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CPG-EE-2018 (Mathematics)-(SET-Y)

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Sr. No. ....

Time : **1½ Hours** Total Questions : **100** Max. Marks : **100**

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SEAL

1. If $A = \begin{bmatrix} x & 3 \\ 3 & x \end{bmatrix}$ and $|A^3| = 343$ then x =

(1) ± 2 (2) ± 3 (3) ± 4 (4) ± 7

2. For two non-singular matrices of the same order, the reversal law of multiplication does not hold for :

(1) transpose (2) adjoint

(3) conjugate (4) transposed conjugate

3. If α is an eigen value of a non-singular matrix A, then $\frac{|A|}{\alpha}$ is an eigen value of :

(1) adj A (2) A (3) A^{-1} (4) None of these

4. If the roots of the equation $x^3 + 3px^2 + 3qx + r = 0$ are in G. P. then :

(1) $p^3 = r^2 q^3$ (2) $p^3 r^2 = q^3$

(3) $p^3 = rq^3$ (4) $p^3 r = q^3$

5. For the equation $x^8 + 5x^3 + 2x - 3 = 0$, the least number of imaginary roots is :

(1) 6 (2) 4 (3) 2 (4) 0

6. $\lim_{x \to 0} \frac{\tan x - \sin x}{\sin^3 x} =$

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

7. If a given curve of nth degree has n asymptotes, then the number of points at which these asymptotes cut the curve, is :

(1) n – 1 (2) n (n – 1) (3) n (n – 2) (4) n (n – 3)

8. The radius of curvature for the cardioide $r = a\,(1 + \cos\theta)$ is given by $\rho =$

(1) $\frac{a}{2} \cos \frac{\theta}{2}$ (2) $\frac{3a}{4} \cos \frac{\theta}{2}$

(3) $\frac{2a}{3} \cos \frac{\theta}{2}$ (4) $\frac{4a}{3} \cos \frac{\theta}{2}$

9. The area common to the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ is :

(1) $32\frac{a^2}{3}$ (2) $16\frac{a^2}{3}$ (3) $8\frac{a^2}{3}$ (4) $\frac{a^2}{3}$

10. The point of oscul-inflexion is a :

(1) Double cusp with change of species (2) Double cusp of first species

(3) Double cusp of second species (4) Single cusp with change of species

11. For two given confocal conics, if the tangents drawn (one to each) are perpendicular then the locus of these tangents is :

(1) an ellipse (2) a hyperbola

(3) a circle (4) a straight line

12. Radius of the sphere $2x^2+2y^2+2z^2-2x+4y+2z+3=0$ is :

(1) 2 (2) 0 (3) 4 (4) 8

13. The condition that the plane $lx+my+nz=0$ may touch the con $4x^2-y^2+3z^2=0$, is :

(1) $4l^2-12m^2+3n^2=0$ (2) $3l^2-12m^2+4n^2=0$

(3) $3l^2-6m^2+4n^2=0$ (4) $4l^2-6m^2+3n^2=0$

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

(1) $\left(\frac{l}{a},\frac{m}{b},\frac{n}{c}\right)$ (2) $\left(\frac{a}{lp},\frac{b}{mp},\frac{c}{np}\right)$

(3) $\left(\frac{pl}{a},\frac{pm}{b},\frac{pn}{c}\right)$ (4) $\left(\frac{l}{ap},\frac{m}{bp},\frac{n}{cp}\right)$

15. The equation of the plane which cuts the paraboloid $x^2-2y^2-z=0$ in a conic with it centre at the point $\left(2,\frac{3}{2},4\right)$, is :

(1) $4x-6y+z-5=0$ (2) $4x-6y-z+5=0$

(3) $4x+6y+z+5=0$ (4) $4x+6y-z-5=0$

16. The statement "The number of primes is infinite" is known as :

(1) Fundamental theorem of arithmetic (2) Euclid's first theorem

(3) Euclid's second theorem (4) Wilson's theorem

17. When 2^{20} is divided by 7, the remainder is :

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

18. $\phi(450) =$

(1) 90 (2) 100 (3) 110 (4) 120

19. If $\sin(u+iv) = x+iy$, then which of the following is true ?

(1) $\frac{x^2}{\sin^2 u}+\frac{y^2}{\cos^2 u}=1$

(2) $\frac{x^2}{\sin^2 u}-\frac{y^2}{\cos^2 u}=1$

(3) $\frac{x^2}{\cos h^2 v}-\frac{y^2}{\sin h^2 v}=1$

(4) $\frac{x^2}{\cos^2 u}-\frac{y^2}{\sin^2 u}=1$

20. If $\tan^{-1} 2x + \tan^{-1} 3x = \pi/4$, then $x = 0$:

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

21. Integrating factor of the differential equation $x^2 y\, dx - (x^3 + y^3)\, dy = 0$ is :

(1) $\frac{1}{xy^2}$ (2) $\frac{1}{y^4}$ (3) $\frac{1}{xy^3}$ (4) $\frac{1}{x^4}$

22. Solution of the equation $p = \log(px - y)$ is :

(1) $y = cx - e^c$

(2) $y = cx - \log c$

(3) $y = cx + c^2$

(4) $y = cx + e^c$

23. Orthogonal trajectories of $y^2 = 4ax$ are given by :

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

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

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

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

24. For the differential equation $\frac{d^2y}{dx^2} - 4y = e^x + \sin 2x$, the particular Integral (P. I.) is :

(1) $-\frac{1}{3}e^x - \frac{1}{8}\cos 2x$

(2) $\frac{1}{3}e^x - \frac{1}{8}\sin 2x$

(3) $-\frac{1}{3}e^x - \frac{1}{8}\sin 2x$

(4) $\frac{1}{3}e^x + \frac{1}{8}\sin 2x$

25. Solution of $(x - 3y - z)\, dx + (2y - 3x)\, dy + (z - x)\, dz = 0$ is :

(1) $x^2 + 2y^2 - z^2 + 6xy + 2xz = c$

(2) $x^2 + 2y^2 - z^2 - 6xy + 2xz = c$

(3) $x^2 + 2y^2 + z^2 + 6xy - 2xz = c$

(4) $x^2 + 2y^2 + z^2 - 6xy - 2xz = c$

26. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{b}$ and $\vec{c}$ are non-parallel and $\vec{a} \times (\vec{b} \times \vec{c}) = \frac{1}{2}\vec{b}$, then the angles which $\vec{a}$ makes with $\vec{b}$ and $\vec{c}$ are :

(1) $\pi/2, \pi/3$ (2) $\pi/3, \pi/2$

(3) $\pi/3, \pi/4$ (4) $\pi/2, \pi/4$

27. A particle moves along the curve given by $x = 3t^2, y = t^2 - 2t, z = t^3$. The acceleration at $t = 1$ in the direction of vector $\hat{i} + \hat{j} - \hat{k}$ is :

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

28. The unit normal vector to the surface $x^4 - 3xyz + z^2 + 1 = 0$ at the point (1, 1, 1) is :

(1) $\frac{1}{\sqrt{11}}\left(\hat{i} + 3\hat{j} - \hat{k}\right)$ (2) $\frac{1}{\sqrt{11}}(\hat{i} - 3\hat{j} - \hat{k})$

(3) $\frac{1}{\sqrt{11}}(\hat{i} - 3\hat{j} + \hat{k})$ (4) $\frac{1}{\sqrt{11}}(\hat{i} + 3\hat{j} + \hat{k})$

29. If ϕ is a scalar point function and $\vec{f}$ is a vector point function, then which of the following is true in an orthogonal curvilinear system ?

(1) div $(grad\ \phi) = 0$ (2) curl $(curl\ \vec{f}) = \vec{0}$

(3) curl $(div\ \vec{f}) = \vec{0}$ (4) div $(curl\ \vec{f}) = 0$

30. If S is the surface of the sphere $x^2 + y^2 + z^2 = a^2$, then $\iint_S (xdydz + y\,dz\,dx + zdxdy) =$

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

31. For the function $f(x) = \sin 2x$ in $\left[0, \frac{\pi}{2}\right]$, the Rolle's theorem is applicable, value of 'C' is :

(1) $\pi/3$ (2) $\pi/4$ (3) $\pi/6$ (4) $3\pi/8$

32. $\lim\limits_{(x,y) \to (0,0)} \frac{x^2 y}{x^4 + y^2} =$

(1) $1/2$ (2) 1

(3) 0 (4) limit does not exist

33. If $u = \sin^{-1}\dfrac{x^2+y^2}{x+y}$, then $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} =$

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

34. $\lim\limits_{x\to 0}\left(\dfrac{1}{x^2} - \dfrac{1}{\sin^2 x}\right) =$

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

35. The arc-rate of rotation of the binormal at a point of the curve is known as :

(1) Tangent vector (2) Principal normal

(3) Normal vector (4) Torsion vector

36. If $z = ae^{-b^2t}\cos bx$, then eliminating the constants a and b, the PDE obtained is :

(1) $\dfrac{\partial^2 z}{\partial t^2} + \dfrac{\partial z}{\partial x} = 0$ (2) $\dfrac{\partial^2 z}{\partial x^2} = \dfrac{\partial^2 z}{\partial t^2}$ (3) $\dfrac{\partial^2 z}{\partial x^2} + \dfrac{\partial z}{\partial t} = 0$ (4) $\dfrac{\partial^2 z}{\partial x^2} = \dfrac{\partial z}{\partial t}$

37. Solution of the equation p + q = z is :

(1) $f(x-y, y+\log z) = 0$ (2) $f(x-y, y-\log z) = 0$

(3) $f(x+y, y-\log z) = 0$ (4) $f(x-y, y-z) = 0$

38. The equation $u_{xx} + 2u_{yy} + u_{zz} = 2u_{xy} + 2u_{yz}$ is :

(1) parabolic (2) elliptic (3) hyperbolic (4) None of these

39. A string is stretched between the fixed points (0, 0) and (1, 0) and released at rest from the position u = A sin π x. The subsequent displacement u(x, t) is given by :

(1) A cos c πt cos πx (2) $A\sin(\pi x + ct)$

(3) $A\sin c\,\pi t\sin \pi x$ (4) $A\cos c\,\pi t\sin \pi x$

40. Particular integral of $(D^2 - D'^2)z = \cos(x+y)$ is :

(1) $\dfrac{x}{4}\sin(x+y)$ (2) $x\sin(x+y)$ (3) $\dfrac{x}{2}\sin(x+y)$ (4) $\dfrac{x}{2}\cos(x+y)$

41. The resultant of two forces P and Q is R. The resolved part of R in the direction of P is of magnitude Q. The angle between P and Q is :

(1) $2\cos^{-1}\sqrt{\dfrac{P}{2Q}}$ (2) $2\sin^{-1}\sqrt{\dfrac{P}{2Q}}$ (3) $\sin^{-1}\sqrt{\dfrac{P}{2Q}}$ (4) $\cos^{-1}\sqrt{\dfrac{P}{2Q}}$

42. Any system of forces acting on a rigid body can be reduced in general to a force acting at an arbitrary chosen point of the body and a :

(1) Screw (2) Wrench (3) Negative force (4) Couple

43. The line of action of a force such that the axis of the couple is coincident with this line is called :

(1) Null line (2) Central axis (3) Wrench (4) Screw

44. If a body is slightly displaced and it remains in equilibrium in any position, then the equilibrium is categorized as :

(1) Stable (2) Unstable (3) Neutral (4) Perfect

45. The constant ratio which the limiting friction bears to the normal reaction is called :

(1) Co-efficient of friction (2) Statical friction

(3) Dynamical friction (4) Normal friction

46. The set of all limit points of a set $A \subseteq R$ is called a :

(1) Closure of set A (2) Open cover of set A

(3) Derived set of A (4) Limiting set of A

47. $\lim_{n\to\infty}\left(\frac{2}{1}.\frac{3}{2}.\frac{4}{3}......\frac{n}{n-1}\right)^{1/n} =$

(1) 0 (2) 1/2 (3) 1 (4) 2

48. The series $\sum_{n=3}^{\infty} x^{\log n}$ is :

(1) Convergent (2) Divergent

(3) Convergent if $x < \frac{1}{e}$ (4) Convergent if $x < e$

49. The series $x + \frac{x^2}{\underline{|2}} + \frac{x^3}{\underline{|3}} + ...$

(1) Converges absolutely (2) Converges conditionally

(3) Does not converge (4) None of these

50. The infinite product $\prod_{n=1}^{\infty}\left(1+\frac{x}{n}\right), x<0$:

(1) Diverges to zero (2) Converges to 1

(3) Converges absolutely (4) Converges to 2

51. $J_{n-1}(x) + J_{n+1}(x) =$

(1) $\frac{n}{x} J_n(x)$ (2) $\frac{n}{x} J'_n(x)$ (3) $\frac{x}{2n} J_n(x)$ (4) $\frac{2n}{x} J_n(x)$

52. $P'_{n+1}(x) - xP'_n(x) =$

(1) n $P_n(x)$ (2) $(n+1) P_n(x)$ (3) $(n+1) P_{n+1}(x)$ (4) $(2n+1) P_n(x)$

53. $H'_n(x) =$

(1) $H_{n+1}(x)$ (2) $n H_{n-1}(x), n \geq 1$ (3) $nH_{n+1}(x)$ (4) $2n H_{n-1}(x), n \geq 1$

54. L $(t e^{-4t} \sin 3t) =$

(1) $\frac{6(s+4)}{(s^2+8s+25)^2}$ (2) $\frac{3(s+4)}{(s^2+8s+25)^2}$

(3) $\frac{6(s+4)}{(s^2+6s+25)^2}$ (4) $\frac{3(s+4)}{(s^2+6s+25)^2}$

55. Fourier transform of $f(x)$ defined by $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases}$ is :

(1) $\frac{2}{s} \cos as$ (2) $\frac{4}{s} \sin as$ (3) $\frac{1}{s} \sin as$ (4) $\frac{2}{s} \sin as$

56. C language is available for which of the operating systems ?

(1) DOS (2) UNIX (3) Windows (4) All of these

57. Which of the following is invalid ?

(1) 'a' (2) 'ab' (3) ' ' (4) " "

58. The continue command cannot be used with :

(1) do (2) for (3) Switch (4) While

59. Which of the following operator has lowest priority ?

(1) || (2) + (3) % (4) ++

60. What should be the expression return value for a do-while to terminate ?

(1) –1 (2) 1 (3) 0 (4) NULL

61. It $f(x) = x+1, x \in [1, 3]$ and partition $P = \{1, 2, 3\}$, then $L(f, P)$ and $U(f, P)$ are :

(1) 2, 4 (2) 3, 6 (3) 4, 7 (4) 5, 7

62. Value of the integral $\int_{-1}^{1}([x]-x)\,dx, [x]$ being the greatest integer function, is :

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

63. The integral $\int_{0}^{1} x^n e^{-mx}\,dx$ converges for :

(1) $n<-1$ (2) $n>-1$ (3) $n<-1, m>1$ (4) $n<-2, m<1$

64. $\int_{1}^{\infty} \frac{\sin x}{x^n}\,dx$ converges absolutely for :

(1) $n=0$ (2) $n<1$ (3) $n=1$ (4) $n>1$

65. If A be any subset of a metric space (X, d) and A° denotes the interior of A, then which of the following is not true ?

(1) $(A\cap B)^\circ = A^\circ \cap B^\circ$

(2) $(A\cup B)^\circ = A^\circ \cup B^\circ$

(3) $(A^\circ \cup B^\circ) \subset (A\cup B)^\circ$

(4) None of these

66. The concepts of continuity and uniform continuity are equivalent on :

(1) a closed set

(2) an open set

(3) a compact set

(4) a finite set

67. Consider the statements :

(a) Every Cauchy sequence in a metric space is convergent.

(b) A metric space is complete if every cauchy sequence in it has a convergent subsequence.

Which of the above is true ?

(1) Both (a) and (b)

(2) Only (a)

(3) Only (b)

(4) Neither (a) nor (b)

68. Given the statements :

(a) In a group, the order of an element and its inverse are same.

(b) Let (G, .) be a group and $a \in G$ be of order m, then $a^n = e$ if and only if m/n.

Which of the above is true ?

(1) Both (a) and (b)

(2) Only (a)

(3) Only (b)

(4) Neither (a) nor (b)

69. Let $\phi : G \to G'$ be a homomorphism. The homo-morphism ϕ is an isomorphism of G onto G' if and only if :

(1) Ker $\phi = 0$ (2) Ker $\phi = \{e\}$ (3) $\phi(a^{-1}) = [\phi(a)]^{-1}$ (4) $\phi(e) = e'$

70. If $G = \{1, i, -1, -i\}$ is a multiplicative group, then order of $-i$ is :

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

71. Consider the statements :

(a) Union of two subgroups of a group is also a subgroup of that group.

(b) Intersection of two subgroups of a group is also a subgroup of that group.

Which of the above is true ?

(1) Only (a) (2) Only (b)

(3) Both (a) and (b) (4) Neither (a) nor (b)

72. Choose the wrong statement :

(1) Every field is an integral domain

(2) Every field is a division ring

(3) Every division ring is a field

(4) Every finite non-zero integral domain is a field

73. If S and T are co-maximal ideals of a commutative ring R with unity then :

(1) $ST = S \cap T$ (2) $ST = S \cup T$

(3) $ST = R$ (4) $S \cap T = R$

74. Choose the incorrect statement :

(1) If R is a UFD, then so is R[x].

(2) If R is an integral domain with unity, then every irreducible element in R[x] is an irreducible polynomial.

(3) If F is a field, then every irreducible polynomial of F[x] is irreducible element of F[x].

(4) Eisenstein's criterion is necessary for the irreducibility of a polynomial.

75. The velocity of a particle moving in a straight line is given by $v^2 = 2x\,e^x$, then its acceleration is :

(1) $\frac{v^2}{2x}(x-1)$ (2) $\frac{v^2}{2}(x+1)$ (3) $\frac{v^2}{2x}(x+1)$ (4) $\frac{v}{2x}(x+1)$

76. Let $P(r,\theta)$ be the position of a moving particle at time t, then its transverse acceleration is :

(1) $\frac{1}{r}\frac{d}{dt}\left(r\frac{d\theta}{dt}\right)$ (2) $\frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right)$ (3) $\frac{1}{r^2}\frac{d}{dt}\left(r\frac{d\theta}{dt}\right)$ (4) $\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right)$

77. A particle is moving with S. H. M. with amplitude a. The distance x from the centre where the velocity is half that of the maximum velocity is given by :

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

78. If the maximum horizontal range of a projectile is R, then the greatest height attained is :

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

79. To a man walking at the rate of 5 km/hr, rain appears to fall vertically. If its real velocity is 10 km/hr, then its real direction to the horizontal is :

(1) $\theta=\pi/6$ (2) $\theta=\pi/2$ (3) $\theta=\pi/4$ (4) $\theta=\pi/3$

80. A particle describes an ellipse under a central orbit, the velocity at any point of its path is :

(1) $v^2=\lambda\left(\frac{2}{r}-\frac{1}{a}\right)$ (2) $v^2=\lambda\left(\frac{2}{r}-\frac{1}{2a}\right)$ (3) $v^2=\lambda\left(\frac{1}{r}-\frac{2}{a}\right)$ (4) $v^2=\lambda\left(\frac{1}{r}-\frac{1}{a}\right)$

81. If $x^2+y^2=v^2-u^2$ and $xy=-uv$, then $\frac{\partial(u,v)}{\partial(x,y)}=$

(1) $\frac{x^2-y^2}{u^2-v^2}$ (2) $\frac{x^2+y^2}{u^2-v^2}$ (3) $\frac{x^2-y^2}{u^2+v^2}$ (4) $\frac{x^2+y^2}{u^2+v^2}$

82. $\int_0^{\pi/2} \sin^3 x \cos^{5/2} x\, dx=$

(1) $\frac{8}{77}$ (2) $\frac{4}{77}$ (3) $\frac{3}{44}$ (4) $\frac{7}{44}$

83. Value of $\int_0^4 \int_0^{2\sqrt{z}} \int_0^{\sqrt{4z-x^2}} dz\, dx\, dy$ is :

(1) 4π (2) 8π (3) 16π (4) 32π

84. If f and g are piecewise smooth periodic functions with fourier co-efficients c_n and d_n respectively, then the result $\frac{1}{T}\int_{-T/2}^{T/2} f(t)\,\overline{g(t)}\,dt=\sum_{k=-\infty}^{\infty} c_k\,\overline{d}_k,$ is known as :

(1) Conjugate property
(2) Parseval equality
(3) Parseval identity
(4) Dirichlet identity

85. The analytic function whose real part is $e^x(x\cos y - y\sin y)$, is :

(1) $ze^z + c$ (2) $z\sin z + c$ (3) $ze^{-z} + c$ (4) $ze^{z+1} + c$

86. Invariant points of the bilinear transformation $w = \dfrac{(2+i)z-2}{z+i}$ are :

(1) $\pm i$ (2) $1 \pm 2i$ (3) $2 \pm i$ (4) $1 \pm i$

87. Under the transformation $w + 1 = \dfrac{4}{z^2}$, the unit circle in the w-plane corresponds to which curve of the z-plane ?

(1) Circle (2) Parabola (3) Ellipse (4) Hyperbola

88. The basis of the sub-space spanned by the vectors $(-3, 1, 2), (0, 1, 3), (2, 1, 0), (1, 1, 1)$ is :

(1) $\{(1,1,1),(0,1,0),(0,0,1)\}$ (2) $\{(1,1,1),(0,1,3),(0,0,1)\}$

(3) $\{(1,1,1),(0,1,2),(0,0,2)\}$ (4) $\{(1,1,1),(0,2,1),(0,0,1)\}$

89. If W_1 and W_2 are subspaces of V and dim $W_1 = 4$, dim $W_2 = 5$, dim $V = 7$, then the possible values of dim $(W_1 \cap W_2)$ are :

(1) 2 or 4 (2) 1, 2 or 3 (3) 2, 3 or 4 (4) 5, 6 or 7

90. Let $T : R^3 \to R^3$ be a linear transformation given by $T(x, y, z) = \left(\dfrac{x}{2}, \dfrac{y}{2}, 0\right)$. The rank of T is :

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

91. Let $T_1 : U \to V$ and $T_2 : V \to W$ be two linear transformations, then which of the following is incorrect ?

(1) $\rho(T_2T_1) = \rho(T_2)$ if T_1 is singular

(2) $\rho(T_2T_1) \le \rho(T_2)$

(3) $\rho(T_2T_1) = \rho(T_2)$ if T_1 is invertible

(4) If T_1, T_2 are invertible then T_2T_1 is also invertible

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

(1) $\left(\dfrac{2}{3}, \dfrac{1}{3}, 0\right)$ (2) $\left(\dfrac{2}{3}, \dfrac{2}{3}, 0\right)$ (3) $\left(\dfrac{1}{3}, \dfrac{2}{3}, 0\right)$ (4) $\left(\dfrac{1}{3}, \dfrac{1}{3}, 0\right)$

93. Select the incorrect one out of the following. Dual space is also named as :

(1) Algebraic dual (2) Double Generated

(3) Conjugate (4) Algebraic Conjugate

94. Choose the wrong statement :

(1) Every normed linear space is an inner product space.

(2) Every finite dimensional vector space is an inner product space.

(3) Every inner product space is a metric space.

(4) Every finite dimensional inner product space has an orthogonal basis.

95. Number of real roots of $x^5 - 5x + 2 = 0$ is :

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

96. The order of convergence of Newton-Raphson iteration formula is :

(1) 2 (2) 1.618 (3) 1.5 (4) 1

97. The convergence in Gauss-Seidal method as compared to Jacobi's method for solving the system of three non-homogeneous linear equations in three variables, is faster by :

(1) Three times (2) Two times

(3) n times (4) Convergence are equal

98. The fourth divided difference of the polynomial $3x^3 + 11x^2 + 5x + 11$ over the points $x = 0, 1, 4, 6$ and 7 is :

(1) 3 (2) 7 (3) 11 (4) 17

99. Which of the following is correct ?

(1) $\nabla = 1 - E$ (2) $\nabla = 1 + E^{-1}$

(3) $\nabla = E^{-1} - 1$ (4) $\nabla = 1 - E^{-1}$

100. For the IVP $y' = -y, y(0) = y_0$ when the second order Runge-Kutta method is applied with step size h, then $y(h) =$

(1) $\frac{y_0}{2}\left(h^2 - 2h + 1\right)$ (2) $\frac{y_0}{2}\left(h^2 - 2h + 2\right)$

(3) $\frac{y_0}{2}\left(h^2 - 2h - 2\right)$ (4) $\frac{y_0}{2}\left(h - \frac{h^2}{2} + \frac{h^3}{6}\right)$

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

CPG-EE-2018 (Mathematics)-(SET-Y)

B

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Sr. No. ....

Time : **1½ Hours** Total Questions : **100** Max. Marks : **100**

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

Candidate's Name ______________________________ Date of Birth ______________

Father's Name ____________________ Mother's Name ____________________

Date of Exam : ____________________

______________________ ______________________

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

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. All questions are ***compulsory*** and carry equal marks. The candidates are required to attempt all questions.
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/misbehaviour 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.
3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing ***within two hours*** after the test is over. No such complaint(s) will be entertained thereafter.
4. 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.
5. ***Use only black or blue ball point pen of good quality in the OMR Answer-Sheet.***
6. There will be ***negative*** marking. Each correct answer will be awarded ***one*** full mark and each incorrect answer will be negatively marked for which the candidate will get ¼ discredit. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.
7. *Before answering the questions, the candidates should ensure that they have been supplied correct & complete question booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. For two given confocal conics, if the tangents drawn (one to each) are perpendicular, then the locus of these tangents is :

(1) an ellipse (2) a hyperbola

(3) a circle (4) a straight line

2. Radius of the sphere $2x^2+2y^2+2z^2-2x+4y+2z+3=0$ is :

(1) 2 (2) 0 (3) 4 (4) 8

3. The condition that the plane $lx+my+nz=0$ may touch the cone $4x^2-y^2+3z^2=0$, is :

(1) $4l^2-12m^2+3n^2=0$ (2) $3l^2-12m^2+4n^2=0$

(3) $3l^2-6m^2+4n^2=0$ (4) $4l^2-6m^2+3n^2=0$

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

(1) $\left(\frac{l}{a},\frac{m}{b},\frac{n}{c}\right)$ (2) $\left(\frac{a}{lp},\frac{b}{mp},\frac{c}{np}\right)$

(3) $\left(\frac{pl}{a},\frac{pm}{b},\frac{pn}{c}\right)$ (4) $\left(\frac{l}{ap},\frac{m}{bp},\frac{n}{cp}\right)$

5. The equation of the plane which cuts the paraboloid $x^2-2y^2-z=0$ in a conic with its centre at the point $\left(2,\frac{3}{2},4\right)$, is :

(1) $4x-6y+z-5=0$ (2) $4x-6y-z+5=0$

(3) $4x+6y+z+5=0$ (4) $4x+6y-z-5=0$

6. The statement "The number of primes is infinite" is known as :

(1) Fundamental theorem of arithmetic (2) Euclid's first theorem

(3) Euclid's second theorem (4) Wilson's theorem

7. When 2^{20} is divided by 7, the remainder is :

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

8. $\phi(450)=$

(1) 90 (2) 100 (3) 110 (4) 120

9. If $\sin(u+iv)=x+iy$, then which of the following is true ?

(1) $\frac{x^2}{\sin^2 u}+\frac{y^2}{\cos^2 u}=1$ (2) $\frac{x^2}{\sin^2 u}-\frac{y^2}{\cos^2 u}=1$

(3) $\frac{x^2}{\cos h^2 v}-\frac{y^2}{\sin h^2 v}=1$ (4) $\frac{x^2}{\cos^2 u}-\frac{y^2}{\sin^2 u}=1$

10. If $\tan^{-1}2x+\tan^{-1}3x=\pi/4$, then $x=0$:

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

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(3) $\frac{y_0}{2}\left(h^2 - 2h - 2\right)$ (4) $\frac{y_0}{2}\left(h - \frac{h^2}{2} + \frac{h^3}{6}\right)$

21. Consider the statements :

(a) Union of two subgroups of a group is also a subgroup of that group.

(b) Intersection of two subgroups of a group is also a subgroup of that group.

Which of the above is true ?

(1) Only (a) (2) Only (b)

(3) Both (a) and (b) (4) Neither (a) nor (b)

22. Choose the wrong statement :

(1) Every field is an integral domain

(2) Every field is a division ring

(3) Every division ring is a field

(4) Every finite non-zero integral domain is a field

23. If S and T are co-maximal ideals of a commutative ring R with unity then :

(1) $ST = S \cap T$ (2) $ST = S \cup T$ (3) $ST = R$ (4) $S \cap T = R$

24. Choose the incorrect statement :

(1) If R is a UFD, then so is R[x].

(2) If R is an integral domain with unity, then every irreducible element in R[x] is an irreducible polynomial.

(3) If F is a field, then every irreducible polynomial of F[x] is irreducible element of F[x].

(4) Eisenstein's criterion is necessary for the irreducibility of a polynomial.

25. The velocity of a particle moving in a straight line is given by $v^2 = 2x\,e^x$, then its acceleration is :

(1) $\frac{v^2}{2x}(x-1)$ (2) $\frac{v^2}{2}(x+1)$ (3) $\frac{v^2}{2x}(x+1)$ (4) $\frac{v}{2x}(x+1)$

26. Let $P(r,\theta)$ be the position of a moving particle at time t, then its transverse acceleration is :

(1) $\frac{1}{r}\frac{d}{dt}\left(r\frac{d\theta}{dt}\right)$ (2) $\frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right)$ (3) $\frac{1}{r^2}\frac{d}{dt}\left(r\frac{d\theta}{dt}\right)$ (4) $\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right)$

27. A particle is moving with S. H. M. with amplitude a. The distance x from the centre where the velocity is half that of the maximum velocity is given by :

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

28. If the maximum horizontal range of a projectile is R, then the greatest height attained is :

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

29. To a man walking at the rate of 5 km/hr, rain appears to fall vertically. If its real velocity is 10 km/hr, then its real direction to the horizontal is :

(1) $\theta = \pi/6$ (2) $\theta = \pi/2$ (3) $\theta = \pi/4$ (4) $\theta = \pi/3$

30. A particle describes an ellipse under a central orbit, the velocity at any point of its path is :

(1) $v^2 = \lambda\left(\frac{2}{r}-\frac{1}{a}\right)$ (2) $v^2 = \lambda\left(\frac{2}{r}-\frac{1}{2a}\right)$ (3) $v^2 = \lambda\left(\frac{1}{r}-\frac{2}{a}\right)$ (4) $v^2 = \lambda\left(\frac{1}{r}-\frac{1}{a}\right)$

31. $J_{n-1}(x) + J_{n+1}(x) =$

(1) $\frac{n}{x}J_n(x)$ (2) $\frac{n}{x}J_n'\,(x)$ (3) $\frac{x}{2n}J_n(x)$ (4) $\frac{2n}{x}J_n(x)$

32. $P_{n+1}'(x) - xP_n'\,(x) =$

(1) $n\;P_n(x)$ (2) $(n+1)\,P_n(x)$ (3) $(n+1)\,P_{n+1}(x)$ (4) $(2n+1)\,P_n(x)$

33. $H_n'(x) =$

(1) $H_{n+1}(x)$ (2) $n\,H_{n-1}(x), n \geq 1$ (3) $nH_{n+1}(x)$ (4) $2n\,H_{n-1}(x), n \geq 1$

34. $L(t\,e^{-4t}\sin 3t) =$

(1) $\frac{6(s+4)}{(s^2+8s+25)^2}$

(2) $\frac{3(s+4)}{(s^2+8s+25)^2}$

(3) $\frac{6(s+4)}{(s^2+6s+25)^2}$

(4) $\frac{3(s+4)}{(s^2+6s+25)^2}$

35. Fourier transform of $f(x)$ defined by $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases}$ is :

(1) $\frac{2}{s}\cos as$ (2) $\frac{4}{s}\sin as$ (3) $\frac{1}{s}\sin as$ (4) $\frac{2}{s}\sin as$

36. C language is available for which of the operating systems ?

(1) DOS (2) UNIX (3) Windows (4) All of these

37. Which of the following is invalid ?

(1) 'a' (2) 'ab' (3) ' ' (4) " "

38. The continue command cannot be used with :

(1) do (2) for (3) Switch (4) While

39. Which of the following operator has lowest priority ?

(1) || (2) + (3) % (4) ++

40. What should be the expression return value for a do-while to terminate ?

(1) –1 (2) 1 (3) 0 (4) NULL

41. For the function $f(x) = \sin 2x$ in $\left[0, \frac{\pi}{2}\right]$, the Rolle's theorem is applicable, value of 'C' is :

(1) $\pi/3$ (2) $\pi/4$ (3) $\pi/6$ (4) $3\pi/8$

42. $\lim_{(x,y)\to(0,0)} \frac{x^2y}{x^4+y^2} =$

(1) 1/2 (2) 1

(3) 0 (4) limit does not exist

43. If $u = \sin^{-1}\frac{x^2+y^2}{x+y}$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} =$

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

44. $\lim_{x \to 0}\left(\frac{1}{x^2}-\frac{1}{\sin^2 x}\right)=$

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

45. The arc-rate of rotation of the binormal at a point of the curve is known as :

(1) Tangent vector (2) Principal normal

(3) Normal vector (4) Torsion vector

46. If $z = ae^{-b^2 t}\cos bx$, then eliminating the constants a and b, the PDE obtained is :

(1) $\frac{\partial^2 z}{\partial t^2}+\frac{\partial z}{\partial x}=0$ (2) $\frac{\partial^2 z}{\partial x^2}=\frac{\partial^2 z}{\partial t^2}$

(3) $\frac{\partial^2 z}{\partial x^2}+\frac{\partial z}{\partial t}=0$ (4) $\frac{\partial^2 z}{\partial x^2}=\frac{\partial z}{\partial t}$

47. Solution of the equation p + q = z is :

(1) $f(x-y, y+\log z)=0$ (2) $f(x-y, y-\log z)=0$

(3) $f(x+y, y-\log z)=0$ (4) $f(x-y, y-z)=0$

48. The equation $u_{xx}+2u_{yy}+u_{zz}=2u_{xy}+2u_{yz}$ is :

(1) parabolic (2) elliptic (3) hyperbolic (4) None of these

49. A string is stretched between the fixed points (0, 0) and (1, 0) and released at rest from the position u = A sin π x. The subsequent displacement u(x, t) is given by :

(1) $A\cos c\pi t\cos \pi x$ (2) $A\sin(\pi x+ct)$

(3) $A\sin c\pi t\sin \pi x$ (4) $A\cos c\pi t\sin \pi x$

50. Particular integral of $(D^2-D'^2)z=\cos(x+y)$ is :

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

51. Integrating factor of the differential equation $x^2y\,dx-(x^3+y^3)\,dy=0$ is :

(1) $\frac{1}{xy^2}$ (2) $\frac{1}{y^4}$ (3) $\frac{1}{xy^3}$ (4) $\frac{1}{x^4}$

52. Solution of the equation $p=\log(px-y)$ is :

(1) $y=cx-e^c$ (2) $y=cx-\log c$

(3) $y=cx+c^2$ (4) $y=cx+e^c$

53. Orthogonal trajectories of $y^2 = 4ax$ are given by :

(1) $2y^2 + x^2 = c^2$
(2) $2x^2 + y^2 = c^2$
(3) $x^2 + y^2 = c^2$
(4) $2x^2 - y^2 = c^2$

54. For the differential equation $\frac{d^2y}{dx^2} - 4y = e^x + \sin 2x$, the particular Integral (P. I.) is :

(1) $-\frac{1}{3}e^x - \frac{1}{8}\cos 2x$
(2) $\frac{1}{3}e^x - \frac{1}{8}\sin 2x$
(3) $-\frac{1}{3}e^x - \frac{1}{8}\sin 2x$
(4) $\frac{1}{3}e^x + \frac{1}{8}\sin 2x$

55. Solution of $(x-3y-z)\,dx + (2y-3x)\,dy + (z-x)\,dz = 0$ is :

(1) $x^2 + 2y^2 - z^2 + 6xy + 2xz = c$
(2) $x^2 + 2y^2 - z^2 - 6xy + 2xz = c$
(3) $x^2 + 2y^2 + z^2 + 6xy - 2xz = c$
(4) $x^2 + 2y^2 + z^2 - 6xy - 2xz = c$

56. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{b}$ and $\vec{c}$ are non-parallel and $\vec{a} \times (\vec{b} \times \vec{c}) = \frac{1}{2}\vec{b}$, then the angles which $\vec{a}$ makes with $\vec{b}$ and $\vec{c}$ are :

(1) $\pi/2, \pi/3$
(2) $\pi/3, \pi/2$
(3) $\pi/3, \pi/4$
(4) $\pi/2, \pi/4$

57. A particle moves along the curve given by $x = 3t^2, y = t^2 - 2t, z = t^3$. The acceleration at $t = 1$ in the direction of vector $\hat{i} + \hat{j} - \hat{k}$ is :

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

58. The unit normal vector to the surface $x^4 - 3xyz + z^2 + 1 = 0$ at the point (1, 1, 1) is :

(1) $\frac{1}{\sqrt{11}}\left(\hat{i} + 3\hat{j} - \hat{k}\right)$
(2) $\frac{1}{\sqrt{11}}(\hat{i} - 3\hat{j} - \hat{k})$
(3) $\frac{1}{\sqrt{11}}(\hat{i} - 3\hat{j} + \hat{k})$
(4) $\frac{1}{\sqrt{11}}(\hat{i} + 3\hat{j} + \hat{k})$

59. If ϕ is a scalar point function and $\vec{f}$ is a vector point function, then which of the following is true in an orthogonal curvilinear system ?

(1) div $(grad\,\phi) = 0$
(2) curl $(curl\,\vec{f}) = \vec{0}$
(3) curl $(div\,\vec{f}) = \vec{0}$
(4) div $(curl\,\vec{f}) = 0$

60. If S is the surface of the sphere $x^2+y^2+z^2=a^2$, then $\iint_S (xdydz+y\,dz\,dx+zdxdy)=$

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

61. The resultant of two forces P and Q is R. The resolved part of R in the direction of P of magnitude Q. The angle between P and Q is :

(1) $2\cos^{-1}\sqrt{\frac{P}{2Q}}$ (2) $2\sin^{-1}\sqrt{\frac{P}{2Q}}$ (3) $\sin^{-1}\sqrt{\frac{P}{2Q}}$ (4) $\cos^{-1}\sqrt{\frac{P}{2Q}}$

62. Any system of forces acting on a rigid body can be reduced in general to a for acting at an arbitrary chosen point of the body and a :

(1) Screw (2) Wrench (3) Negative force (4) Couple

63. The line of action of a force such that the axis of the couple is coincident with this li is called :

(1) Null line (2) Central axis (3) Wrench (4) Screw

64. If a body is slightly displaced and it remains in equilibrium in any position, then equilibrium is categorized as :

(1) Stable (2) Unstable (3) Neutral (4) Perfect

65. The constant ratio which the limiting friction bears to the normal reaction is called :

(1) Co-efficient of friction (2) Statical friction

(3) Dynamical friction (4) Normal friction

66. The set of all limit points of a set $A \subseteq R$ is called a :

(1) Closure of set A (2) Open cover of set A

(3) Derived set of A (4) Limiting set of A

67. $\lim_{n\to\infty}\left(\frac{2}{1}.\frac{3}{2}.\frac{4}{3}......\frac{n}{n-1}\right)^{1/n}=$

(1) 0 (2) 1/2 (3) 1 (4) 2

68. The series $\sum_{n=3}^{\infty} x^{\log n}$ is :

(1) Convergent (2) Divergent

(3) Convergent if $x<\frac{1}{e}$ (4) Convergent if $x<e$

69. The series $x+\frac{x^2}{\lfloor 2}+\frac{x^3}{\lfloor 3}+.........$

(1) Converges absolutely
(2) Converges conditionally
(3) Does not converge
(4) None of these

70. The infinite product $\prod_{n=1}^{\infty}\left(1+\frac{x}{n}\right), x<0$:

(1) Diverges to zero
(2) Converges to 1
(3) Converges absolutely
(4) Converges to 2

71. It $f(x)=x+1, x\in[1, 3]$ and partition $P=\{1, 2, 3\}$, then $L(f,P)$ and $U(f,P)$ are :

(1) 2, 4
(2) 3, 6
(3) 4, 7
(4) 5, 7

72. Value of the integral $\int_{-1}^{1}([x]-x)\,dx$, $[x]$ being the greatest integer function, is :

(1) –1
(2) 0
(3) 1
(4) 2

73. The integral $\int_0^1 x^n e^{-mx}\,dx$ converges for :

(1) $n<-1$
(2) $n>-1$
(3) $n<-1, m>1$
(4) $n<-2, m<1$

74. $\int_1^{\infty}\frac{\sin x}{x^n}\,dx$ converges absolutely for :

(1) n = 0
(2) n < 1
(3) n = 1
(4) n > 1

75. If A be any subset of a metric space (X, d) and A° denotes the interior of A, then which of the following is not true ?

(1) $(A\cap B)^{\circ}=A^{\circ}\cap B^{\circ}$
(2) $(A\cup B)^{\circ}=A^{\circ}\cup B^{\circ}$
(3) $(A^{\circ}\cup B^{\circ})\subset(A\cup B)^{\circ}$
(4) None of these

76. The concepts of continuity and uniform continuity are equivalent on :

(1) a closed set
(2) an open set
(3) a compact set
(4) a finite set

77. Consider the statements :

(a) Every Cauchy sequence in a metric space is convergent.

(b) A metric space is complete if every cauchy sequence in it has a convergent subsequence.

Which of the above is true ?

(1) Both (a) and (b)
(2) Only (a)
(3) Only (b)
(4) Neither (a) nor (b)

78. Given the statements :

(a) In a group, the order of an element and its inverse are same.

(b) Let (G, .) be a group and $a \in G$ be of order m, then $a^n = e$ if and only if m / n.

Which of the above is true ?

(1) Both (a) and (b)
(2) Only (a)
(3) Only (b)
(4) Neither (a) nor (b)

79. Let $\phi : G \to G'$ be a homomorphism. The homo-morphism ϕ is an isomorphism of G onto G' if and only if :

(1) Ker $\phi = 0$
(2) Ker $\phi = \{e\}$
(3) $\phi(a^{-1}) = [\phi(a)]^{-1}$
(4) $\phi(e) = e'$

80. If $G = \{1, i, -1, -i\}$ is a multiplicative group, then order of $-i$ is :

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

81. If $A = \begin{bmatrix} x & 3 \\ 3 & x \end{bmatrix}$ and $|A^3| = 343$ then x =

(1) ± 2
(2) ± 3
(3) ± 4
(4) ± 7

82. For two non-singular matrices of the same order, the reversal law of multiplication does not hold for :

(1) transpose
(2) adjoint
(3) conjugate
(4) transposed conjugate

83. If α is an eigen value of a non-singular matrix A, then $\dfrac{|A|}{\alpha}$ is an eigen value of :

(1) adj A
(2) A
(3) A^{-1}
(4) None of these

84. If the roots of the equation $x^3 + 3px^2 + 3qx + r = 0$ are in G. P. then :

(1) $p^3 = r^2 q^3$
(2) $p^3 r^2 = q^3$
(3) $p^3 = rq^3$
(4) $p^3 r = q^3$

85. For the equation $x^8 + 5x^3 + 2x - 3 = 0$, the least number of imaginary roots is :

(1) 6 (2) 4 (3) 2 (4) 0

86. $\lim\limits_{x \to 0} \dfrac{\tan x - \sin x}{\sin^3 x} =$

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

87. If a given curve of nth degree has n asymptotes, then the number of points at which these asymptotes cut the curve, is :

(1) n – 1 (2) n (n – 1) (3) n (n – 2) (4) n (n – 3)

88. The radius of curvature for the cardioide $r = a\,(1 + \cos\,\theta)$ is given by $\rho =$

(1) $\dfrac{a}{2} \cos \dfrac{\theta}{2}$ (2) $\dfrac{3a}{4} \cos \dfrac{\theta}{2}$

(3) $\dfrac{2a}{3} \cos \dfrac{\theta}{2}$ (4) $\dfrac{4a}{3} \cos \dfrac{\theta}{2}$

89. The area common to the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ is :

(1) $32\dfrac{a^2}{3}$ (2) $16\dfrac{a^2}{3}$ (3) $8\dfrac{a^2}{3}$ (4) $\dfrac{a^2}{3}$

90. The point of oscul-inflexion is a :

(1) Double cusp with change of species (2) Double cusp of first species

(3) Double cusp of second species (4) Single cusp with change of species

91. If $x^2 + y^2 = v^2 - u^2$ and $xy = -uv$, then $\dfrac{\partial\,(u, v)}{\partial\,(x, y)} =$

(1) $\dfrac{x^2 - y^2}{u^2 - v^2}$ (2) $\dfrac{x^2 + y^2}{u^2 - v^2}$ (3) $\dfrac{x^2 - y^2}{u^2 + v^2}$ (4) $\dfrac{x^2 + y^2}{u^2 + v^2}$

92. $\int_0^{\pi/2} \sin^3 x \cos^{5/2} x \, dx =$

(1) $\dfrac{8}{77}$ (2) $\dfrac{4}{77}$ (3) $\dfrac{3}{44}$ (4) $\dfrac{7}{44}$

93. Value of $\int_0^4 \int_0^{2\sqrt{z}} \int_0^{\sqrt{4z - x^2}} dz\, dx\, dy$ is :

(1) 4π (2) 8π (3) 16π (4) 32π

94. If f and g are piecewise smooth periodic functions with fourier co-efficients c_n and d_n respectively, then the result $\frac{1}{T}\int_{-T/2}^{T/2} f(t)\,\overline{g(t)}\,dt = \sum_{k=-\infty}^{\infty} c_k\,\bar{d}_k,$ is known as :

(1) Conjugate property
(2) Parseval equality
(3) Parseval identity
(4) Dirichlet identity

95. The analytic function whose real part is $e^x(x\cos y - y\sin y)$, is :

(1) $ze^z + c$
(2) $z\sin z + c$
(3) $ze^{-z} + c$
(4) $ze^{z+1} + c$

96. Invariant points of the bilinear transformation $w = \frac{(2+i)z-2}{z+i}$ are :

(1) $\pm i$
(2) $1 \pm 2i$
(3) $2 \pm i$
(4) $1 \pm i$

97. Under the transformation $w + 1 = \frac{4}{z^2}$, the unit circle in the w-plane corresponds to which curve of the z-plane ?

(1) Circle
(2) Parabola
(3) Ellipse
(4) Hyperbola

98. The basis of the sub-space spanned by the vectors $(-3,1,2), (0,1,3), (2,1,0), (1,1,1)$ is :

(1) $\{(1,1,1), (0,1,0), (0,0,1)\}$
(2) $\{(1,1,1), (0,1,3), (0,0,1)\}$
(3) $\{(1,1,1), (0,1,2), (0,0,2)\}$
(4) $\{(1,1,1), (0,2,1), (0,0,1)\}$

99. If W_1 and W_2 are subspaces of V and $\dim W_1 = 4$, $\dim W_2 = 5$, $\dim V = 7$, then the possible values of $\dim(W_1 \cap W_2)$ are :

(1) 2 or 4
(2) 1, 2 or 3
(3) 2, 3 or 4
(4) 5, 6 or 7

100. Let $T : R^3 \to R^3$ be a linear transformation given by $T(x,y,z) = \left(\frac{x}{2}, \frac{y}{2}, 0\right)$. The rank of T is :

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

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CPG-EE-2018 (Mathematics)-(SET-Y)

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Time : **1½ Hours** Total Questions : **100** Max. Marks : **100**

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

Candidate's Name ______________________ Date of Birth ____________

Father's Name ______________________ Mother's Name ____________

Date of Exam : ____________

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

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. All questions are ***compulsory*** and carry equal marks. The candidates are required to attempt all questions.
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/misbehaviour 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.
3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing ***within two hours*** after the test is over. No such complaint(s) will be entertained thereafter.
4. 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.
5. ***Use only black or blue ball point pen of good quality in the OMR Answer-Sheet.***
6. There will be ***negative*** marking. Each correct answer will be awarded ***one*** full mark and each incorrect answer will be negatively marked for which the candidate will get ¼ discredit. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.
7. *Before answering the questions, the candidates should ensure that they have been supplied correct & complete question booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. The resultant of two forces P and Q is R. The resolved part of R in the direction of P is of magnitude Q. The angle between P and Q is :

(1) $2\cos^{-1}\sqrt{\frac{P}{2Q}}$ (2) $2\sin^{-1}\sqrt{\frac{P}{2Q}}$ (3) $\sin^{-1}\sqrt{\frac{P}{2Q}}$ (4) $\cos^{-1}\sqrt{\frac{P}{2Q}}$

2. Any system of forces acting on a rigid body can be reduced in general to a force acting at an arbitrary chosen point of the body and a :

(1) Screw (2) Wrench (3) Negative force (4) Couple

3. The line of action of a force such that the axis of the couple is coincident with this line is called :

(1) Null line (2) Central axis (3) Wrench (4) Screw

4. If a body is slightly displaced and it remains in equilibrium in any position, then the equilibrium is categorized as :

(1) Stable (2) Unstable (3) Neutral (4) Perfect

5. The constant ratio which the limiting friction bears to the normal reaction is called :

(1) Co-efficient of friction (2) Statical friction

(3) Dynamical friction (4) Normal friction

6. The set of all limit points of a set $A \subseteq R$ is called a :

(1) Closure of set A (2) Open cover of set A

(3) Derived set of A (4) Limiting set of A

7. $\lim_{n\to\infty}\left(\frac{2}{1}.\frac{3}{2}.\frac{4}{3}......\frac{n}{n-1}\right)^{1/n} =$

(1) 0 (2) 1/2 (3) 1 (4) 2

8. The series $\sum_{n=3}^{\infty} x^{\log n}$ is :

(1) Convergent (2) Divergent

(3) Convergent if $x < \frac{1}{e}$ (4) Convergent if $x < e$

9. The series $x + \frac{x^2}{\underline{|2}} + \frac{x^3}{\underline{|3}} + ...$

(1) Converges absolutely (2) Converges conditionally

(3) Does not converge (4) None of these

10. The infinite product $\prod_{n=1}^{\infty}\left(1+\frac{x}{n}\right), x<0$:

(1) Diverges to zero (2) Converges to 1

(3) Converges absolutely (4) Converges to 2

11. Integrating factor of the differential equation $x^2y\,dx-(x^3+y^3)\,dy=0$ is :

(1) $\frac{1}{xy^2}$ (2) $\frac{1}{y^4}$ (3) $\frac{1}{xy^3}$ (4) $\frac{1}{x^4}$

12. Solution of the equation $p=\log(px-y)$ is :

(1) $y=cx-e^c$ (2) $y=cx-\log c$

(3) $y=cx+c^2$ (4) $y=cx+e^c$

13. Orthogonal trajectories of $y^2=4ax$ are given by :

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

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

14. For the differential equation $\frac{d^2y}{dx^2}-4y=e^x+\sin 2x$, the particular Integral (P. I.) is :

(1) $-\frac{1}{3}e^x-\frac{1}{8}\cos 2x$ (2) $\frac{1}{3}e^x-\frac{1}{8}\sin 2x$

(3) $-\frac{1}{3}e^x-\frac{1}{8}\sin 2x$ (4) $\frac{1}{3}e^x+\frac{1}{8}\sin 2x$

15. Solution of $(x-3y-z)\,dx+(2y-3x)\,dy+(z-x)\,dz=0$ is :

(1) $x^2+2y^2-z^2+6xy+2xz=c$ (2) $x^2+2y^2-z^2-6xy+2xz=c$

(3) $x^2+2y^2+z^2+6xy-2xz=c$ (4) $x^2+2y^2+z^2-6xy-2xz=c$

16. If $\vec{a},\vec{b},\vec{c}$ are unit vectors such that $\vec{b}$ and $\vec{c}$ are non-parallel and $\vec{a}\times(\vec{b}\times\vec{c})=\frac{1}{2}\vec{b}$, then the angles which $\vec{a}$ makes with $\vec{b}$ and $\vec{c}$ are :

(1) $\pi/2, \pi/3$ (2) $\pi/3, \pi/2$

(3) $\pi/3, \pi/4$ (4) $\pi/2, \pi/4$

17. A particle moves along the curve given by $x=3t^2, y=t^2-2t, z=t^3$. The acceleration at $t=1$ in the direction of vector $\hat{i}+\hat{j}-\hat{k}$ is :

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

18. The unit normal vector to the surface $x^4-3xyz+z^2+1=0$ at the point (1, 1, 1) is :

(1) $\frac{1}{\sqrt{11}}\left(\hat{i}+3\hat{j}-\hat{k}\right)$ (2) $\frac{1}{\sqrt{11}}(\hat{i}-3\hat{j}-\hat{k})$

(3) $\frac{1}{\sqrt{11}}(\hat{i}-3\hat{j}+\hat{k})$ (4) $\frac{1}{\sqrt{11}}(\hat{i}+3\hat{j}+\hat{k})$

19. If ϕ is a scalar point function and $\overrightarrow{f}$ is a vector point function, then which of the following is true in an orthogonal curvilinear system ?

(1) div $(grad\,\phi)=0$ (2) curl $(curl\,\overrightarrow{f})=\overrightarrow{0}$

(3) curl $(div\,\overrightarrow{f})=\overrightarrow{0}$ (4) div $(curl\,\overrightarrow{f})=0$

20. If S is the surface of the sphere $x^2+y^2+z^2=a^2$, then $\iint_S (xdydz+y\,dz\,dx+zdxdy)=$

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

21. If A = $\begin{bmatrix} x & 3 \\ 3 & x \end{bmatrix}$ and $|A^3|=343$ then x =

(1) ± 2 (2) ± 3 (3) ± 4 (4) ± 7

22. For two non-singular matrices of the same order, the reversal law of multiplication does not hold for :

(1) transpose (2) adjoint

(3) conjugate (4) transposed conjugate

23. If α is an eigen value of a non-singular matrix A, then $\frac{|A|}{\alpha}$ is an eigen value of :

(1) adj A (2) A (3) A^{-1} (4) None of these

24. If the roots of the equation $x^3+3px^2+3qx+r=0$ are in G. P. then :

(1) $p^3=r^2q^3$ (2) $p^3r^2=q^3$

(3) $p^3=rq^3$ (4) $p^3r=q^3$

25. For the equation $x^8 + 5x^3 + 2x - 3 = 0$, the least number of imaginary roots is :

(1) 6 (2) 4 (3) 2 (4) 0

26. $\lim\limits_{x \to 0} \dfrac{\tan x - \sin x}{\sin^3 x} =$

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

27. If a given curve of nth degree has n asymptotes, then the number of points at which these asymptotes cut the curve, is :

(1) n – 1 (2) n (n – 1) (3) n (n – 2) (4) n (n – 3)

28. The radius of curvature for the cardioide $r = a\,(1 + \cos\,\theta)$ is given by $\rho =$

(1) $\dfrac{a}{2}\cos\dfrac{\theta}{2}$ (2) $\dfrac{3a}{4}\cos\dfrac{\theta}{2}$

(3) $\dfrac{2a}{3}\cos\dfrac{\theta}{2}$ (4) $\dfrac{4a}{3}\cos\dfrac{\theta}{2}$

29. The area common to the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ is :

(1) $32\dfrac{a^2}{3}$ (2) $16\dfrac{a^2}{3}$ (3) $8\dfrac{a^2}{3}$ (4) $\dfrac{a^2}{3}$

30. The point of oscul-inflexion is a :

(1) Double cusp with change of species (2) Double cusp of first species

(3) Double cusp of second species (4) Single cusp with change of species

31. Let $T_1 : U \to V$ and $T_2 : V \to W$ be two linear transformations, then which of the following is incorrect ?

(1) $\rho(T_2T_1) = \rho(T_2)$ if T_1 is singular

(2) $\rho(T_2T_1) \le \rho(T_2)$

(3) $\rho(T_2T_1) = \rho(T_2)$ if T_1 is invertible

(4) If T_1, T_2 are invertible then T_2T_1 is also invertible

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

(1) $\left(\dfrac{2}{3}, \dfrac{1}{3}, 0\right)$ (2) $\left(\dfrac{2}{3}, \dfrac{2}{3}, 0\right)$ (3) $\left(\dfrac{1}{3}, \dfrac{2}{3}, 0\right)$ (4) $\left(\dfrac{1}{3}, \dfrac{1}{3}, 0\right)$

33. Select the incorrect one out of the following. Dual space is also named as :

(1) Algebraic dual (2) Double Generated

(3) Conjugate (4) Algebraic Conjugate

34. Choose the wrong statement :

(1) Every normed linear space is an inner product space.

(2) Every finite dimensional vector space is an inner product space.

(3) Every inner product space is a metric space.

(4) Every finite dimensional inner product space has an orthogonal basis.

35. Number of real roots of $x^5 - 5x + 2 = 0$ is :

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

36. The order of convergence of Newton-Raphson iteration formula is :

(1) 2 (2) 1.618 (3) 1.5 (4) 1

37. The convergence in Gauss-Seidal method as compared to Jacobi's method for solving the system of three non-homogeneous linear equations in three variables, is faster by :

(1) Three times (2) Two times

(3) n times (4) Convergence are equal

38. The fourth divided difference of the polynomial $3x^3 + 11x^2 + 5x + 11$ over the points $x = 0, 1, 4, 6$ and 7 is :

(1) 3 (2) 7 (3) 11 (4) 17

39. Which of the following is correct ?

(1) $\nabla = 1 - E$ (2) $\nabla = 1 + E^{-1}$

(3) $\nabla = E^{-1} - 1$ (4) $\nabla = 1 - E^{-1}$

40. For the IVP $y' = -y, y(0) = y_0$ when the second order Runge-Kutta method is applied with step size h, then $y(h) =$

(1) $\frac{y_0}{2}\left(h^2 - 2h + 1\right)$ (2) $\frac{y_0}{2}\left(h^2 - 2h + 2\right)$

(3) $\frac{y_0}{2}\left(h^2 - 2h - 2\right)$ (4) $\frac{y_0}{2}\left(h - \frac{h^2}{2} + \frac{h^3}{6}\right)$

41. It $f(x) = x + 1, x \in [1, 3]$ and partition $P = \{1, 2, 3\}$, then $L(f, P)$ and $U(f, P)$ are :

(1) 2, 4 (2) 3, 6 (3) 4, 7 (4) 5, 7

42. Value of the integral $\int_{-1}^{1} ([x] - x)\, dx$, $[x]$ being the greatest integer function, is :

(1) –1 (2) 0 (3) 1 (4) 2

43. The integral $\int_0^1 x^n e^{-mx} dx$ converges for :

(1) $n < -1$ (2) $n > -1$ (3) $n < -1, m > 1$ (4) $n < -2, m < 1$

44. $\int_1^{\infty} \frac{\sin x}{x^n} dx$ converges absolutely for :

(1) n = 0 (2) n < 1 (3) n = 1 (4) n > 1 .

45. If A be any subset of a metric space (X, d) and A° denotes the interior of A, then which of the following is not true ?

(1) $(A \cap B)^\circ = A^\circ \cap B^\circ$ (2) $(A \cup B)^\circ = A^\circ \cup B^\circ$

(3) $(A^\circ \cup B^\circ) \subset (A \cup B)^\circ$ (4) None of these

46. The concepts of continuity and uniform continuity are equivalent on :

(1) a closed set (2) an open set

(3) a compact set (4) a finite set

47. Consider the statements :

(a) Every Cauchy sequence in a metric space is convergent.

(b) A metric space is complete if every cauchy sequence in it has a convergent subsequence.

Which of the above is true ?

(1) Both (a) and (b) (2) Only (a)

(3) Only (b) (4) Neither (a) nor (b)

48. Given the statements :

(a) In a group, the order of an element and its inverse are same.

(b) Let (G, .) be a group and $a \in G$ be of order m, then $a^n = e$ if and only if m / n.

Which of the above is true ?

(1) Both (a) and (b) (2) Only (a)

(3) Only (b) (4) Neither (a) nor (b)

49. Let $\phi : G \to G'$ be a homomorphism. The homo-morphism ϕ is an isomorphism of G onto G' if and only if :

(1) Ker $\phi = 0$ (2) Ker $\phi = \{e\}$ (3) $\phi(a^{-1}) = [\phi(a)]^{-1}$ (4) $\phi(e) = e'$

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50. If $G = \{1, i, -1, -i\}$ is a multiplicative group, then order of $-i$ is :

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

51. For the function $f(x) = \sin 2x$ in $\left[0, \frac{\pi}{2}\right]$, the Rolle's theorem is applicable, value of 'C' is :

(1) $\pi/3$ (2) $\pi/4$ (3) $\pi/6$ (4) $3\pi/8$

52. $\lim\limits_{(x,y)\to(0,0)} \frac{x^2 y}{x^4 + y^2} =$

(1) $1/2$ (2) 1

(3) 0 (4) limit does not exist

53. If $u = \sin^{-1} \frac{x^2 + y^2}{x + y}$, then $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} =$

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

54. $\lim\limits_{x \to 0} \left(\frac{1}{x^2} - \frac{1}{\sin^2 x} \right) =$

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

55. The arc-rate of rotation of the binormal at a point of the curve is known as :

(1) Tangent vector (2) Principal normal

(3) Normal vector (4) Torsion vector

56. If $z = ae^{-b^2 t} \cos bx$, then eliminating the constants *a* and *b*, the PDE obtained is :

(1) $\frac{\partial^2 z}{\partial t^2} + \frac{\partial z}{\partial x} = 0$ (2) $\frac{\partial^2 z}{\partial x^2} = \frac{\partial^2 z}{\partial t^2}$ (3) $\frac{\partial^2 z}{\partial x^2} + \frac{\partial z}{\partial t} = 0$ (4) $\frac{\partial^2 z}{\partial x^2} = \frac{\partial z}{\partial t}$

57. Solution of the equation p + q = z is :

(1) $f(x-y, y+\log z) = 0$ (2) $f(x-y, y-\log z) = 0$

(3) $f(x+y, y-\log z) = 0$ (4) $f(x-y, y-z) = 0$

58. The equation $u_{xx} + 2u_{yy} + u_{zz} = 2u_{xy} + 2u_{yz}$ is :

(1) parabolic (2) elliptic

(3) hyperbolic (4) None of these

59. A string is stretched between the fixed points (0, 0) and (1, 0) and released at rest from the position u = A sin π x. The subsequent displacement u(x, t) is given by :

(1) $A \cos c\pi t \cos \pi x$ (2) $A \sin(\pi x + ct)$

(3) $A \sin c\, \pi t \sin \pi x$ (4) $A \cos c\, \pi t \sin \pi x$

60. Particular integral of $(D^2 - D'^2)z = \cos(x+y)$ is :

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

61. Consider the statements :

(a) Union of two subgroups of a group is also a subgroup of that group.

(b) Intersection of two subgroups of a group is also a subgroup of that group.

Which of the above is true ?

(1) Only (a) (2) Only (b)

(3) Both (a) and (b) (4) Neither (a) nor (b)

62. Choose the wrong statement :

(1) Every field is an integral domain

(2) Every field is a division ring

(3) Every division ring is a field

(4) Every finite non-zero integral domain is a field

63. If S and T are co-maximal ideals of a commutative ring R with unity then :

(1) $ST = S \cap T$ (2) $ST = S \cup T$ (3) $ST = R$ (4) $S \cap T = R$

64. Choose the incorrect statement :

(1) If R is a UFD, then so is R[x].

(2) If R is an integral domain with unity, then every irreducible element in R[x] is an irreducible polynomial.

(3) If F is a field, then every irreducible polynomial of F[x] is irreducible element of F[x].

(4) Eisenstein's criterion is necessary for the irreducibility of a polynomial.

65. The velocity of a particle moving in a straight line is given by $v^2 = 2x\,e^x$, then its acceleration is :

(1) $\frac{v^2}{2x}(x-1)$ (2) $\frac{v^2}{2}(x+1)$ (3) $\frac{v^2}{2x}(x+1)$ (4) $\frac{v}{2x}(x+1)$

66. Let $P(r, \theta)$ be the position of a moving particle at time t, then its transverse acceleration is :

(1) $\frac{1}{r}\frac{d}{dt}\left(r\frac{d\theta}{dt}\right)$ (2) $\frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right)$ (3) $\frac{1}{r^2}\frac{d}{dt}\left(r\frac{d\theta}{dt}\right)$ (4) $\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right)$

67. A particle is moving with S. H. M. with amplitude a. The distance x from the centre where the velocity is half that of the maximum velocity is given by :

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

68. If the maximum horizontal range of a projectile is R, then the greatest height attained is :

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

69. To a man walking at the rate of 5 km/hr, rain appears to fall vertically. If its real velocity is 10 km/hr, then its real direction to the horizontal is :

(1) $\theta = \pi/6$ (2) $\theta = \pi/2$ (3) $\theta = \pi/4$ (4) $\theta = \pi/3$

70. A particle describes an ellipse under a central orbit, the velocity at any point of its path is :

(1) $v^2 = \lambda\left(\frac{2}{r} - \frac{1}{a}\right)$ (2) $v^2 = \lambda\left(\frac{2}{r} - \frac{1}{2a}\right)$ (3) $v^2 = \lambda\left(\frac{1}{r} - \frac{2}{a}\right)$ (4) $v^2 = \lambda\left(\frac{1}{r} - \frac{1}{a}\right)$

71. If $x^2 + y^2 = v^2 - u^2$ and $xy = -uv$, then $\frac{\partial(u, v)}{\partial(x, y)} =$

(1) $\frac{x^2 - y^2}{u^2 - v^2}$ (2) $\frac{x^2 + y^2}{u^2 - v^2}$ (3) $\frac{x^2 - y^2}{u^2 + v^2}$ (4) $\frac{x^2 + y^2}{u^2 + v^2}$

72. $\int_0^{\pi/2} \sin^3 x \cos^{5/2} x\, dx =$

(1) $\frac{8}{77}$ (2) $\frac{4}{77}$ (3) $\frac{3}{44}$ (4) $\frac{7}{44}$

73. Value of $\int_0^4 \int_0^{2\sqrt{z}} \int_0^{\sqrt{4z - x^2}} dz\, dx\, dy$ is :

(1) 4π (2) 8π (3) 16π (4) 32π

74. If f and g are piecewise smooth periodic functions with fourier co-efficients c_n and d_n respectively, then the result $\frac{1}{T}\int_{-T/2}^{T/2} f(t)\,\overline{g(t)}\,dt = \sum_{k=-\infty}^{\infty} c_k\,\bar{d}_k$, is known as :

(1) Conjugate property
(2) Parseval equality
(3) Parseval identity
(4) Dirichlet identity

75. The analytic function whose real part is $e^x\,(x\cos y - y\sin y)$, is :

(1) $ze^z + c$
(2) $z\sin z + c$
(3) $ze^{-z} + c$
(4) $ze^{z+1} + c$

76. Invariant points of the bilinear transformation $w = \frac{(2+i)\,z-2}{z+i}$ are :

(1) $\pm i$
(2) $1 \pm 2i$
(3) $2 \pm i$
(4) $1 \pm i$

77. Under the transformation $w+1=\frac{4}{z^2}$, the unit circle in the w-plane corresponds to which curve of the z-plane ?

(1) Circle
(2) Parabola
(3) Ellipse
(4) Hyperbola

78. The basis of the sub-space spanned by the vectors $(-3, 1, 2), (0, 1, 3), (2, 1, 0), (1, 1, 1)$ is :

(1) $\{(1, 1, 1), (0, 1, 0), (0, 0, 1)\}$
(2) $\{(1, 1, 1), (0, 1, 3), (0, 0, 1)\}$
(3) $\{(1, 1, 1), (0, 1, 2), (0, 0, 2)\}$
(4) $\{(1, 1, 1), (0, 2, 1), (0, 0, 1)\}$

79. If W_1 and W_2 are subspaces of V and dim $W_1 = 4$, dim $W_2 = 5$, dim $V = 7$, then the possible values of dim $(W_1 \cap W_2)$ are :

(1) 2 or 4
(2) 1, 2 or 3
(3) 2, 3 or 4
(4) 5, 6 or 7

80. Let $T : R^3 \to R^3$ be a linear transformation given by $T(x, y, z) = \left(\frac{x}{2}, \frac{y}{2}, 0\right)$. The rank of T is :

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

81. For two given confocal conics, if the tangents drawn (one to each) are perpendicular, then the locus of these tangents is :

(1) an ellipse
(2) a hyperbola
(3) a circle
(4) a straight line

82. Radius of the sphere $2x^2 + 2y^2 + 2z^2 - 2x + 4y + 2z + 3 = 0$ is :

(1) 2
(2) 0
(3) 4
(4) 8

83. The condition that the plane $lx+my+nz=0$ may touch the cone $4x^2-y^2+3z^2=0$, is :

(1) $4l^2-12m^2+3n^2=0$ (2) $3l^2-12m^2+4n^2=0$

(3) $3l^2-6m^2+4n^2=0$ (4) $4l^2-6m^2+3n^2=0$

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

(1) $\left(\frac{l}{a},\frac{m}{b},\frac{n}{c}\right)$ (2) $\left(\frac{a}{lp},\frac{b}{mp},\frac{c}{np}\right)$

(3) $\left(\frac{pl}{a},\frac{pm}{b},\frac{pn}{c}\right)$ (4) $\left(\frac{l}{ap},\frac{m}{bp},\frac{n}{cp}\right)$

85. The equation of the plane which cuts the paraboloid $x^2-2y^2-z=0$ in a conic with its centre at the point $\left(2,\frac{3}{2},4\right)$, is :

(1) $4x-6y+z-5=0$ (2) $4x-6y-z+5=0$

(3) $4x+6y+z+5=0$ (4) $4x+6y-z-5=0$

86. The statement "The number of primes is infinite" is known as :

(1) Fundamental theorem of arithmetic (2) Euclid's first theorem

(3) Euclid's second theorem (4) Wilson's theorem

87. When 2^{20} is divided by 7, the remainder is :

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

88. $\phi(450)=$

(1) 90 (2) 100 (3) 110 (4) 120

89. If $\sin(u+iv)=x+iy$, then which of the following is true ?

(1) $\frac{x^2}{\sin^2 u}+\frac{y^2}{\cos^2 u}=1$ (2) $\frac{x^2}{\sin^2 u}-\frac{y^2}{\cos^2 u}=1$

(3) $\frac{x^2}{\cos h^2 v}-\frac{y^2}{\sin h^2 v}=1$ (4) $\frac{x^2}{\cos^2 u}-\frac{y^2}{\sin^2 u}=1$

90. If $\tan^{-1}2x+\tan^{-1}3x=\pi/4$, then $x=0$:

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

91. $J_{n-1}(x) + J_{n+1}(x) =$

(1) $\frac{n}{x} J_n(x)$ (2) $\frac{n}{x} J'_n(x)$ (3) $\frac{x}{2n} J_n(x)$ (4) $\frac{2n}{x} J_n(x)$

92. $P'_{n+1}(x) - xP'_n(x) =$

(1) $n\, P_n(x)$ (2) $(n+1)\, P_n(x)$ (3) $(n+1)\, P_{n+1}(x)$ (4) $(2n+1)\, P_n(x)$

93. $H'_n(x) =$

(1) $H_{n+1}(x)$ (2) $n\, H_{n-1}(x), n \geq 1$ (3) $nH_{n+1}(x)$ (4) $2n\, H_{n-1}(x), n \geq 1$

94. $L\,(t\, e^{-4t} \sin 3t) =$

(1) $\frac{6\,(s+4)}{(s^2+8s+25)^2}$ (2) $\frac{3\,(s+4)}{(s^2+8s+25)^2}$

(3) $\frac{6\,(s+4)}{(s^2+6s+25)^2}$ (4) $\frac{3\,(s+4)}{(s^2+6s+25)^2}$

95. Fourier transform of $f(x)$ defined by $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases}$ is :

(1) $\frac{2}{s} \cos as$ (2) $\frac{4}{s} \sin as$ (3) $\frac{1}{s} \sin as$ (4) $\frac{2}{s} \sin as$

96. C language is available for which of the operating systems ?

(1) DOS (2) UNIX (3) Windows (4) All of these

97. Which of the following is invalid ?

(1) 'a' (2) 'ab' (3) ' ' (4) " "

98. The continue command cannot be used with :

(1) do (2) for (3) Switch (4) While

99. Which of the following operator has lowest priority ?

(1) || (2) + (3) % (4) ++

100. What should be the expression return value for a do-while to terminate ?

(1) –1 (2) 1 (3) 0 (4) NULL

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

CPG-EE-2018 (Mathematics)-(SET-Y)

D

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Time : **1½ Hours** Total Questions : **100** Max. Marks : **100**

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

Candidate's Name ________________________________ Date of Birth ______________

Father's Name ______________________ Mother's Name ______________________

Date of Exam : ______________________

______________________ ______________________

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

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. All questions are ***compulsory*** and carry equal marks. The candidates are required to attempt all questions.
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/misbehaviour 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.
3. In case there is any discrepancy in any question(s) in the Question Booklet, the same may be brought to the notice of the Controller of Examinations in writing ***within two hours*** after the test is over. No such complaint(s) will be entertained thereafter.
4. 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.
5. ***Use only black or blue ball point pen of good quality in the OMR Answer-Sheet.***
6. There will be ***negative*** marking. Each correct answer will be awarded ***one*** full mark and each incorrect answer will be negatively marked for which the candidate will get ¼ discredit. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.
7. *Before answering the questions, the candidates should ensure that they have been supplied correct & complete question booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

SEAL

1. Consider the statements :

   (a) Union of two subgroups of a group is also a subgroup of that group.

   (b) Intersection of two subgroups of a group is also a subgroup of that group.

   Which of the above is true ?

   (1) Only (a) (2) Only (b)

   (3) Both (a) and (b) (4) Neither (a) nor (b)

2. Choose the wrong statement :

   (1) Every field is an integral domain

   (2) Every field is a division ring

   (3) Every division ring is a field

   (4) Every finite non-zero integral domain is a field

3. If S and T are co-maximal ideals of a commutative ring R with unity then :

   (1) $ST = S \cap T$ (2) $ST = S \cup T$

   (3) $ST = R$ (4) $S \cap T = R$

4. Choose the incorrect statement :

   (1) If R is a UFD, then so is R[x].

   (2) If R is an integral domain with unity, then every irreducible element in R[x] is an irreducible polynomial.

   (3) If F is a field, then every irreducible polynomial of F[x] is irreducible element of F[x].

   (4) Eisenstein's criterion is necessary for the irreducibility of a polynomial.

5. The velocity of a particle moving in a straight line is given by $v^2 = 2x\,e^x$, then its acceleration is :

   (1) $\dfrac{v^2}{2x}(x-1)$ (2) $\dfrac{v^2}{2}(x+1)$ (3) $\dfrac{v^2}{2x}(x+1)$ (4) $\dfrac{v}{2x}(x+1)$

6. Let $P(r, \theta)$ be the position of a moving particle at time t, then its transverse acceleration is :

   (1) $\dfrac{1}{r}\dfrac{d}{dt}\left(r\dfrac{d\theta}{dt}\right)$ (2) $\dfrac{1}{r}\dfrac{d}{dt}\left(r^2\dfrac{d\theta}{dt}\right)$

   (3) $\dfrac{1}{r^2}\dfrac{d}{dt}\left(r\dfrac{d\theta}{dt}\right)$ (4) $\dfrac{d}{dt}\left(r^2\dfrac{d\theta}{dt}\right)$

7. A particle is moving with S. H. M. with amplitude a. The distance x from the centre where the velocity is half that of the maximum velocity is given by :

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

8. If the maximum horizontal range of a projectile is R, then the greatest height attained is :

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

9. To a man walking at the rate of 5 km/hr, rain appears to fall vertically. If its real velocity is 10 km/hr, then its real direction to the horizontal is :

(1) $\theta = \pi/6$ (2) $\theta = \pi/2$ (3) $\theta = \pi/4$ (4) $\theta = \pi/3$

10. A particle describes an ellipse under a central orbit, the velocity at any point of its path is :

(1) $v^2 = \lambda\left(\frac{2}{r} - \frac{1}{a}\right)$ (2) $v^2 = \lambda\left(\frac{2}{r} - \frac{1}{2a}\right)$ (3) $v^2 = \lambda\left(\frac{1}{r} - \frac{2}{a}\right)$ (4) $v^2 = \lambda\left(\frac{1}{r} - \frac{1}{a}\right)$

11. $J_{n-1}(x) + J_{n+1}(x) =$

(1) $\frac{n}{x} J_n(x)$ (2) $\frac{n}{x} J_n'(x)$ (3) $\frac{x}{2n} J_n(x)$ (4) $\frac{2n}{x} J_n(x)$

12. $P_{n+1}'(x) - xP_n'(x) =$

(1) $n\, P_n(x)$ (2) $(n+1)\, P_n(x)$ (3) $(n+1)\, P_{n+1}(x)$ (4) $(2n+1)\, P_n(x)$

13. $H_n'(x) =$

(1) $H_{n+1}(x)$ (2) $n\, H_{n-1}(x), n \geq 1$ (3) $nH_{n+1}(x)$ (4) $2n\, H_{n-1}(x), n \geq 1$

14. $L\,(t\, e^{-4t} \sin 3t) =$

(1) $\frac{6\,(s+4)}{(s^2+8s+25)^2}$ (2) $\frac{3\,(s+4)}{(s^2+8s+25)^2}$

(3) $\frac{6\,(s+4)}{(s^2+6s+25)^2}$ (4) $\frac{3\,(s+4)}{(s^2+6s+25)^2}$

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16. C language is available for which of the operating systems ?

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17. Which of the following is invalid ?

(1) 'a' (2) 'ab' (3) ' ' (4) " "

18. The continue command cannot be used with :

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19. Which of the following operator has lowest priority ?

(1) || (2) + (3) % (4) ++

20. What should be the expression return value for a do-while to terminate ?

(1) –1 (2) 1 (3) 0 (4) NULL

21. For the function $f(x) = \sin 2x$ in $\left[0, \frac{\pi}{2}\right]$, the Rolle's theorem is applicable, value of 'C' is :

(1) $\pi/3$ (2) $\pi/4$ (3) $\pi/6$ (4) $3\pi/8$

22. $\lim\limits_{(x, y) \to (0, 0)} \frac{x^2 y}{x^4 + y^2} =$

(1) $1/2$

(2) 1

(3) 0

(4) limit does not exist

23. If $u = \sin^{-1} \frac{x^2 + y^2}{x + y}$, then $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} =$

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

24. $\lim\limits_{x \to 0} \left(\frac{1}{x^2} - \frac{1}{\sin^2 x} \right) =$

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

25. The arc-rate of rotation of the binormal at a point of the curve is known as :

(1) Tangent vector

(2) Principal normal

(3) Normal vector

(4) Torsion vector

26. If $z = ae^{-b^2 t}\cos bx$, then eliminating the constants a and b, the PDE obtained is :

(1) $\frac{\partial^2 z}{\partial t^2}+\frac{\partial z}{\partial x}=0$ (2) $\frac{\partial^2 z}{\partial x^2}=\frac{\partial^2 z}{\partial t^2}$ (3) $\frac{\partial^2 z}{\partial x^2}+\frac{\partial z}{\partial t}=0$ (4) $\frac{\partial^2 z}{\partial x^2}=\frac{\partial z}{\partial t}$

27. Solution of the equation p + q = z is :

(1) $f(x-y, y+\log z)=0$ (2) $f(x-y, y-\log z)=0$

(3) $f(x+y, y-\log z)=0$ (4) $f(x-y, y-z)=0$

28. The equation $u_{xx}+2u_{yy}+u_{zz}=2u_{xy}+2u_{yz}$ is :

(1) parabolic (2) elliptic (3) hyperbolic (4) None of these

29. A string is stretched between the fixed points (0, 0) and (1, 0) and released at rest from the position u = A sin π x. The subsequent displacement u(x, t) is given by :

(1) A cos c πt cos πx (2) $A\sin(\pi x + ct)$

(3) $A\sin c\,\pi t\sin\pi x$ (4) $A\cos c\,\pi t\sin\pi x$

30. Particular integral of $(D^2 - D'^2)z = \cos(x+y)$ is :

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

31. For two given confocal conics, if the tangents drawn (one to each) are perpendicular, then the locus of these tangents is :

(1) an ellipse (2) a hyperbola

(3) a circle (4) a straight line

32. Radius of the sphere $2x^2+2y^2+2z^2-2x+4y+2z+3=0$ is :

(1) 2 (2) 0 (3) 4 (4) 8

33. The condition that the plane $lx+my+nz=0$ may touch the cone $4x^2-y^2+3z^2=0$, is :

(1) $4l^2-12m^2+3n^2=0$ (2) $3l^2-12m^2+4n^2=0$

(3) $3l^2-6m^2+4n^2=0$ (4) $4l^2-6m^2+3n^2=0$

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

(1) $\left(\frac{l}{a},\frac{m}{b},\frac{n}{c}\right)$ (2) $\left(\frac{a}{lp},\frac{b}{mp},\frac{c}{np}\right)$

(3) $\left(\frac{pl}{a},\frac{pm}{b},\frac{pn}{c}\right)$ (4) $\left(\frac{l}{ap},\frac{m}{bp},\frac{n}{cp}\right)$

35. The equation of the plane which cuts the paraboloid $x^2 - 2y^2 - z = 0$ in a conic with its centre at the point $\left(2, \frac{3}{2}, 4\right)$, is :

(1) $4x - 6y + z - 5 = 0$
(2) $4x - 6y - z + 5 = 0$
(3) $4x + 6y + z + 5 = 0$
(4) $4x + 6y - z - 5 = 0$

36. The statement "The number of primes is infinite" is known as :

(1) Fundamental theorem of arithmetic
(2) Euclid's first theorem
(3) Euclid's second theorem
(4) Wilson's theorem

37. When 2^{20} is divided by 7, the remainder is :

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

38. $\phi(450) =$

(1) 90
(2) 100
(3) 110
(4) 120

39. If $\sin(u + iv) = x + iy$, then which of the following is true ?

(1) $\frac{x^2}{\sin^2 u} + \frac{y^2}{\cos^2 u} = 1$
(2) $\frac{x^2}{\sin^2 u} - \frac{y^2}{\cos^2 u} = 1$
(3) $\frac{x^2}{\cos h^2 v} - \frac{y^2}{\sin h^2 v} = 1$
(4) $\frac{x^2}{\cos^2 u} - \frac{y^2}{\sin^2 u} = 1$

40. If $\tan^{-1} 2x + \tan^{-1} 3x = \pi / 4$, then $x = 0$:

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

41. Let $T_1 : U \to V$ and $T_2 : V \to W$ be two linear transformations, then which of the following is incorrect ?

(1) $\rho(T_2T_1) = \rho(T_2)$ if T_1 is singular
(2) $\rho(T_2T_1) \leq \rho(T_2)$
(3) $\rho(T_2T_1) = \rho(T_2)$ if T_1 is invertible
(4) If T_1, T_2 are invertible then T_2T_1 is also invertible

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

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

43. Select the incorrect one out of the following. Dual space is also named as :

(1) Algebraic dual (2) Double Generated

(3) Conjugate (4) Algebraic Conjugate

44. Choose the wrong statement :

(1) Every normed linear space is an inner product space.

(2) Every finite dimensional vector space is an inner product space.

(3) Every inner product space is a metric space.

(4) Every finite dimensional inner product space has an orthogonal basis.

45. Number of real roots of $x^5 - 5x + 2 = 0$ is :

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

46. The order of convergence of Newton-Raphson iteration formula is :

(1) 2 (2) 1.618 (3) 1.5 (4) 1

47. The convergence in Gauss-Seidal method as compared to Jacobi's method for solving the system of three non-homogeneous linear equations in three variables, is faster by :

(1) Three times (2) Two times

(3) n times (4) Convergence are equal

48. The fourth divided difference of the polynomial $3x^3 + 11x^2 + 5x + 11$ over the points $x = 0, 1, 4, 6$ and 7 is :

(1) 3 (2) 7 (3) 11 (4) 17

49. Which of the following is correct ?

(1) $\nabla = 1 - E$ (2) $\nabla = 1 + E^{-1}$

(3) $\nabla = E^{-1} - 1$ (4) $\nabla = 1 - E^{-1}$

50. For the IVP $y' = -y$, $y(0) = y_0$ when the second order Runge-Kutta method is applied with step size h, then $y(h) =$

(1) $\frac{y_0}{2}\left(h^2 - 2h + 1\right)$ (2) $\frac{y_0}{2}\left(h^2 - 2h + 2\right)$

(3) $\frac{y_0}{2}\left(h^2 - 2h - 2\right)$ (4) $\frac{y_0}{2}\left(h - \frac{h^2}{2} + \frac{h^3}{6}\right)$

51. It $f(x) = x + 1$, $x \in [1, 3]$ and partition $P = \{1, 2, 3\}$, then $L(f, P)$ and $U(f, P)$ are :

(1) 2, 4 (2) 3, 6 (3) 4, 7 (4) 5, 7

52. Value of the integral $\int_{-1}^{1}([x]-x)\,dx$, $[x]$ being the greatest integer function, is :

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

53. The integral $\int_{0}^{1} x^{n} e^{-mx}\,dx$ converges for :

(1) $n<-1$ (2) $n>-1$ (3) $n<-1, m>1$ (4) $n<-2, m<1$

54. $\int_{1}^{\infty} \frac{\sin x}{x^{n}}\,dx$ converges absolutely for :

(1) $n=0$ (2) $n<1$ (3) $n=1$ (4) $n>1$

55. If A be any subset of a metric space (X, d) and A° denotes the interior of A, then which of the following is not true ?

(1) $(A\cap B)^{\circ} = A^{\circ}\cap B^{\circ}$
(2) $(A\cup B)^{\circ} = A^{\circ}\cup B^{\circ}$
(3) $(A^{\circ}\cup B^{\circ})\subset(A\cup B)^{\circ}$
(4) None of these

56. The concepts of continuity and uniform continuity are equivalent on :

(1) a closed set
(2) an open set
(3) a compact set
(4) a finite set

57. Consider the statements :

(a) Every Cauchy sequence in a metric space is convergent.

(b) A metric space is complete if every cauchy sequence in it has a convergent subsequence.

Which of the above is true ?

(1) Both (a) and (b)
(2) Only (a)
(3) Only (b)
(4) Neither (a) nor (b)

58. Given the statements :

(a) In a group, the order of an element and its inverse are same.

(b) Let (G, .) be a group and $a\in G$ be of order m, then $a^{n}=e$ if and only if m/n.

Which of the above is true ?

(1) Both (a) and (b)
(2) Only (a)
(3) Only (b)
(4) Neither (a) nor (b)

59. Let $\phi: G \to G'$ be a homomorphism. The homo-morphism ϕ is an isomorphism of G onto G' if and only if :

(1) Ker $\phi = 0$ (2) Ker $\phi = \{e\}$ (3) $\phi(a^{-1}) = [\phi(a)]^{-1}$ (4) $\phi(e) = e'$

60. If $G = \{1, i, -1, -i\}$ is a multiplicative group, then order of $-i$ is :

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

61. If $x^2 + y^2 = v^2 - u^2$ and $xy = -uv$, then $\dfrac{\partial(u, v)}{\partial(x, y)} =$

(1) $\dfrac{x^2 - y^2}{u^2 - v^2}$ (2) $\dfrac{x^2 + y^2}{u^2 - v^2}$

(3) $\dfrac{x^2 - y^2}{u^2 + v^2}$ (4) $\dfrac{x^2 + y^2}{u^2 + v^2}$

62. $\int_0^{\pi/2} \sin^3 x \cos^{5/2} x \, dx =$

(1) $\dfrac{8}{77}$ (2) $\dfrac{4}{77}$ (3) $\dfrac{3}{44}$ (4) $\dfrac{7}{44}$

63. Value of $\int_0^4 \int_0^{2\sqrt{z}} \int_0^{\sqrt{4z - x^2}} dz \, dx \, dy$ is :

(1) 4π (2) 8π (3) 16π (4) 32π

64. If f and g are piecewise smooth periodic functions with fourier co-efficients c_n and d_n respectively, then the result $\dfrac{1}{T}\int_{-T/2}^{T/2} f(t)\,\overline{g(t)}\,dt = \sum_{k=-\infty}^{\infty} c_k \bar{d}_k,$ is known as :

(1) Conjugate property (2) Parseval equality

(3) Parseval identity (4) Dirichlet identity

65. The analytic function whose real part is $e^x (x \cos y - y \sin y)$, is :

(1) $ze^z + c$ (2) $z \sin z + c$ (3) $ze^{-z} + c$ (4) $ze^{z+1} + c$

66. Invariant points of the bilinear transformation w $= \dfrac{(2+i)\,z - 2}{z + i}$ are :

(1) $\pm i$ (2) $1 \pm 2i$ (3) $2 \pm i$ (4) $1 \pm i$

67. Under the transformation $w + 1 = \dfrac{4}{z^2}$, the unit circle in the w-plane corresponds to which curve of the z-plane ?

(1) Circle (2) Parabola (3) Ellipse (4) Hyperbola

68. The basis of the sub-space spanned by the vectors $(-3, 1, 2), (0, 1, 3), (2, 1, 0), (1, 1, 1)$ is :

(1) $\{(1,1,1),(0,1,0),(0,0,1)\}$
(2) $\{(1,1,1),(0,1,3),(0,0,1)\}$
(3) $\{(1,1,1),(0,1,2),(0,0,2)\}$
(4) $\{(1,1,1),(0,2,1),(0,0,1)\}$

69. If W_1 and W_2 are subspaces of V and $\dim W_1 = 4$, $\dim W_2 = 5$, $\dim V = 7$, then the possible values of $\dim(W_1 \cap W_2)$ are :

(1) 2 or 4
(2) 1, 2 or 3
(3) 2, 3 or 4
(4) 5, 6 or 7

70. Let $T : R^3 \to R^3$ be a linear transformation given by $T(x, y, z) = \left(\frac{x}{2}, \frac{y}{2}, 0\right)$. The rank of T is :

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

71. The resultant of two forces P and Q is R. The resolved part of R in the direction of P is of magnitude Q. The angle between P and Q is :

(1) $2\cos^{-1}\sqrt{\frac{P}{2Q}}$
(2) $2\sin^{-1}\sqrt{\frac{P}{2Q}}$
(3) $\sin^{-1}\sqrt{\frac{P}{2Q}}$
(4) $\cos^{-1}\sqrt{\frac{P}{2Q}}$

72. Any system of forces acting on a rigid body can be reduced in general to a force acting at an arbitrary chosen point of the body and a :

(1) Screw
(2) Wrench
(3) Negative force
(4) Couple

73. The line of action of a force such that the axis of the couple is coincident with this line is called :

(1) Null line
(2) Central axis
(3) Wrench
(4) Screw

74. If a body is slightly displaced and it remains in equilibrium in any position, then the equilibrium is categorized as :

(1) Stable
(2) Unstable
(3) Neutral
(4) Perfect

75. The constant ratio which the limiting friction bears to the normal reaction is called :

(1) Co-efficient of friction
(2) Statical friction
(3) Dynamical friction
(4) Normal friction

76. The set of all limit points of a set $A \subseteq R$ is called a :

(1) Closure of set A
(2) Open cover of set A
(3) Derived set of A
(4) Limiting set of A

77. $\lim_{n \to \infty} \left(\frac{2}{1} \cdot \frac{3}{2} \cdot \frac{4}{3} \cdot \ldots \cdot \frac{n}{n-1} \right)^{1/n} =$

(1) 0 (2) 1/2 (3) 1 (4) 2

78. The series $\sum_{n=3}^{\infty} x^{\log n}$ is :

(1) Convergent (2) Divergent

(3) Convergent if $x < \frac{1}{e}$ (4) Convergent if $x < e$

79. The series $x + \frac{x^2}{\lfloor 2} + \frac{x^3}{\lfloor 3} + \ldots\ldots\ldots$

(1) Converges absolutely (2) Converges conditionally

(3) Does not converge (4) None of these

80. The infinite product $\prod_{n=1}^{\infty} \left(1 + \frac{x}{n}\right), x < 0$:

(1) Diverges to zero (2) Converges to 1

(3) Converges absolutely (4) Converges to 2

81. Integrating factor of the differential equation $x^2 y\, dx - (x^3 + y^3)\, dy = 0$ is :

(1) $\frac{1}{xy^2}$ (2) $\frac{1}{y^4}$ (3) $\frac{1}{xy^3}$ (4) $\frac{1}{x^4}$

82. Solution of the equation $p = \log (px - y)$ is :

(1) $y = cx - e^c$ (2) $y = cx - \log c$

(3) $y = cx + c^2$ (4) $y = cx + e^c$

83. Orthogonal trajectories of $y^2 = 4ax$ are given by :

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

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

84. For the differential equation $\frac{d^2y}{dx^2} - 4y = e^x + \sin 2x$, the particular Integral (P. I.) is :

(1) $-\frac{1}{3}e^x - \frac{1}{8}\cos 2x$ (2) $\frac{1}{3}e^x - \frac{1}{8}\sin 2x$

(3) $-\frac{1}{3}e^x - \frac{1}{8}\sin 2x$ (4) $\frac{1}{3}e^x + \frac{1}{8}\sin 2x$

85. Solution of $(x-3y-z)\,dx+(2y-3x)\,dy+(z-x)\,dz=0$ is :

(1) $x^2+2y^2-z^2+6xy+2xz=c$ (2) $x^2+2y^2-z^2-6xy+2xz=c$

(3) $x^2+2y^2+z^2+6xy-2xz=c$ (4) $x^2+2y^2+z^2-6xy-2xz=c$

86. If $\vec{a},\vec{b},\vec{c}$ are unit vectors such that $\vec{b}$ and $\vec{c}$ are non-parallel and $\vec{a}\times(\vec{b}\times\vec{c})=\frac{1}{2}\vec{b}$, then the angles which $\vec{a}$ makes with $\vec{b}$ and $\vec{c}$ are :

(1) $\pi/2, \pi/3$ (2) $\pi/3, \pi/2$

(3) $\pi/3, \pi/4$ (4) $\pi/2, \pi/4$

87. A particle moves along the curve given by $x=3t^2, y=t^2-2t, z=t^3$. The acceleration at $t=1$ in the direction of vector $\hat{i}+\hat{j}-\hat{k}$ is :

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

88. The unit normal vector to the surface $x^4-3xyz+z^2+1=0$ at the point (1, 1, 1) is :

(1) $\frac{1}{\sqrt{11}}\left(\hat{i}+3\hat{j}-\hat{k}\right)$ (2) $\frac{1}{\sqrt{11}}(\hat{i}-3\hat{j}-\hat{k})$

(3) $\frac{1}{\sqrt{11}}(\hat{i}-3\hat{j}+\hat{k})$ (4) $\frac{1}{\sqrt{11}}(\hat{i}+3\hat{j}+\hat{k})$

89. If ϕ is a scalar point function and $\vec{f}$ is a vector point function, then which of the following is true in an orthogonal curvilinear system ?

(1) div $(grad\,\phi)=0$ (2) curl $(curl\,\vec{f})=\vec{0}$

(3) curl $(div\,\vec{f})=\vec{0}$ (4) div $(curl\,\vec{f})=0$

90. If S is the surface of the sphere $x^2+y^2+z^2=a^2$, then $\iint_S (xdydz+y\,dz\,dx+zdxdy)=$

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

91. If A = $\begin{bmatrix} x & 3 \\ 3 & x \end{bmatrix}$ and $|A^3|=343$ then x =

(1) ± 2 (2) ± 3 (3) ± 4 (4) ± 7

92. For two non-singular matrices of the same order, the reversal law of multiplication does not hold for :

(1) transpose
(2) adjoint
(3) conjugate
(4) transposed conjugate

93. If α is an eigen value of a non-singular matrix A, then $\frac{|A|}{\alpha}$ is an eigen value of :

(1) adj A
(2) A
(3) A^{-1}
(4) None of these

94. If the roots of the equation $x^3 + 3px^2 + 3qx + r = 0$ are in G. P. then :

(1) $p^3 = r^2 q^3$
(2) $p^3 r^2 = q^3$
(3) $p^3 = rq^3$
(4) $p^3 r = q^3$

95. For the equation $x^8 + 5x^3 + 2x - 3 = 0$, the least number of imaginary roots is :

(1) 6
(2) 4
(3) 2
(4) 0

96. $\lim_{x \to 0} \frac{\tan x - \sin x}{\sin^3 x} =$

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

97. If a given curve of nth degree has n asymptotes, then the number of points at which these asymptotes cut the curve, is :

(1) n − 1
(2) n (n − 1)
(3) n (n − 2)
(4) n (n − 3)

98. The radius of curvature for the cardioide $r = a(1 + \cos\theta)$ is given by $\rho =$

(1) $\frac{a}{2}\cos\frac{\theta}{2}$
(2) $\frac{3a}{4}\cos\frac{\theta}{2}$
(3) $\frac{2a}{3}\cos\frac{\theta}{2}$
(4) $\frac{4a}{3}\cos\frac{\theta}{2}$

99. The area common to the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ is :

(1) $32\frac{a^2}{3}$
(2) $16\frac{a^2}{3}$
(3) $8\frac{a^2}{3}$
(4) $\frac{a^2}{3}$

100. The point of oscul-inflexion is a :

(1) Double cusp with change of species
(2) Double cusp of first species
(3) Double cusp of second species
(4) Single cusp with change of species

ANSWER KEY OF MATHEMATICS GROUP MDU CEE 2018

Q. NO.	A	B	C	D
1	3	3	2	2
2	3	2	4	3
3	1	2	2	1
4	4	4	3	4
5	1	2	1	3
6	4	3	3	2
7	3	1	3	4
8	4	4	3	3
9	2	2	1	4
10	1	1	1	1
11	3	1	2	4
12	2	4	1	2
13	2	2	2	4
14	4	1	3	1
15	2	3	4	4
16	3	1	1	4
17	1	2	4	2
18	4	3	2	3
19	2	4	4	1
20	1	2	3	3
21	2	2	3	2
22	1	3	3	4
23	2	1	1	3
24	3	4	4	1
25	4	3	1	4
26	1	2	4	4
27	4	4	3	2
28	2	3	4	1
29	4	4	2	4
30	3	1	1	3
31	2	4	1	3
32	4	2	4	2
33	3	4	2	2
34	1	1	1	4
35	4	4	3	2
36	4	4	1	3

ANSWER KEY OF MATHEMATICS GROUP MDU CEE 2018

Q. NO.	A	B	C	D
37	2	2	2	1
38	1	3	3	4
39	4	1	4	2
40	3	3	2	1
41	2	2	4	1
42	4	4	1	4
43	2	3	2	2
44	3	1	4	1
45	1	4	2	3
46	3	4	3	1
47	3	2	3	2
48	3	1	1	3
49	1	4	2	4
50	1	3	1	2
51	4	2	2	4
52	2	1	4	1
53	4	2	3	2
54	1	3	1	4
55	4	4	4	2
56	4	1	4	3
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58	3	2	1	1
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60	3	3	3	1
61	4	2	2	3
62	1	4	3	1
63	2	2	1	2
64	4	3	4	3
65	2	1	3	1
66	3	3	2	4
67	3	3	4	4
68	1	3	3	2
69	2	1	4	3
70	1	1	1	4
71	2	4	3	2
72	3	1	1	4

ANSWER KEY OF MATHEMATICS GROUP MDU CEE 2018

Q. NO.	A	B	C	D
73	1	2	2	2
74	4	4	3	3
75	3	2	1	1
76	2	3	4	3
77	4	3	4	3
78	3	1	2	3
79	4	2	3	1
80	1	1	4	1
81	3	3	3	2
82	1	3	2	1
83	2	1	2	2
84	3	4	4	3
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91	1	3	4	3
92	4	1	2	3
93	2	2	4	1
94	1	3	1	4
95	3	1	4	1
96	1	4	4	4
97	2	4	2	3
98	3	2	3	4
99	4	3	1	2
100	2	4	3	1