these

93. In the Fourier expansion of $f(x) = \frac{1}{4}(\pi - x)^2$, $0 < x < 2\pi$, the Fourier co-efficient a_0 is equal to :

(1) π^2

(2) $\frac{\pi^2}{3}$

(3) $\frac{\pi^2}{6}$

(4) $\frac{\pi^2}{12}$

94. If a function $f(x) = x \sin x$ is represented by a series of cosines of multiples of x in the interval $(0, \pi)$, then a_0 for the series is :

(1) 4 (2) 1 (3) 6 (4) 2

95. The image of the point $1 + i$ on the sphere of radius 1 and centre (0, 0, 0) is :

(1) $\left(\frac{2}{3}, \frac{1}{3}, \frac{2}{3}\right)$

(2) $\left(\frac{1}{3}, \frac{2}{3}, \frac{1}{3}\right)$

(3) $\left(\frac{2}{3}, \frac{1}{3}, \frac{1}{3}\right)$

(4) $\left(\frac{2}{3}, \frac{2}{3}, \frac{1}{3}\right)$

96. The co-efficient of magnification at $z = 2 + i$ for the transformation $w = z^2$ is :

(1) $2\sqrt{5}$

(2) $5\sqrt{2}$

(3) $\frac{2}{\sqrt{5}}$

(4) $\frac{\sqrt{5}}{2}$

97. The function $z = \sinh u \cos v + i \cosh u \sin v$ ceases to be analytic at :

(1) $z = i$

(2) $z = -i$

(3) $z = \pm i$

(4) $z = 0$

98. Which of the following statement is ***not*** true ?

(1) A set containing the null vector 0 is linearly independent.

(2) Every superset of a linearly dependent set of vectors is linearly dependent.

(3) Every subset of a linearly independent set is linearly independent.

(4) The non-zero rows in an echelon matrix form a linearly independent set.

99. Which of the following statement is ***not*** true ?

(1) There exists a basis for each finitely generated vector space.

(2) If $S = \{v_1, v_2, v_3, \ldots\ldots, v_n\}$ spans V(F), then any $n + 1$ vectors in V are linearly independent.

(3) If S is linearly independent and $v \notin \langle S \rangle$, then the set $S\ U\{v\}$ is linearly independent.

(4) If V is finitely generated vector space, then any two bases of V have the same number of elements.

100. A function $T : R^2 \rightarrow R^2$ defined by $T(x, y) = (x, -y)$ is linear transformation and is called :

(1) Contraction

(2) Dilatation

(3) Reflection

(4) None of these

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C

SET-X

PG-EE-2021

SUBJECT : Mathematics

10319

Sr. No. ....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)__________________(in words)__________________________

Name____________________________________Date of Birth________________

Father's Name__________________________Mother's Name______________________

Date of Examination______________________

(Signature of the Candidate) (Signature of the Invigilator)

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3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
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5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
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8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. Which of the following is converse of Lami's theorem ?

(1) If three coplanar forces acting at a point be such that each is proportional to the sine of the angle between the directions of other two, then the forces are in equilibrium

(2) Every given system of forces acting on a rigid body can be reduced to a wrench

(3) A system of coplanar forces acting on a rigid body can be reduced to either a single force or single couple

(4) None of these

2. If AB = 40 cm and two unlike parallel forces 40 N and 5 N act at A and B respectively, then the resultant of these forces acts at a distance from A given by :

(1) 40 cm
(2) $\frac{40}{7}$ cm

(3) 7 cm
(4) 40.7 cm

3. Three forces 3P, 7P, 5P act along the sides AB, BC, CA of an equilateral triangle ABC. Then the magnitude of the resultant is given by :

(1) $2\sqrt{3}\,P$
(2) $3\sqrt{2}\,P$

(3) $\frac{\sqrt{3}}{2}P$
(4) $\frac{\sqrt{2}}{3}P$

4. Which of the following statement is ***not*** true ?

(1) Two couples in the same plane of equal moments and acting in the same sense are equivalent.

(2) Two couples of equal and opposite moments in parallel planes don't balance each other.

(3) The resultant of a number of coplanar couples is equivalent to a single couple whose moment is equal to the algebraic sum of the moments of the given couples.

(4) None of these

5. The equations of the central axis of any given system of forces acting on a rigid body is :

(1) $\dfrac{X - yZ + zY}{L} = \dfrac{Y - zX + xZ}{M} = \dfrac{Z - xY + yX}{N} = p$

(2) $\dfrac{L - yZ + zY}{X} = \dfrac{M - zX + xZ}{Y} = \dfrac{N - xY + yX}{Z} = p$

(3) $\dfrac{L + yZ + zY}{X} = \dfrac{M + zX - xZ}{Y} = \dfrac{N + xY - yX}{Z} = p$

(4) None of these

6. Which of the following statement is ***not*** true ?

(1) Interior of a set is an open set.

(2) The interior of a set A is the largest open subset of A.

(3) A point p is a limit point of a set A if and only if every neighbourhood of p contains one point of A.

(4) None of these

7. Which of the following statement is ***not*** true ?

(1) If a sequence $<a_n>$ diverges to ∞, then $<a_n>$ is bounded below but unbounded above.

(2) If a sequence $<a_n>$ diverges to $-\infty$, then $<a_n>$ is unbounded below but bounded above.

(3) Every monotonically increasing sequence unbounded above diverges to $-\infty$.

(4) Every monotonically decreasing sequence unbounded below diverges to $-\infty$.

8. A geometrical series $a + ar + ar^2 + \dots\dots\dots + \infty$ oscillates infinitely, if :

(1) $|r| < 1$

(2) $r \geq 1$

(3) $r = -1$

(4) $r < -1$

9. Which of the following is ***not*** true ?

(1) Every absolutely convergent infinite product is convergent.

(2) A series $\sum_{n=1}^{\infty} a_n$ is said to be absolutely convergent, if the series $\sum_{n=1}^{\infty} |a_n|$ converges.

(3) If $a_n \geq 0$, then the infinite series $\sum_{n=1}^{\infty} a_n$ and the infinite product $\prod_{n=1}^{\infty}(1+a_n)$ converge or diverge together.

(4) Every absolutely convergent infinite product may not be always convergent.

10. The series $\sum_{n=1}^{\infty}\left(1+\frac{1}{n}\right)^n x^n$, $x > 0$ is divergent, if :

(1) $x \geq 1$

(2) $x < 1$

(3) $x \leq \frac{1}{2}$

(4) None of these

11. The integrating factor of the differential equation $(y^2 + 2x + x^2)\,dx + 2y\,dy = 0$ is :

(1) e^y

(2) e^{-x}

(3) e^{-y}

(4) e^x

12. The particular integral of the differential equation $(D^2 - 6D + 9)y = e^{3x}$ is :

(1) $\frac{x^2}{2}e^{3x}$

(2) $x^2 e^{3x}$

(3) xe^{3x}

(4) $x^2 e^{3x}$

13. The complementary function of the differential equation $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} - 3y = x^2 \log x$ is :

(1) $\frac{c_1}{x^3} + c_2 x$

(2) $c_1 x^3 + \frac{c_2}{x}$

(3) $c_1 x^3 + c_2 x$

(4) $(c_1 + c_2 x)x^3$

14. The value of determinant used for solving the differential equation $\frac{d^2y}{dx^2}+4y=\tan 2x$ by the method of variation of parameters is :

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

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

(3) 2

(4) 3

15. Using 1, y and z as multipliers, one part of the complete solution of $\frac{xdx}{z^2-2yz-y^2}=\frac{dy}{y+z}=\frac{dz}{y-z}$ is :

(1) $x^2+y^2+z^2=c$

(2) $x^2-y^2+z^2=c$

(3) $x^2+y^2-z^2=c$

(4) $-x^2+y^2+z^2=c$

16. The necessary and sufficient condition for the vector function $\vec{f}$ of a scalar variable t to have constant direction is :

(1) $\vec{f}.\frac{d\vec{f}}{dt}=0$

(2) $\vec{f}\times\frac{d\vec{f}}{dt}=\vec{0}$

(3) $\vec{f}+\frac{d\vec{f}}{dt}=\vec{0}$

(4) $\vec{f}-\frac{d\vec{f}}{dt}=\vec{0}$

17. If $r=|\vec{r}|$, where $\vec{r}=x\hat{i}+y\hat{j}+z\hat{k}$, then $\nabla \log|\vec{r}|$ is equal to :

(1) $\vec{r}+r^2$

(2) $\vec{r}\times\log\vec{r}$

(3) $\frac{\vec{r}}{r^2}$

(4) $-\frac{\vec{r}}{r^3}$

18. If $\vec{f}$ and $\vec{g}$ are irrotational, then which of the following is solenoidal ?

(1) $\vec{f}+\vec{g}$

(2) $\vec{f}-\vec{g}$

(3) $\vec{f}.\vec{g}$

(4) $\vec{f}\times\vec{g}$

19. If a vector $\vec{r}$ satisfies the equation $\frac{d^2\vec{r}}{dt^2} = t\vec{a} + \vec{b}$, where $\vec{a}$ and $\vec{b}$ are constant vectors, then $\vec{r}$ is given by :

(1) $\frac{t^3}{6}\vec{a} + \vec{c}_1 t$

(2) $\frac{t^3}{6}\vec{a} + \frac{t^2}{2}\vec{b} + \vec{c}_1 t + \vec{c}_2$

(3) $\frac{t^3}{2}\vec{a} + \frac{t^2}{6}\vec{b} + \vec{c}_1 t + \vec{c}_2$

(4) $\frac{t^2}{3}\vec{a} + \frac{t^2}{2}\vec{b} + \vec{c}_1 t$

where $\vec{c}_1$ and $\vec{c}_2$ are constant vectors.

20. If S represents the surface of a sphere $x^2 + y^2 + z^2 = a^2$, then $\iint_S (x\,dy\,dz + y\,dz\,dx + z\,dx\,dy)$ is equal to :

(1) $4\pi a^3$

(2) $\frac{4}{3}\pi a^3$

(3) $\frac{4}{\pi}a^3$

(4) $\frac{4\pi}{a^3}$

21. The rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ is :

(1) Less than 2

(2) Less than 3

(3) Greater than 2

(4) Greater than 3

22. Which one of the following statement is ***not*** true ?

(1) A set containing only the zero vector is linearly independent.

(2) A set containing only a non-zero vector is linearly independent.

(3) Every super set of a linearly dependent set is linearly dependent.

(4) None of these

23. If $A = \begin{bmatrix} 1 & \sqrt{2} \\ -\sqrt{2} & -1 \end{bmatrix}$, then by Cayley Hamilton theorem :

(1) $A^2 = \sqrt{2}I$ (2) $A^2 = -\sqrt{2}I$

(3) $A^2 = -I$ (4) $A^2 = I$

24. If 1, α, β, γ, ... are roots of the equation $x^n - 1 = 0$, then $(1 - \alpha)(1 - \beta)(1 - \gamma)$ ...... is equal to :

(1) n (2) $-n$

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

25. If α, β, γ are the roots of the equation $x^3 + px^2 + qx + r = 0$, then $\sum \frac{1}{\alpha}$ is equal to :

(1) $\frac{r}{q}$ (2) $\frac{q}{r}$

(3) $-\frac{r}{q}$ (4) $-\frac{q}{r}$

26. The equation of curve having $x + y - 1 = 0$ and $x - y + 2 = 0$ as its asymptotes and passing through origin is :

(1) $(x - y + 2)(x + y - 1) - 2 = 0$ (2) $(x + y - 1)(x - y + 2) + 2 = 0$

(3) $(x + y - 1)(x - y + 2) - 4 = 0$ (4) None of these

27. For the curve $r^n = a^n \cos n\theta$, the angle ϕ is given by :

(1) $\frac{\pi}{2} - n\theta$ (2) $\pi + n\theta$

(3) $\frac{\pi}{2} + n\theta$ (4) $\pi - n\theta$

28. The double point (2, 0) of the curve $y^2 = (x - 2)^2 (x - 1)$ is a :

(1) Node (2) Cusp

(3) Conjugate point (4) Point of inflexion

29. For the curve $r = a(1 - \sin\theta)$, the tangent to the curve at the origin is :

(1) $\theta = \pi$

(2) $\theta = \frac{\pi}{3}$

(3) $\theta = \frac{\pi}{2}$

(4) $\theta = \frac{\pi}{4}$

30. $\int_0^1 \frac{x^3}{\sqrt{1-x^2}} dx$ is equal to :

(1) $\frac{1}{3}$

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

(3) $\frac{3}{2}$

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

31. If $T : U(F) \to V(F)$ is a linear transformation, then Rank T + Nullity T is equal to :

(1) dim V

(2) dim $(U + V)$

(3) dim $(U - V)$

(4) dim U

32. The linear transformation $T : R^2 \to R^2$ defined by $T(x, y) = (x + y, x - y, y)$ is a :

(1) Singular transformation

(2) Non-singular transformation

(3) Symmetric transformation

(4) None of these

33. The co-ordinates of vector (1, 1, 1) relative to basis (1, 1, 2), (2, 2, 1), (1, 2, 2) are :

(1) $\left(\frac{1}{3}, \frac{1}{3}, 0\right)$

(2) $\left(\frac{1}{3}, 0, \frac{1}{3}\right)$

(3) $\left(0, \frac{1}{3}, \frac{1}{3}\right)$

(4) None of these

34. If u is an eigen vector of A, then the number of eigen values of λ for which u is the eigen vector is :

(1) At least one

(2) Only one

(3) Infinite

(4) None of these

35. The order of convergence of Regula Falsi method is :

(1) 2

(2) 1

(3) 1.618

(4) None of these

36. The missing term in the table

x	0	1	2	3	4	5
y	1	2	4	8	–	32

is :

(1) 16

(2) 16.4

(3) 16.2

(4) 15.8

37. For the following table

Wages (in Rs.)	**Frequency**
0-10	9
10-20	30
20-30	35
30-40	42

the third forward difference is :

(1) 0

(2) 40

(3) 5

(4) 2

38. The binomial distribution whose mean is 3 and variance 2 is given by :

(1) ${}^9C_r\left(\frac{1}{3}\right)^r$

(2) ${}^9C_r\left(\frac{1}{3}\right)^r\left(\frac{2}{3}\right)^{9-r}$

(3) ${}^9C_r\left(\frac{1}{3}\right)^{9-r}\left(\frac{2}{3}\right)^r$

(4) None of these

39. If $A = \begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$ and the initial eigen vector is $X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$, then by power method the smallest eigen value is :

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

40. $\int\limits_{x_0}^{x_0+nh} f(x)\,dx = \frac{h}{2}$ [(sum of first and last ordinates) + 2 (sum of all the intermediates ordinates)] is called :

(1) Trapezoidal rule (2) Simpson's $\frac{1}{3}$rd rule

(3) Simpson's $\frac{3}{8}$th rule (4) None of these

41. For the function f defined by $f(x) = x$, $x \in [0, 1]$ $L(f, P)$ is given by :

(1) $\dfrac{\left(1-\frac{1}{n}\right)}{2}$ (2) $\dfrac{\left(1-\frac{1}{n}\right)^2}{2}$

(3) $\dfrac{2}{\left(1-\frac{1}{n}\right)}$ (4) $\left(1-\frac{1}{n^2}\right)$

42. Which of the following is ***not*** true ?

(1) The improper integral $\int\limits_a^b \frac{dx}{(x-a)^n}$ is convergent if and only if $n < 1$.

(2) The improper integral $\int\limits_a^b \frac{dx}{(b-x)^n}$ is convergent if and only if $n > 1$.

(3) If f and g are two positive functions an $[a, \infty)$ such that $\lim\limits_{x\to\infty} \frac{f(x)}{g(x)} = 0$ and $\int\limits_a^\infty g\,dx$ converges, then $\int\limits_a^\infty f\,dx$ converges.

(4) None of these

43. If (X, d) is a metric space and x, y, z are points of X, then which of the following is ***not*** true ?

(1) $d(x, y) \leq |d(x, z) - d(z, y)|$

(2) $d(x, z) - d(z, y) \leq d(x, y)$

(3) $d(x, y) \geq |d(x, z) - d(z, y)|$

(4) None of these

44. If d is the usual metric, $d(x, y) = |x - y|$ for $x, y \in [0, 1]$, then $S_{1/8}(0)$ is described by :

(1) $\left[-1, \frac{1}{8}\right]$

(2) $[-1, -8]$

(3) $\left[0, \frac{1}{8}\right)$

(4) $[-1, 0]$

45. Let (R, d) be the usual metric space. Then the derived set of $[0, 1)$ is :

(1) $[-1, 1]$

(2) $[-1, 0]$

(3) $(0, 1)$

(4) $[0, 1]$

46. Which of the following statement is ***not*** true ?

(1) Every convergent sequence in a metric space has a unique limit.

(2) Every convergent sequence in a metric space is a Cauchy sequence but converse need not be true.

(3) A Cauchy sequence in a metric space is convergent iff it has at least one convergent and one divergent subsequence.

(4) None of these

47. Which of the following statement is ***false*** ?

(1) Every closed subset of a compact metric space is compact.

(2) A metric space is sequentially compact iff it has no BWP.

(3) Every countably compact metric space has BWP.

(4) None of these

48. Let $(G, \bullet)$ be a group such that $a^2 = e$ for all $a \in G$. Then G is :

(1) Abelian

(2) Not Abelian

(3) May or may not be abelian

(4) None of these

49. If G is a cyclic group of order 8, then the number of generators of G is :

(1) 2

(2) 4

(3) 8

(4) 1

50. If $O(\text{Aut } G) > 1$, then $O(G)$ is :

(1) 2

(2) 3

(3) >2

(4) <2

51. $\lim\limits_{x \to 0} \dfrac{(\tan^{-1} x)^2}{\log(1+x^2)}$ is equal to :

(1) $\dfrac{1}{2}$

(2) $\log 1$

(3) 2

(4) 1

52. If $u = \tan^{-1} \dfrac{x^3 + y^3}{x - y}$, then $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y}$ is equal to :

(1) $\sin u$

(2) $\sin 2u$

(3) $\cos u$

(4) $\tan u$

53. The magnitude of screw curvature is given by :

(1) $\sqrt{k^2 - \tau^2}$

(2) $\sqrt{\tau^2 - k^2}$

(3) $\sqrt{\dfrac{k^3}{\tau^5}}$

(4) $\sqrt{k^2 + \tau^2}$

54. The necessary and sufficient condition for a given curve to be a plane curve is that :

(1) $\tau = \infty$ at all points of the curve (2) $\tau = -\infty$ at all points of the curve

(3) $\tau = 1$ at all points of the curve (4) $\tau = 0$ at all points of the curve

55. The normal which is perpendicular to the osculating plane at a point is called :

(1) Principal Normal (2) Right Normal

(3) Left Normal (4) Bi-Normal

56. The complementary function of the differential equation $\frac{\partial^3 z}{\partial x^3} - 3\frac{\partial^3 z}{\partial x^2 \partial y} + 4\frac{\partial^3 z}{\partial y^3} = e^{x+2y}$ is :

(1) $\phi_1(y-x) + \phi_2(y+2x) + x\phi_3(y+2x)$ (2) $\phi_1(y-x) + \phi_2(y+2x) + \phi_3(y+2x)$

(3) $\phi_1(y+2x) + \phi_2(y-x) + \phi_3(y+2x)$ (4) None of these

57. The particular integral of the differential equation $x^2\frac{\partial^2 z}{\partial x^2} + 2xy\frac{\partial^2 z}{\partial x \partial y} - x\frac{\partial z}{\partial x} = \frac{x^3}{y^2}$ is :

(1) $-\frac{1}{9}x^{-2}y^3$

(2) $-\frac{1}{9}\cdot\frac{x^3}{y^2}$

(3) $-\frac{1}{9}\frac{y^2}{x^3}$

(4) $-\frac{1}{9}\frac{x^3}{y^3}$

58. The equation $\frac{\partial^2 z}{\partial y^2} - \frac{\partial^2 z}{\partial x \partial y} + \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y}\left(1 + \frac{1}{x}\right) + \frac{z}{x} = 0$ is :

(1) Elliptic (2) Parabolic

(3) Hyperbolic (4) None of these

59. For the partial differential equation $r = a^2 t$, the Monge's subsidiary equations are :

(1) $dp\,dy + a^2 dq\,dx = 0,\ (dy)^2 - a^2(dx)^2 = 0$

(2) $dp\,dy - a^2 dq\,dx = 0,\ (dy)^2 + a^2(dx)^2 = 0$

(3) $dp\,dy - a^2 dq\,dx = 0,\ (dy)^2 - a^2(dx)^2 = 0$

(4) $dp\,dy + a^2 dq\,dx = 0,\ (dy)^2 + a^2(dx)^2 = 0$

60. The two dimensional wave equation is given by :

(1) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(2) $\frac{\partial^2 u}{\partial x^2} + \left(\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}\right) = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(3) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(4) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2}\frac{\partial u}{\partial t}$

61. A division ring has :

(1) At least one zero divisors

(2) Infinite number of zero divisors

(3) No zero divisors

(4) None of these

62. An ideal S of a ring R is called a prime ideal of R, if :

(1) $ab \in S \Rightarrow a \in S, b \notin S$

(2) $ab \in S \Rightarrow a \notin S, b \in S$

(3) $ab \in S \Rightarrow a \notin S, b \notin S$

(4) $ab \in S \Rightarrow a \in S$ or $b \in S$

63. If p is a irreducible element of a commutative ring R with unity, then which of the following is ***not*** true ?

(1) p has no proper factors

(2) $p \neq 0$ and p is not a unit

(3) For every $a, b \in R$ if $p/ab \Rightarrow p/a$ or p/b

(4) None of these

64. Which of the following statement is ***not*** true ?

(1) In a UFD, every pair of non-zero elements have a *g.c.d.* and *l.c.m.*

(2) Every principal ideal domain is a unique factorization domain.

(3) Every Euclidean ring is a unique factorization domain.

(4) If R is a UFD, then the product of two primitive polynomials in $R[x]$ is not a primitive polynomial.

65. If a particle describes the cycloid $s = 4a \sin \psi$ with uniform speed v, then the normal acceleration is given by :

(1) $\frac{v^2}{4a \sin \psi}$

(2) $\frac{v^2}{4a \cos \psi}$

(3) $\frac{v^2}{4a}$

(4) $\frac{v^2}{\sin \psi \cos \psi}$

66. A particle moving with S.H.M. of period 12 seconds travels 10 cm from the position of rest in 2 seconds. Then the amplitude at the end of a 2 seconds is :

(1) 20 cm

(2) 10 cm

(3) 30 cm

(4) 40 cm

67. A force of 150 Newtons acts on a body of mass 15 kg for 5 minutes and then ceases. The force required to bring the body to rest in 2 minutes is given by :

(1) 375 N

(2) 275 N

(3) 175 N

(4) 475 N

68. Horizontal range of a projectile is given by :

(1) $\frac{u^2 \sin 2\alpha}{2g}$

(2) $\frac{u^2 \sin \alpha}{2g}$

(3) $\frac{u^2 \sin \alpha}{g^2}$

(4) $\frac{u^2 \sin 2\alpha}{g}$

69. If the time of flight of a bullet over a horizontal range R is T seconds, then the inclination of the direction of projection to the horizontal is :

(1) $\tan^{-1}\left(\frac{gT}{2R}\right)$ (2) $\tan^{-1}\left(\frac{gT^2}{2R}\right)$

(3) $\tan^{-1}\left(\frac{g^2T}{2R}\right)$ (4) $\tan^{-1}\left(\frac{gT^3}{2R}\right)$

70. If a particle moves in an ellipse given by $\frac{l}{r}=1+e\cos\theta$ under a force which is always directed towards its focus, then the periodic time is :

(1) $2\pi\sqrt{\frac{a}{\lambda}}$ (2) $2\pi\frac{a^{3/2}}{\sqrt{\lambda}}$ (3) $\pi^2\sqrt{\frac{a}{\lambda}}$ (4) $\pi\frac{a^{3/2}}{\sqrt{\lambda}}$

Where a is the length of semi-major axis, $\frac{h}{2}$ is the rate of description of the sectorial area and $\lambda=\frac{h^2}{l}$.

71. Which of the following is a duplication formula ?

(1) $\Gamma(m)\,\Gamma(m+\frac{1}{2})=\frac{\sqrt{\pi}}{2^{2m-1}}\Gamma(2m)$ (2) $\Gamma(m)\,\Gamma(m+1)=\frac{\sqrt{\pi}}{2^{2m-1}}\Gamma(2m)$

(3) $\Gamma(m)\,\Gamma(m+\frac{1}{2})=\frac{\sqrt{\pi}}{2^{2m}}\Gamma(2m)$ (4) None of these

72. On changing the order of integration, the integral $\int_0^1\int_{4y}^4 e^{x^2}\,dx\,dy$ becomes :

(1) $\int_1^4\int_0^{x/4} e^{x^2}\,dy\,dx$ (2) $\int_0^4\int_0^{x/4} e^{x^2}\,dy\,dx$

(3) $\int_0^{1/4}\int_0^{x/4} e^{x^2}\,dy\,dx$ (4) None of these

73. In the Fourier expansion of $f(x)=\frac{1}{4}(\pi-x)^2$, $0<x<2\pi$, the Fourier co-efficient a_0 is equal to :

(1) π^2

(2) $\frac{\pi^2}{3}$

(3) $\frac{\pi^2}{6}$

(4) $\frac{\pi^2}{12}$

74. If a function $f(x)=x\sin x$ is represented by a series of cosines of multiples of x in the interval $(0, \pi)$, then a_0 for the series is :

(1) 4 (2) 1 (3) 6 (4) 2

75. The image of the point $1+i$ on the sphere of radius 1 and centre $(0, 0, 0)$ is :

(1) $\left(\frac{2}{3}, \frac{1}{3}, \frac{2}{3}\right)$

(2) $\left(\frac{1}{3}, \frac{2}{3}, \frac{1}{3}\right)$

(3) $\left(\frac{2}{3}, \frac{1}{3}, \frac{1}{3}\right)$

(4) $\left(\frac{2}{3}, \frac{2}{3}, \frac{1}{3}\right)$

76. The co-efficient of magnification at $z=2+i$ for the transformation $w=z^2$ is :

(1) $2\sqrt{5}$

(2) $5\sqrt{2}$

(3) $\frac{2}{\sqrt{5}}$

(4) $\frac{\sqrt{5}}{2}$

77. The function $z=\sinh u\cos v+i\cos hu\sin v$ ceases to be analytic at :

(1) $z=i$

(2) $z=-i$

(3) $z=\pm i$

(4) $z=0$

78. Which of the following statement is ***not*** true ?

(1) A set containing the null vector 0 is linearly independent.

(2) Every superset of a linearly dependent set of vectors is linearly dependent.

(3) Every subset of a linearly independent set is linearly independent.

(4) The non-zero rows in an echelon matrix form a linearly independent set.

79. Which of the following statement is ***not*** true ?

(1) There exists a basis for each finitely generated vector space.

(2) If $S = \{v_1, v_2, v_3, \ldots\ldots, v_n\}$ spans V(F), then any $n + 1$ vectors in V are linearly independent.

(3) If S is linearly independent and $v \notin < S >$, then the set $S\ U\{v\}$ is linearly independent.

(4) If V is finitely generated vector space, then any two bases of V have the same number of elements.

80. A function $T : R^2 \to R^2$ defined by $T(x, y) = (x, -y)$ is linear transformation and is called :

(1) Contraction (2) Dilatation

(3) Reflection (4) None of these

81. The equation $36x^2 + 24xy + 29y^2 - 72x + 126y + 81 = 0$ represents a :

(1) Parabola (2) Ellipse

(3) Hyperbola (4) Circle

82. The centre of conic $8x^2 - 4xy + 5y^2 - 16x - 14y + 17 = 0$ is :

(1) $\left(\frac{3}{2}, 2\right)$ (2) $\left(2, \frac{3}{2}\right)$

(3) $\left(\frac{2}{3}, 2\right)$ (4) $\left(2, \frac{2}{3}\right)$

83. The equation of sphere which passes through the origin and meets the axes in $A(a, 0, 0)$, $B\ (0, b, 0)$ and $C(0, 0, c)$ is :

(1) $ax^2 + by^2 + cz^2 - ax - by - cz = 0$

(2) $x^2 + y^2 + z^2 + ax + by - cz = 0$

(3) $x^2 + y^2 + z^2 - ax - by - cz = 0$

(4) $x^2 + y^2 + z^2 + ax - by + cz = 0$

84. The pole of the plane $lx + my + nz = p$ w.r.t. the conicoid $ax^2 + by^2 + cz^2 = 1$ is :

(1) $\left(\frac{ap}{l}, \frac{bp}{m}, \frac{cp}{n}\right)$

(2) (lap, mbp, ncp)

(3) (ap, bp, cp)

(4) $\left(\frac{l}{ap}, \frac{m}{bp}, \frac{n}{cp}\right)$

85. The discriminating cubic to reduce $2x^2 - 7y^2 + 2z^2 - 10yz - 8zx - 10xy + 6x + 12y - 6z + 5 = 0$ to the standard form is :

(1) $\lambda^3 + 3\lambda^2 - 90\lambda + 216 = 0$

(2) $\lambda^3 - 3\lambda^2 + 90\lambda + 216 = 0$

(3) $\lambda^3 + 3\lambda^2 + 90\lambda + 216 = 0$

(4) $\lambda^3 + 3\lambda^2 - 90\lambda - 216 = 0$

86. Which of the following statement is ***not*** true ?

(1) If p is a prime number and p/ab, then either p/a or p/b.

(2) If $a \equiv b \pmod{m}$, then a and b leave the same remainder when divided by m.

(3) If p is a prime number, then by Wilson theorem, $\underline{|p} + 1 \equiv 0 \pmod{p}$.

(4) None of these

87. $\tan\frac{\theta}{7} + \tan\frac{\theta + \pi}{7} + \ldots\ldots\ldots + \tan\frac{\theta + 6\pi}{7}$ is equal to :

(1) $\tan 7\theta$

(2) $\tan\frac{\theta}{7}$

(3) $7 \tan \theta$

(4) $\frac{\tan\theta}{7}$

88. The principal value of $\log(-5)$ is :

(1) $\frac{\log 5}{\pi i}$

(2) $\log 5 + i\pi$

(3) $\log 5 - i\pi$

(4) $\log 5$

89. $\tan^{-1}\frac{x}{\sqrt{a^2-x^2}}$ is equal to :

(1) $\sin^{-1}(ax)$

(2) $\sin^{-1}\left(\frac{a}{x}\right)$

(3) $\sin^{-1}\left(\frac{x}{a}\right)$

(4) $\sin^{-1}\left(\frac{x}{\sqrt{a}}\right)$

90. The real part of $\sin h(x+iy)$ is :

(1) $\sin h\, x \cos y$ (2) $\sin x \cos h\, y$ (3) $\sin h\, x \cos h\, y$ (4) $\cos h\, x \sin h\, y$

91. $\frac{d}{dx}(x^n J_n(x))$ is equal to :

(1) $x^{n-1}J_n(x)$

(2) $x^n J_{n-1}(x)$

(3) $nx^{n-1}J_n(x)$

(4) $nx^n J_{n-1}(x)$

92. Rodrigue's formula for Legendre polynomial is :

(1) $P_n(x)=\frac{1}{\lfloor n\, 2^n}\frac{d^n}{dx^n}(x^2-1)^{n+1}$

(2) $P_n(x)=\frac{1}{\lfloor n\, 2^n}\frac{d^n}{dx^n}(x^2-1)^n$

(3) $P_n(x)=\frac{1}{\lfloor n-1\; 2^n}\frac{d^{n-1}}{dx^{n-1}}(x^2-1)^n$

(4) None of these

93. $H_n'(x)$ is equal to :

(1) $\frac{n}{2}H_{n-1}(x),\ n\geq 1$

(2) $n^2H_{n-1}(x),\ n\geq 1$

(3) $2nH_{n-1}(x),\ n\geq 1$

(4) None of these

94. If $L(t^2) = \frac{2}{s^3}$, then $L(t^3)$ is :

(1) $\frac{6}{s^4}$ (2) $\frac{3}{s^4}$

(3) $\frac{4}{s^4}$ (4) $\frac{8}{s^4}$

95. If $\bar{f}(s)$ is the Fourier transform of $f(x)$, then the Fourier transform of $f(x-a)$ is :

(1) $e^{ias}\bar{f}(s)$ (2) $\frac{e^{ias}}{\bar{f}(s)}$

(3) $e^{-ias}\bar{f}(s)$ (4) $\frac{e^{-ias}}{\bar{f}(s)}$

96. Which of the following is ***not*** derived data type ?

(1) Functions (2) Pointers

(3) Arrays (4) Character

97. Which of the following is ***not*** a relational operator ?

(1) = = (2) > =

(3) ! (4) ! =

98. Which of the following is ***not*** related to function implementation ?

(1) Parameter list (2) Statement block

(3) Declaration of local variables (4) ROM

99. Pointers are :

(1) A data type in C (2) Not related to C

(3) Called reading strings (4) Called reading and Copying strings

100. The structure definition is specified by the keyword :

(1) stru (2) struct

(3) strct (4) struc

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SET-X

PG-EE-2021

SUBJECT : Mathematics

Sr. No. ....10320....

Time : 1¼ **Hours** | Max. Marks : **100** | Total Questions : **100**

Roll No. (in figures)________________(in words)________________________

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Father's Name________________________Mother's Name______________________

Date of Examination____________________

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(Signature of the Candidate) (Signature of the Invigilator)

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1. A division ring has :

(1) At least one zero divisors (2) Infinite number of zero divisors

(3) No zero divisors (4) None of these

2. An ideal S of a ring R is called a prime ideal of R, if :

(1) $ab \in S \Rightarrow a \in S, b \notin S$ (2) $ab \in S \Rightarrow a \notin S, b \in S$

(3) $ab \in S \Rightarrow a \notin S, b \notin S$ (4) $ab \in S \Rightarrow a \in S$ or $b \in S$

3. If p is a irreducible element of a commutative ring R with unity, then which of the following is ***not*** true ?

(1) p has no proper factors

(2) $p \neq 0$ and p is not a unit

(3) For every $a, b \in R$ if $p/ab \Rightarrow p/a$ or p/b

(4) None of these

4. Which of the following statement is ***not*** true ?

(1) In a UFD, every pair of non-zero elements have a *g.c.d.* and *l.c.m.*

(2) Every principal ideal domain is a unique factorization domain.

(3) Every Euclidean ring is a unique factorization domain.

(4) If R is a UFD, then the product of two primitive polynomials in $R[x]$ is not a primitive polynomial.

5. If a particle describes the cycloid $s = 4a \sin \psi$ with uniform speed v, then the normal acceleration is given by :

(1) $\frac{v^2}{4a \sin \psi}$ (2) $\frac{v^2}{4a \cos \psi}$

(3) $\frac{v^2}{4a}$ (4) $\frac{v^2}{\sin \psi \cos \psi}$

6. A particle moving with S.H.M. of period 12 seconds travels 10 cm from the position of rest in 2 seconds. Then the amplitude at the end of a 2 seconds is :

(1) 20 cm
(2) 10 cm
(3) 30 cm
(4) 40 cm

7. A force of 150 Newtons acts on a body of mass 15 kg for 5 minutes and then ceases. The force required to bring the body to rest in 2 minutes is given by :

(1) 375 N
(2) 275 N
(3) 175 N
(4) 475 N

8. Horizontal range of a projectile is given by :

(1) $\frac{u^2 \sin 2\alpha}{2g}$
(2) $\frac{u^2 \sin \alpha}{2g}$
(3) $\frac{u^2 \sin \alpha}{g^2}$
(4) $\frac{u^2 \sin 2\alpha}{g}$

9. If the time of flight of a bullet over a horizontal range R is T seconds, then the inclination of the direction of projection to the horizontal is :

(1) $\tan^{-1}\left(\frac{gT}{2R}\right)$
(2) $\tan^{-1}\left(\frac{gT^2}{2R}\right)$
(3) $\tan^{-1}\left(\frac{g^2T}{2R}\right)$
(4) $\tan^{-1}\left(\frac{gT^3}{2R}\right)$

10. If a particle moves in an ellipse given by $\frac{l}{r} = 1 + e\cos\theta$ under a force which is always directed towards its focus, then the periodic time is :

(1) $2\pi\sqrt{\frac{a}{\lambda}}$
(2) $2\pi\frac{a^{3/2}}{\sqrt{\lambda}}$
(3) $\pi^2\sqrt{\frac{a}{\lambda}}$
(4) $\pi\frac{a^{3/2}}{\sqrt{\lambda}}$

Where a is the length of semi-major axis, $\frac{h}{2}$ is the rate of description of the sectorial area and $\lambda = \frac{h^2}{l}$.

11. $\frac{d}{dx}(x^n J_n(x))$ is equal to :

(1) $x^{n-1} J_n(x)$
(2) $x^n J_{n-1}(x)$
(3) $nx^{n-1} J_n(x)$
(4) $nx^n J_{n-1}(x)$

12. Rodrigue's formula for Legendre polynomial is :

(1) $P_n(x) = \frac{1}{\lfloor n \, 2^n} \frac{d^n}{dx^n}(x^2-1)^{n+1}$

(2) $P_n(x) = \frac{1}{\lfloor n \, 2^n} \frac{d^n}{dx^n}(x^2-1)^n$

(3) $P_n(x) = \frac{1}{\lfloor n-1 \, 2^n} \frac{d^{n-1}}{dx^{n-1}}(x^2-1)^n$

(4) None of these

13. $H'_n(x)$ is equal to :

(1) $\frac{n}{2} H_{n-1}(x), n \geq 1$
(2) $n^2 H_{n-1}(x), n \geq 1$
(3) $2n H_{n-1}(x), n \geq 1$
(4) None of these

14. If $L(t^2) = \frac{2}{s^3}$, then $L(t^3)$ is :

(1) $\frac{6}{s^4}$
(2) $\frac{3}{s^4}$
(3) $\frac{4}{s^4}$
(4) $\frac{8}{s^4}$

15. If $\vec{f}(s)$ is the Fourier transform of $f(x)$, then the Fourier transform of $f(x-a)$ is :

(1) $e^{ias}\vec{f}(s)$
(2) $\frac{e^{ias}}{\vec{f}(s)}$
(3) $e^{-ias}\vec{f}(s)$
(4) $\frac{e^{-ias}}{\vec{f}(s)}$

16. Which of the following is ***not*** derived data type ?

(1) Functions (2) Pointers

(3) Arrays (4) Character

17. Which of the following is ***not*** a relational operator ?

(1) == (2) >=

(3) ! (4) !=

18. Which of the following is ***not*** related to function implementation ?

(1) Parameter list

(2) Statement block

(3) Declaration of local variables

(4) ROM

19. Pointers are :

(1) A data type in C

(2) Not related to C

(3) Called reading strings

(4) Called reading and Copying strings

20. The structure definition is specified by the keyword :

(1) stru (2) struct

(3) strct (4) struc

21. $\lim\limits_{x \to 0} \dfrac{(\tan^{-1} x)^2}{\log(1+x^2)}$ is equal to :

(1) $\dfrac{1}{2}$ (2) log 1

(3) 2 (4) 1

22. If $u = \tan^{-1}\frac{x^3 + y^3}{x - y}$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(1) $\sin u$ (2) $\sin 2u$

(3) $\cos u$ (4) $\tan u$

23. The magnitude of screw curvature is given by :

(1) $\sqrt{k^2 - \tau^2}$ (2) $\sqrt{\tau^2 - k^2}$

(3) $\sqrt{\frac{k^3}{\tau^5}}$ (4) $\sqrt{k^2 + \tau^2}$

24. The necessary and sufficient condition for a given curve to be a plane curve is that :

(1) $\tau = \infty$ at all points of the curve

(2) $\tau = -\infty$ at all points of the curve

(3) $\tau = 1$ at all points of the curve

(4) $\tau = 0$ at all points of the curve

25. The normal which is perpendicular to the osculating plane at a point is called :

(1) Principal Normal (2) Right Normal

(3) Left Normal (4) Bi-Normal

26. The complementary function of the differential equation $\frac{\partial^3 z}{\partial x^3} - 3\frac{\partial^3 z}{\partial x^2 \partial y} + 4\frac{\partial^3 z}{\partial y^3} = e^{x+2y}$ is :

(1) $\phi_1(y - x) + \phi_2(y + 2x) + x\phi_3(y + 2x)$

(2) $\phi_1(y - x) + \phi_2(y + 2x) + \phi_3(y + 2x)$

(3) $\phi_1(y + 2x) + \phi_2(y - x) + \phi_3(y + 2x)$

(4) None of these

27. The particular integral of the differential equation $x^2\frac{\partial^2 z}{\partial x^2}+2xy\frac{\partial^2 z}{\partial x\,\partial y}-x\frac{\partial z}{\partial x}=\frac{x^3}{y^2}$ is :

(1) $-\frac{1}{9}x^{-2}y^3$

(2) $-\frac{1}{9}\cdot\frac{x^3}{y^2}$

(3) $-\frac{1}{9}\frac{y^2}{x^3}$

(4) $-\frac{1}{9}\frac{x^3}{y^3}$

28. The equation $\frac{\partial^2 z}{\partial y^2}-\frac{\partial^2 z}{\partial x\,\partial y}+\frac{\partial z}{\partial x}-\frac{\partial z}{\partial y}\left(1+\frac{1}{x}\right)+\frac{z}{x}=0$ is :

(1) Elliptic

(2) Parabolic

(3) Hyperbolic

(4) None of these

29. For the partial differential equation $r=a^2t$, the Monge's subsidiary equations are :

(1) $dp\,dy+a^2dq\,dx=0,\ (dy)^2-a^2(dx)^2=0$

(2) $dp\,dy-a^2dq\,dx=0,\ (dy)^2+a^2(dx)^2=0$

(3) $dp\,dy-a^2dq\,dx=0,\ (dy)^2-a^2(dx)^2=0$

(4) $dp\,dy+a^2dq\,dx=0,\ (dy)^2+a^2(dx)^2=0$

30. The two dimensional wave equation is given by :

(1) $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}=\frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(2) $\frac{\partial^2 u}{\partial x^2}+\left(\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}\right)=\frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(3) $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=\frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$

(4) $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=\frac{1}{c^2}\frac{\partial u}{\partial t}$

31. The equation $36x^2 + 24xy + 29y^2 - 72x + 126y + 81 = 0$ represents a :

(1) Parabola (2) Ellipse

(3) Hyperbola (4) Circle

32. The centre of conic $8x^2 - 4xy + 5y^2 - 16x - 14y + 17 = 0$ is :

(1) $\left(\frac{3}{2}, 2\right)$ (2) $\left(2, \frac{3}{2}\right)$

(3) $\left(\frac{2}{3}, 2\right)$ (4) $\left(2, \frac{2}{3}\right)$

33. The equation of sphere which passes through the origin and meets the axes in $A(a, 0, 0)$, $B(0, b, 0)$ and $C(0, 0, c)$ is :

(1) $ax^2 + by^2 + cz^2 - ax - by - cz = 0$

(2) $x^2 + y^2 + z^2 + ax + by - cz = 0$

(3) $x^2 + y^2 + z^2 - ax - by - cz = 0$

(4) $x^2 + y^2 + z^2 + ax - by + cz = 0$

34. The pole of the plane $lx + my + nz = p$ w.r.t. the conicoid $ax^2 + by^2 + cz^2 = 1$ is :

(1) $\left(\frac{ap}{l}, \frac{bp}{m}, \frac{cp}{n}\right)$ (2) (lap, mbp, ncp)

(3) (ap, bp, cp) (4) $\left(\frac{l}{ap}, \frac{m}{bp}, \frac{n}{cp}\right)$

35. The discriminating cubic to reduce $2x^2 - 7y^2 + 2z^2 - 10yz - 8zx - 10xy + 6x + 12y - 6z + 5 = 0$ to the standard form is :

(1) $\lambda^3 + 3\lambda^2 - 90\lambda + 216 = 0$

(2) $\lambda^3 - 3\lambda^2 + 90\lambda + 216 = 0$

(3) $\lambda^3 + 3\lambda^2 + 90\lambda + 216 = 0$

(4) $\lambda^3 + 3\lambda^2 - 90\lambda - 216 = 0$

36. Which of the following statement is ***not*** true ?

(1) If p is a prime number and p/ab, then either p/a or p/b.

(2) If $a \equiv b \pmod{m}$, then a and b leave the same remainder when divided by m.

(3) If p is a prime number, then by Wilson theorem, $\underline{|p} + 1 \equiv 0 \pmod{p}$.

(4) None of these

37. $\tan\frac{\theta}{7} + \tan\frac{\theta+\pi}{7} + \ldots\ldots\ldots + \tan\frac{\theta+6\pi}{7}$ is equal to :

(1) $\tan 7\theta$ (2) $\tan\frac{\theta}{7}$

(3) $7\tan\theta$ (4) $\frac{\tan\theta}{7}$

38. The principal value of $\log(-5)$ is :

(1) $\frac{\log 5}{\pi i}$ (2) $\log 5 + i\pi$

(3) $\log 5 - i\pi$ (4) $\log 5$

39. $\tan^{-1}\frac{x}{\sqrt{a^2 - x^2}}$ is equal to :

(1) $\sin^{-1}(ax)$ (2) $\sin^{-1}\left(\frac{a}{x}\right)$

(3) $\sin^{-1}\left(\frac{x}{a}\right)$ (4) $\sin^{-1}\left(\frac{x}{\sqrt{a}}\right)$

40. The real part of $\sin h\,(x + iy)$ is :

(1) $\sin h\, x \cos y$ (2) $\sin x \cos h\, y$

(3) $\sin h\, x \cos h\, y$ (4) $\cos h\, x \sin h\, y$

41. If $T : U(F) \to V(F)$ is a linear transformation, then Rank T + Nullity T is equal to :

(1) $\dim V$ (2) $\dim (U + V)$

(3) $\dim (U - V)$ (4) $\dim U$

42. The linear transformation $T: R^2 \to R^2$ defined by $T(x, y) = (x+y, x-y, y)$ is a :

(1) Singular transformation

(2) Non-singular transformation

(3) Symmetric transformation

(4) None of these

43. The co-ordinates of vector (1, 1, 1) relative to basis (1, 1, 2), (2, 2, 1), (1, 2, 2) are :

(1) $\left(\frac{1}{3}, \frac{1}{3}, 0\right)$

(2) $\left(\frac{1}{3}, 0, \frac{1}{3}\right)$

(3) $\left(0, \frac{1}{3}, \frac{1}{3}\right)$

(4) None of these

44. If u is an eigen vector of A, then the number of eigen values of λ for which u is the eigen vector is :

(1) At least one

(2) Only one

(3) Infinite

(4) None of these

45. The order of convergence of Regula Falsi method is :

(1) 2

(2) 1

(3) 1.618

(4) None of these

46. The missing term in the table

x	0	1	2	3	4	5
y	1	2	4	8	–	32

is :

(1) 16

(2) 16.4

(3) 16.2

(4) 15.8

47. For the following table

Wages (in Rs.)	Frequency
0-10	9
10-20	30
20-30	35
30-40	42

the third forward difference is :

(1) 0
(2) 40
(3) 5
(4) 2

48. The binomial distribution whose mean is 3 and variance 2 is given by :

(1) ${}^9C_r\left(\frac{1}{3}\right)^r$
(2) ${}^9C_r\left(\frac{1}{3}\right)^r\left(\frac{2}{3}\right)^{9-r}$
(3) ${}^9C_r\left(\frac{1}{3}\right)^{9-r}\left(\frac{2}{3}\right)^r$
(4) None of these

49. If $A=\begin{bmatrix}4 & 2\\ 1 & 3\end{bmatrix}$ and the initial eigen vector is $X_0=\begin{bmatrix}1\\ 0\end{bmatrix}$, then by power method the smallest eigen value is :

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

50. $\int_{x_0}^{x_0+nh} f(x)\,dx=\frac{h}{2}$ [(sum of first and last ordinates) + 2 (sum of all the intermediates ordinates)] is called :

(1) Trapezoidal rule
(2) Simpson's $\frac{1}{3}$rd rule
(3) Simpson's $\frac{3}{8}$th rule
(4) None of these

51. For the function f defined by $f(x) = x, x \in [0, 1]$ $L(f, P)$ is given by :

(1) $\dfrac{\left(1-\frac{1}{n}\right)}{2}$ (2) $\dfrac{\left(1-\frac{1}{n}\right)^2}{2}$

(3) $\dfrac{2}{\left(1-\frac{1}{n}\right)}$ (4) $\left(1-\frac{1}{n^2}\right)$

52. Which of the following is ***not*** true ?

(1) The improper integral $\int_a^b \frac{dx}{(x-a)^n}$ is convergent if and only if $n < 1$.

(2) The improper integral $\int_a^b \frac{dx}{(b-x)^n}$ is convergent if and only if $n > 1$.

(3) If f and g are two positive functions an $[a, \infty)$ such that $\lim_{x\to\infty} \frac{f(x)}{g(x)} = 0$ and $\int_a^\infty g\,dx$ converges, then $\int_a^\infty f\,dx$ converges.

(4) None of these

53. If (X, d) is a metric space and x, y, z are points of X, then which of the following is ***not*** true ?

(1) $d(x, y) \leq |d(x, z) - d(z, y)|$

(2) $d(x, z) - d(z, y) \leq d(x, y)$

(3) $d(x, y) \geq |d(x, z) - d(z, y)|$

(4) None of these

54. If d is the usual metric, $d(x, y) = |x - y|$ for $x, y \in [0, 1]$, then $S_{1/8}(0)$ is described by :

(1) $\left[-1, \frac{1}{8}\right]$ (2) $[-1, -8]$

(3) $\left[0, \frac{1}{8}\right)$ (4) $[-1, 0]$

55. Let (R, d) be the usual metric space. Then the derived set of $[0, 1)$ is :

(1) $[-1, 1]$ (2) $[-1, 0]$

(3) $(0, 1)$ (4) $[0, 1]$

56. Which of the following statement is ***not*** true ?

(1) Every convergent sequence in a metric space has a unique limit.

(2) Every convergent sequence in a metric space is a Cauchy sequence but converse need not be true.

(3) A Cauchy sequence in a metric space is convergent iff it has at least one convergent and one divergent subsequence.

(4) None of these

57. Which of the following statement is ***false*** ?

(1) Every closed subset of a compact metric space is compact.

(2) A metric space is sequentially compact iff it has no BWP.

(3) Every countably compact metric space has BWP.

(4) None of these

58. Let $(G, \bullet)$ be a group such that $a^2 = e$ for all $a \in G$. Then G is :

(1) Abelian (2) Not Abelian

(3) May or may not be abelian (4) None of these

59. If G is a cyclic group of order 8, then the number of generators of G is :

(1) 2 (2) 4

(3) 8 (4) 1

60. If $O(\text{Aut } G) > 1$, then $O(G)$ is :

(1) 2 (2) 3

(3) >2 (4) <2

61. Which of the following is a duplication formula ?

(1) $\Gamma(m)\,\Gamma\left(m+\frac{1}{2}\right)=\frac{\sqrt{\pi}}{2^{2m-1}}\Gamma(2m)$

(2) $\Gamma(m)\,\Gamma(m+1)=\frac{\sqrt{\pi}}{2^{2m-1}}\Gamma(2m)$

(3) $\Gamma(m)\,\Gamma\left(m+\frac{1}{2}\right)=\frac{\sqrt{\pi}}{2^{2m}}\Gamma(2m)$

(4) None of these

62. On changing the order of integration, the integral $\int_0^1\int_{4y}^4 e^{x^2}\,dx\,dy$ becomes :

(1) $\int_1^4\int_0^{x/4} e^{x^2}\,dy\,dx$

(2) $\int_0^4\int_0^{x/4} e^{x^2}\,dy\,dx$

(3) $\int_0^{1/4}\int_0^{x/4} e^{x^2}\,dy\,dx$

(4) None of these

63. In the Fourier expansion of $f(x)=\frac{1}{4}(\pi-x)^2$, $0<x<2\pi$, the Fourier co-efficient a_0 is equal to :

(1) π^2

(2) $\frac{\pi^2}{3}$

(3) $\frac{\pi^2}{6}$

(4) $\frac{\pi^2}{12}$

64. If a function $f(x)=x\sin x$ is represented by a series of cosines of multiples of x in the interval $(0, \pi)$, then a_0 for the series is :

(1) 4 (2) 1 (3) 6 (4) 2

65. The image of the point $1+i$ on the sphere of radius 1 and centre (0, 0, 0) is :

(1) $\left(\frac{2}{3},\frac{1}{3},\frac{2}{3}\right)$

(2) $\left(\frac{1}{3},\frac{2}{3},\frac{1}{3}\right)$

(3) $\left(\frac{2}{3},\frac{1}{3},\frac{1}{3}\right)$

(4) $\left(\frac{2}{3},\frac{2}{3},\frac{1}{3}\right)$

66. The co-efficient of magnification at $z = 2 + i$ for the transformation $w = z^2$ is :

(1) $2\sqrt{5}$

(2) $5\sqrt{2}$

(3) $\frac{2}{\sqrt{5}}$

(4) $\frac{\sqrt{5}}{2}$

67. The function $z = \sinh u \cos v + i \cos hu \sin v$ ceases to be analytic at :

(1) $z = i$

(2) $z = -i$

(3) $z = \pm i$

(4) $z = 0$

68. Which of the following statement is ***not*** true ?

(1) A set containing the null vector 0 is linearly independent.

(2) Every superset of a linearly dependent set of vectors is linearly dependent.

(3) Every subset of a linearly independent set is linearly independent.

(4) The non-zero rows in an echelon matrix form a linearly independent set.

69. Which of the following statement is ***not*** true ?

(1) There exists a basis for each finitely generated vector space.

(2) If $S = \{v_1, v_2, v_3, \ldots\ldots\ldots, v_n\}$ spans V(F), then any $n + 1$ vectors in V are linearly independent.

(3) If S is linearly independent and $v \notin < S >$, then the set $S\ U\{v\}$ is linearly independent.

(4) If V is finitely generated vector space, then any two bases of V have the same number of elements.

70. A function $T : R^2 \to R^2$ defined by $T(x, y) = (x, -y)$ is linear transformation and is called :

(1) Contraction

(2) Dilatation

(3) Reflection

(4) None of these

71. Which of the following is converse of Lami's theorem ?

(1) If three coplanar forces acting at a point be such that each is proportional to the sine of the angle between the directions of other two, then the forces are in equilibrium

(2) Every given system of forces acting on a rigid body can be reduced to a wrench

(3) A system of coplanar forces acting on a rigid body can be reduced to either a single force or single couple

(4) None of these

72. If AB = 40 cm and two unlike parallel forces 40 N and 5 N act at A and B respectively, then the resultant of these forces acts at a distance from A given by :

(1) 40 cm (2) $\frac{40}{7}$ cm

(3) 7 cm (4) 40.7 cm

73. Three forces 3P, 7P, 5P act along the sides AB, BC, CA of an equilateral triangle ABC. Then the magnitude of the resultant is given by :

(1) $2\sqrt{3}\,P$ (2) $3\sqrt{2}\,P$

(3) $\frac{\sqrt{3}}{2}P$ (4) $\frac{\sqrt{2}}{3}P$

74. Which of the following statement is ***not*** true ?

(1) Two couples in the same plane of equal moments and acting in the same sense are equivalent.

(2) Two couples of equal and opposite moments in parallel planes don't balance each other.

(3) The resultant of a number of coplanar couples is equivalent to a single couple whose moment is equal to the algebraic sum of the moments of the given couples.

(4) None of these

75. The equations of the central axis of any given system of forces acting on a rigid body is :

(1) $\dfrac{X - yZ + zY}{L} = \dfrac{Y - zX + xZ}{M} = \dfrac{Z - xY + yX}{N} = p$

(2) $\dfrac{L - yZ + zY}{X} = \dfrac{M - zX + xZ}{Y} = \dfrac{N - xY + yX}{Z} = p$

(3) $\dfrac{L + yZ + zY}{X} = \dfrac{M + zX - xZ}{Y} = \dfrac{N + xY - yX}{Z} = p$

(4) None of these

76. Which of the following statement is ***not*** true ?

(1) Interior of a set is an open set.

(2) The interior of a set A is the largest open subset of A.

(3) A point p is a limit point of a set A if and only if every neighbourhood of p contains one point of A.

(4) None of these

77. Which of the following statement is ***not*** true ?

(1) If a sequence $<a_n>$ diverges to ∞, then $<a_n>$ is bounded below but unbounded above.

(2) If a sequence $<a_n>$ diverges to $-\infty$, then $<a_n>$ is unbounded below but bounded above.

(3) Every monotonically increasing sequence unbounded above diverges to $-\infty$.

(4) Every monotonically decreasing sequence unbounded below diverges to $-\infty$.

78. A geometrical series $a + ar + ar^2 + \ldots\ldots\ldots + \infty$ oscillates infinitely, if :

(1) $|r| < 1$

(2) $r \geq 1$

(3) $r = -1$

(4) $r < -1$

79. Which of the following is ***not*** true ?

(1) Every absolutely convergent infinite product is convergent.

(2) A series $\sum_{n=1}^{\infty} a_n$ is said to be absolutely convergent, if the series $\sum_{n=1}^{\infty} |a_n|$ converges.

(3) If $a_n \geq 0$, then the infinite series $\sum_{n=1}^{\infty} a_n$ and the infinite product $\prod_{n=1}^{\infty}(1+a_n)$ converge or diverge together.

(4) Every absolutely convergent infinite product may not be always convergent.

80. The series $\sum_{n=1}^{\infty}\left(1+\frac{1}{n}\right)^n x^n$, $x > 0$ is divergent, if :

(1) $x \geq 1$

(2) $x < 1$

(3) $x \leq \frac{1}{2}$

(4) None of these

81. The integrating factor of the differential equation $(y^2 + 2x + x^2)dx + 2y\,dy = 0$ is :

(1) e^y

(2) e^{-x}

(3) e^{-y}

(4) e^x

82. The particular integral of the differential equation $(D^2 - 6D + 9)y = e^{3x}$ is :

(1) $\frac{x^2}{2}e^{3x}$

(2) $x^2 e^{3x}$

(3) xe^{3x}

(4) $x^2 e^{3x}$

83. The complementary function of the differential equation $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} - 3y = x^2 \log x$ is :

(1) $\frac{c_1}{x^3} + c_2 x$

(2) $c_1 x^3 + \frac{c_2}{x}$

(3) $c_1 x^3 + c_2 x$

(4) $(c_1 + c_2 x)x^3$

84. The value of determinant used for solving the differential equation $\frac{d^2y}{dx^2} + 4y = \tan 2x$ by the method of variation of parameters is :

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

85. Using 1, y and z as multipliers, one part of the complete solution of $\frac{xdx}{z^2 - 2yz - y^2} = \frac{dy}{y+z} = \frac{dz}{y-z}$ is :

(1) $x^2 + y^2 + z^2 = c$ (2) $x^2 - y^2 + z^2 = c$

(3) $x^2 + y^2 - z^2 = c$ (4) $-x^2 + y^2 + z^2 = c$

86. The necessary and sufficient condition for the vector function $\vec{f}$ of a scalar variable t to have constant direction is :

(1) $\vec{f} . \frac{d\vec{f}}{dt} = 0$ (2) $\vec{f} \times \frac{d\vec{f}}{dt} = \vec{0}$ (3) $\vec{f} + \frac{d\vec{f}}{dt} = \vec{0}$ (4) $\vec{f} - \frac{d\vec{f}}{dt} = \vec{0}$

87. If $r = |\vec{r}|$, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then $\nabla \log|\vec{r}|$ is equal to :

(1) $\vec{r} + r^2$ (2) $\vec{r} \times \log \vec{r}$ (3) $\frac{\vec{r}}{r^2}$ (4) $-\frac{\vec{r}}{r^3}$

88. If $\vec{f}$ and $\vec{g}$ are irrotational, then which of the following is solenoidal ?

(1) $\vec{f} + \vec{g}$ (2) $\vec{f} - \vec{g}$ (3) $\vec{f} . \vec{g}$ (4) $\vec{f} \times \vec{g}$

89. If a vector $\vec{r}$ satisfies the equation $\frac{d^2\vec{r}}{dt^2} = t\vec{a} + \vec{b}$, where $\vec{a}$ and $\vec{b}$ are constant vectors, then $\vec{r}$ is given by :

(1) $\frac{t^3}{6}\vec{a} + \vec{c}_1 t$ (2) $\frac{t^3}{6}\vec{a} + \frac{t^2}{2}\vec{b} + \vec{c}_1 t + \vec{c}_2$

(3) $\frac{t^3}{2}\vec{a} + \frac{t^2}{6}\vec{b} + \vec{c}_1 t + \vec{c}_2$ (4) $\frac{t^2}{3}\vec{a} + \frac{t^2}{2}\vec{b} + \vec{c}_1 t$

where $\vec{c}_1$ and $\vec{c}_2$ are constant vectors.

90. If S represents the surface of a sphere $x^2 + y^2 + z^2 = a^2$, then $\iint_S (x\,dy\,dz + y\,dz\,dx + z\,dx\,dy)$ is equal to :

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

(3) $\frac{4}{\pi}a^3$ (4) $\frac{4\pi}{a^3}$

91. The rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ is :

(1) Less than 2 (2) Less than 3

(3) Greater than 2 (4) Greater than 3

92. Which one of the following statement is ***not*** true ?

(1) A set containing only the zero vector is linearly independent.

(2) A set containing only a non-zero vector is linearly independent.

(3) Every super set of a linearly dependent set is linearly dependent.

(4) None of these

93. If $A = \begin{bmatrix} 1 & \sqrt{2} \\ -\sqrt{2} & -1 \end{bmatrix}$, then by Cayley Hamilton theorem :

(1) $A^2 = \sqrt{2}I$ (2) $A^2 = -\sqrt{2}I$

(3) $A^2 = -I$ (4) $A^2 = I$

94. If 1, α, β, γ, …….. are roots of the equation $x^n - 1 = 0$, then $(1-\alpha)(1-\beta)(1-\gamma)$ …… is equal to :

(1) n (2) $-n$

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

95. If α, β, γ are the roots of the equation $x^3 + px^2 + qx + r = 0$, then $\sum \frac{1}{\alpha}$ is equal to :

(1) $\frac{r}{q}$ (2) $\frac{q}{r}$

(3) $-\frac{r}{q}$ (4) $-\frac{q}{r}$

96. The equation of curve having $x + y - 1 = 0$ and $x - y + 2 = 0$ as its asymptotes and passing through origin is :

(1) $(x - y + 2)(x + y - 1) - 2 = 0$ (2) $(x + y - 1)(x - y + 2) + 2 = 0$

(3) $(x + y - 1)(x - y + 2) - 4 = 0$ (4) None of these

97. For the curve $r^n = a^n \cos n\theta$, the angle ϕ is given by :

(1) $\frac{\pi}{2} - n\theta$ (2) $\pi + n\theta$

(3) $\frac{\pi}{2} + n\theta$ (4) $\pi - n\theta$

98. The double point (2, 0) of the curve $y^2 = (x-2)^2(x-1)$ is a :

(1) Node (2) Cusp

(3) Conjugate point (4) Point of inflexion

99. For the curve $r = a(1 - \sin\theta)$, the tangent to the curve at the origin is :

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

100. $\int_0^1 \frac{x^3}{\sqrt{1-x^2}} dx$ is equal to :

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

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

Entrance Test Answer Key of Mathematics exam held on 22.09.2021 at 12:30 P.M

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49	4	3	2	2
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22/9/21 22/09/2021 22.9.21 Sep 22/2021.

Entrance Test Answer Key of Mathematics exam held on 22.09.2021 at 12:30 P.M

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98	2	1	4	1
99	2	2	1	3
100	1	3	2	4

22/9/21

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Poonam 22.9.21

Sep 22/2021