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A

SET-Z

PG-EE-July, 2024

SUBJECT : Mathematics

Sr. No. 10225

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

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

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SEAL

1. A matrix A such that $A^2 = I$ or $(I + A)(I - A) = 0$ is called :

(1) Idempotent

(2) Nilpotent

(3) Involuntory

(4) None of the above

2. If for a square matrix A of order n, $| A - \lambda I | = a_0\lambda^n + a_1\lambda^{n-1} + \dots\dots\dots + a_n$, then $a_0A^n + a_1A^{n-1} + \dots\dots\dots + a_nI$ is equal to :

(1) 0

(2) I_n

(3) $J_{n \times n}$

(4) I_nA^{-1}

3. If A is an $m \times n$ matrix of rank r_A and B is an $n \times p$ matrix of rank r_B such that $AB = 0$, then which of the following is ***true*** ?

(1) $r_A + r_B = p$

(2) $r_A + r_B \leq n$

(3) $r_A + r_B > n$

(4) $r_A + r_B = n + p$

4. A square matrix A of order n is such that $A'A = I = AA'$, then $| A |$ is equal to :

(1) 1

(2) n

(3) ± 1

(4) $n - 1$

5. The canonical form of a Quadratic Form is $-21y_1^2 - \frac{2}{7}y_2^2$. The rank and the index of this Q. F. are 2 and 0 respectively, then the nature of this Q. F. is :

(1) Positive definite

(2) Negative definite

(3) Semi-positive definite

(4) Semi-negative definite

6. Given the function $f(x)=\begin{cases} x^2 & , \quad x\le c \\ ax+b & , \quad x>c \end{cases}$ is differentiable at $x=c$. The values of a and b are respectively :

(1) $2c, -c^2$
(2) $c^2, 2c$
(3) $c, -c^2$
(4) $-c^2, 2c$

7. If $y=\sqrt{x+\sqrt{x+\sqrt{x+\ldots\ldots \text{ to } \infty}}}$, then $\frac{dy}{dx}$ is equal to :

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

8. The radius of curvature at the vertex of the cycloid $x=a(\theta+\sin\theta)$, $y=a(1-\cos\theta)$ is :

(1) $4a$
(2) $a+\sin\theta$
(3) $2a$
(4) $2a+3$

9. The asymptotes of the curve $(x^2-y^2)(x+2y+1)+x+y+1=0$ are :

(1) $y=\pm x\,;\, x+2y+1=0$
(2) $y=\pm x\,;\, x+y+1=0$
(3) $y=x\,;\, x+2y+1=0\,;\, x+y+1=0$
(4) $y=-x\,;\, x+2y+1=0\,;\, x+y+1=0$

10. The curve $y^2(2a-x)=x^3$ has :

(1) Node
(2) Cusp
(3) Conjugate point
(4) None of these

11. The centre and radius of the sphere $7x^2+7y^2+7z^2-6x-3y-2z=0$ are respectively :

(1) $\left(\frac{6}{7},\frac{3}{7},\frac{2}{7}\right),\frac{1}{4}$

(2) $\left(\frac{3}{7},\frac{3}{14},\frac{2}{7}\right),\frac{1}{2}$

(3) $\left(\frac{3}{7},\frac{3}{14},\frac{1}{7}\right),\frac{1}{2}$

(4) $\left(\frac{6}{7},\frac{3}{7},\frac{2}{7}\right),\frac{1}{2}$

12. The equation of the plane that bisects the line joining the points (1, 2, 3); (3, 4, 5) at right angles is :

(1) $x+y+z=0$

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

(3) $x-y+z=0$

(4) $x+y+z-9=0$

13. The equations of a straight line through the point (3, 1, – 6) and parallel to each of the planes $x+y+2z-4=0$ and $2x-3y+z+5=0$ are :

(1) $\frac{x-3}{7}=\frac{y-1}{3}=\frac{z+6}{-5}$

(2) $\frac{x+4}{3}=\frac{y-1}{3}=\frac{z-6}{5}$

(3) $\frac{x-3}{7}=\frac{y+1}{3}=\frac{z-6}{-5}$

(4) None of the above

14. The equation of the cylinder whose generators are parallel to the line, $\frac{x}{1}=\frac{y}{-2}=\frac{z}{3}$ and whose guiding curve is the ellipse $x^2+2y^2=1, z=0$ is :

(1) $3(x^2+2y^2+z^2)-2xz=0$

(2) $3(x^2+2y^2+z^2)-2xz+8yz-3=0$

(3) $x^2+y^2+z^2-2xz-8yz+3=0$

(4) None of the above

15. The vertex of the cone $4x^2-y^2+2z^2+2xy-3yz+12x-11y+6z+4=0$ is :

(1) (1, 2, 3)

(2) (1, 3, 4)

(3) (–1, –2, –3)

(4) (1, 2, –3)

16. The integrating factor of the differential equation $x(x-1)\frac{dy}{dx}=(x-2)y+x^3(2x-1)$ is :

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

17. The solution of the following differential equation is :

$$\frac{dy}{dx}=\sin(x+y)+\cos(x+y)$$

(1) $ce^x=\tan\left(\frac{x+y}{2}\right)+1$ (2) $ce^x=\tan(x+y)+1$

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

18. Singular solution of the following D. E. is :

$$y^2-2pxy+p^2x^2-(a^2p^2+b^2)=0$$

(1) $a^2x^2+b^2y^2=1$ (2) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

(3) $x^2+y^2=\frac{a^2}{b^2}$ (4) $x^2+y^2=a^2b^2$

19. The P. I. of the following D. E. is :

$$(D^2-5D+6)y=5^x \qquad \left[D\equiv\frac{d}{dx}\right]$$

(1) $5^x\log_e 5$ (2) $\frac{5^x}{2\log_e 5}$ (3) $\frac{5^x}{3\log_e 5}$ (4) $\frac{5^x}{\log_e\left(\frac{5}{e^2}\right).\log_e\left(\frac{5}{e^3}\right)}$

20. Integrating factor of the following D. E. is :

$$\sin^2 x\frac{d^2y}{dx^2}=2y$$

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

21. If $r = a\cos t\, i + a\sin t\, j + tk$, then the value of $\left|\dfrac{d^2r}{dt^2}\right|$ is :

(1) $-a\cos t\, i - a\sin t\, j$
(2) $\sqrt{(a^2\cos^2 t + a^2\sin^2 t) + t}$
(3) $a\cos t + a\sin t$
(4) a

22. If $r = xi + yj + zk$, then grad r is :

(1) $\dfrac{x}{r} + \dfrac{y}{r} + \dfrac{z}{r}$
(2) $\dfrac{1}{r}(xi + yj + zk)$
(3) $xi + yj + zk$
(4) None of the above

23. If c is a regular closed curse in xy-plane, enclosing a region S and $P(x, y)$ and $Q(x, y)$ be two continuously differentiable functions in the region S i.e. inside and on c, then $\iint_S \left(\dfrac{\partial Q}{\partial x} - \dfrac{\partial P}{\partial y}\right) dx\, dy$ is equal to :

(1) $\int_c (P\,dx + Q\,dy)$
(2) $\int_c (Q\,dy - P\,dx)$
(3) $\int_c \dfrac{\partial x}{\partial y}(P + Q)$
(4) $\int_c \dfrac{\partial^2}{\partial y^2}(P\,dx + Q\,dy)$

24. The value of $\int_S (axi + byj + czk).\hat{n}\, ds$ is :

(1) $a + b + c$
(2) $\dfrac{4}{3}(a + b + c)$
(3) $\dfrac{4}{3}\pi(a + c + b)$
(4) $a^2 + b^2 + c^2$

25. If $f(t) = ti - 3j + 2tk$, $g(t) = i - 2j + 2k$ and $h(t) = 3i + tj - k$, then the value of $\int_1^2 f.(g \times h)\, dt$ is :

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

26. If $u = \tan^{-1}\left(\frac{y}{x}\right)$, then $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$ is equal to :

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

(2) $\frac{x}{x^2+y^2}$

(3) 0

(4) $\frac{x}{y}$

27. Which of the following function is not differentiable at $x = 0$?

(1) $x|x|$

(2) $x + |x|$

(3) e^{-x}

(4) x^3

28. If $f(x) = 3x^3 - 5x^2 + 2x$, then the interval for which f satisfies all the conditions of Roll's theorem is :

(1) [0, 1]

(2) [–1, 1]

(3) [–1, 0]

(4) [1, 2]

29. If Lagrange's theorem is true for the function $f(x) = x^3 - 3x - 2$ in the interval [–2, 3], then the value of c where it is true is :

(1) 0

(2) $\sqrt{7/3}$

(3) $\sqrt{\frac{3}{7}}$

(4) 1

30. If the function $f(x) = x(x - 2)$ is continuous in $\left[0, \frac{3}{2}\right]$ and differentiable in $\left(0, \frac{3}{2}\right)$, then the value of '$c$' of the mean value theorem is :

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

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

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

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

31. The pedal equation of the curve $x^2 + y^2 = 2ax$ is :

(1) $r^2 = ap$

(2) $r^2 = \frac{a}{p}$

(3) $r^2 = 2ap$

(4) $r^2 = ap^2$

32. The length of subnormal to parabola $y^2 = 4ax$ is :

(1) $2a$ (2) $4a$

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

33. For the curve $y = a\log\left(\sec\frac{x}{a}\right)$, the chord of curvature parallel to y-axis is equal to :

(1) a (2) $2a$

(3) $3a$ (4) $4a$

34. The radius of curvature of the curve $y = a\sin\psi\cos\psi$ is :

(1) p (2) $3p$

(3) $4p$ (4) $2p$

35. If $u = \tan^{-1}\frac{x^3 + y^3 + x^2y - xy^2}{x^2 - xy + y^2}$, then the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(1) 0

(2) $\sin u$

(3) $\sin 2u$

(4) $\frac{1}{2}\sin 2u$

36. If $x = r\cos\theta$ and $y = r\sin\theta$, then $\frac{\partial(r, \theta)}{\partial(x, y)}$ is :

(1) r
(2) $r\sin\theta$
(3) $\frac{r}{\sin\theta}$
(4) $\frac{1}{r}$

37. If $a > 0$, $b > 0$, then the maximum value of $a\cos\theta + b\sin\theta$ is :

(1) $a+b$
(2) $a-b$
(3) a or b
(4) $\sqrt{a^2+b^2}$

38. Sequence $\left(1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \frac{1}{5}, -\frac{1}{6}, ...\right)$ is :

(1) Monotonic but not bounded
(2) Bounded but not monotonic
(3) Monotonic and bounded
(4) Neither monotonic nor bounded

39. Maxima and Minima value of the set $S = \left\{1 + \frac{(-1)^n}{n}\ ;\ n \in N\right\}$ are :

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

40. Series $\left(\frac{2^2}{1^2} - \frac{2}{1}\right)^{-1} + \left(\frac{3^3}{2^3} - \frac{3}{2}\right)^{-2} + \left(\frac{4^4}{3^4} - \frac{4}{3}\right)^{-3} + ...$ is :

(1) Convergent
(2) Divergent
(3) Oscillatory finitely
(4) Oscillatory infinitely

41. If $y=\tan^{-1}\left(\frac{x}{a}\right)$, then its nth derivative y_n is :

(1) $\frac{(-1)^{n-1}(n-1)!}{a^n}\sin^n\theta\cos n\theta$

(2) $\frac{(-1)^{n-1}(n-1)!}{a^n}\tan^n\theta\cos n\theta$

(3) $\frac{(-1)^{n-1}(n-1)!}{a^n}\sin^n\theta\sin n\theta$

(4) $\frac{(-1)^{n-1}(n-1)!}{a^n}\cos^n\theta\cos n\theta$

where $\theta=\tan^{-1}\left(\frac{a}{x}\right)$.

42. If $u=\phi(x-y, y-z, z-x)$, then $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}$ is equal to :

(1) 0

(2) 1

(3) u

(4) xyz

43. If α is a parameter, then envelop of the family of lines $x\cos\alpha+y\sin\alpha=a$ is :

(1) Parabola

(2) Circle

(3) Ellipse

(4) Hyperbola

44. The evolute of curve $2xy=a^2$ is :

(1) $x^{2/3}+y^{2/3}=a^{2/3}$

(2) $(x+y)^{2/3}+(x-y)^{2/3}=a^{2/3}$

(3) $(x+y)^{2/3}+(x-y)^{2/3}=2a^{2/3}$

(4) $(x+y)^{2/3}-(x-y)^{2/3}=2a^{2/3}$

45. Maximum curvature of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is :

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

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

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

(4) $\frac{b}{2a}$

46. The minimum value of $\sqrt{x^2+y^2}$, under the condition $x^2+xy+y^2=1$ is :

(1) 1

(2) $\sqrt{2}$

(3) $\sqrt{3}$

(4) $\frac{\sqrt{6}}{2}$

47. The sequence $\{x_n\}$ where :

$x_n = \frac{1}{n+1} + \frac{1}{n+2} + \dots\dots\dots + \frac{1}{2n}$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory

(4) None of the above

48. If $x = a(\cos\theta + \theta\sin\theta)$, $y = a(\sin\theta - \theta\sin\theta)$, then the value of $\frac{d^2y}{dx^2}$ at $\theta = \pi$ is :

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

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

(3) $-\frac{1}{a\pi}$

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

49. What is the degree and order of the following differential equation ?

$$\left(\frac{d^3y}{dx^3}\right)^{2/3} - 3\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 4y = 1$$

(1) 3, 3

(2) $2/3$, 3

(3) 3, 2

(4) 2, 3

50. If n is a natural number, then

$$\frac{\sum_{r=1}^{n} r^3}{\sum_{r=1}^{n} r(r+1)}$$ is equal to :

(1) $\frac{3}{2}.\frac{n}{n+1}$

(2) $\frac{3}{2}.\frac{n+1}{n+2}$

(3) $\frac{3}{2}.\frac{n}{n+4}$

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

51. If a and b are any two positive integers with $a > b$ and n is the number of divisions in Euclid's algorithm, and if p is the number of digits in b then :

(1) $n \le p$ (2) $n \ge 7p$

(3) $n \le 5p$ (4) $n > 5p$

52. If $F_n = 2^{2^n} + 1$, then $F_0 F_1$ .... F_{n-1} is equal to :

(1) F_n (2) $F_n + 3$

(3) $F_n - 2$ (4) $F_n + 4$

53. If $n = p_1^{a1}, p_2^{a2}$.........$p_t^{a_t}$ be any positive integer where $p_1, p_2, \ldots\ldots, p_t$ are distinct prime, then Euler's $\phi(n)$ is equal to :

(1) $n\left(1-\frac{1}{p_1}\right)\left(1-\frac{1}{p_2}\right)\ldots\ldots\left(1-\frac{1}{p_t}\right)$

(2) $n.p_1\, p_2 \ldots\ldots p_n$

(3) $n(p_1+1)(p_2+2)\ldots\ldots(p_t+t)$

(4) $n\left(1+\frac{1}{p_1}\right)\left(1+\frac{1}{p_2}\right)\ldots\ldots\left(1+\frac{1}{p_t}\right)$

54. Using Euler method, the general solution of the equation $21x + 13y = 1791$ is :

(1) $x = -t, y = 141 + 12t$ (2) $x = -2t, y = 141 + 13t$

(3) $x = 4t, y = -141 + 13t$ (4) $x = -2t, y = 122 + 13t$

55. A square of side a revolves about a line through a corner and perpendicular to the diagonal through that corner, then the volume and area of the surface of the solid generated are :

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

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

56. If both m and n are positive integers, then $B(m, n)$ is equal to :

(1) $\dfrac{\lfloor m \lfloor n}{\lfloor m+n-1}$ (2) $\dfrac{\lfloor m-1 \lfloor n-1}{\lfloor m+n-1}$ (3) $\dfrac{\lfloor m+1 \lfloor n+1}{\lfloor m+n}$ (4) $\dfrac{\lfloor m+1 \lfloor n+1}{\lfloor m+n-2}$

57. $\int_0^{\pi/2} \sin^n \theta \, d\theta$ is equal to : (where $n > -1$)

(1) $\sqrt{\pi}.\dfrac{\Gamma(n+1)}{\Gamma(n+2)}$

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

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

(4) $\dfrac{\pi}{2}.\dfrac{\Gamma\left(\frac{n+1}{2}\right)}{\Gamma\left(\frac{n+2}{2}\right)}$

58. Area of the curve $r^2 = a^2\cos^2\theta + b^2\sin^2\theta$ is :

(1) $(a+b)\dfrac{\pi}{2}$ (2) $2\pi(a^2+b^2)$ (3) $(a^2+b^2)\dfrac{\pi}{2}$ (4) $4\pi(a^2+b^2)$

59. $\underset{n\to\infty}{Lt} \sum_{r=1}^{n-1} \dfrac{1}{n}\sqrt{\dfrac{n+r}{n-r}} =$

(1) $\pi + 1$

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

(3) $2\pi + 3$

(4) $\dfrac{4}{3}\left(\dfrac{\pi}{2}+1\right)$

60. If $f(t) = e^{-t}t^n$, then its Laplace Transform $F(s)$ is :

(1) $\dfrac{\Gamma(n+1)}{(s+1)^{n+1}}$

(2) $\dfrac{1}{s^2+1}$

(3) $\dfrac{\Gamma(n)}{s^{n+1}}$

(4) $\dfrac{\Gamma(n+1)}{s^2+1}$

61. Let X has a two parameter gamma distribution with parameters λ, k (λ > 0 is the scale parameter and k > 0 is the shape parameter) with density function

$$f_{\lambda,k}(x) = \begin{cases} \dfrac{\lambda^k x^{k-1} e^{-\lambda x}}{\Gamma(k)} & , \ x > 0 \\ 0 & , \ x < 0 \end{cases}$$, then its L.T. $f^*(s)$ is given by :

(1) $\frac{1}{(s+1)^2}$ (2) $\left(\frac{\lambda}{s+\lambda}\right)^k$ (3) $\left(\frac{s+\lambda}{\lambda}\right)^k$ (4) $\left(\frac{\lambda+k}{s+\lambda}\right)^{k-1}$

62. What will be the output of the program :

```
main ( )
{
int a = 1, b = 2, c = 3 ;
printf ("%d", a += (a += 3, 5, a))
}
```

(1) 6 (2) 9 (3) 12 (4) 8

63. Which of the following comment is correct when a macro definition includes arguments ?

(1) The opening parenthesis should immediately follow the macro name.
(2) There should be at least one blank between the macro name and the opening parenthesis.
(3) There should be only one blank between the macro name and the opening parenthesis.
(4) All the above comments are correct.

64. Which one of the following is a loop construct that will always be executed once ?

(1) for (2) while (3) switch (4) do while

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

(1) A pointer to an int and a pointer to a double are of the same size.
(2) A pointer must point to a data item on the heap (free store).
(3) A pointer can be reassigned to point to another data item.
(4) A pointer can point to an array.

66. What does this statement mean ?

$x -= y + 1$;

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

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

(3) $x = x - y - 1$

(4) $x = x + y - 1$

67. Value of $\int \cos^2 x \sin^2 x\, dx$ is :

(1) $\frac{1}{8}\left[x - \frac{\cos 2x}{2}\right]$

(2) $\frac{1}{4}\left[x - \frac{\cos 2x}{2}\right]$

(3) $\frac{1}{8}\left[x - \frac{\sin 2x}{2}\right]$

(4) $\frac{1}{4}\left[x - \frac{\sin 2x}{2}\right]$

68. If $f(x) = x$, $x \in [0, 1]$ and f is R-integrable on $[0, 1]$, then $\int_0^1 x\, dx$ is equal to :

(1) 1

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

(3) 2

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

69. The sum of n terms of a series is $S_n = \frac{n^2 x}{1 + n^4 x^2}$, then for this series which statement is ***true*** ?

(1) Converges uniformly.

(2) Does not converge uniformly.

(3) Converges uniformly only in the interval (0, 1).

(4) Each term is continuous in an interval (a, b).

70. Find the value of c which satisfies the mean value theorem for the given function, $f(x) = x^2 + 2x + 1$ on $[1, 2]$?

(1) $10/2$

(2) $13/2$

(3) $-13/2$

(4) $-7/2$

71. Which of the following is ***not*** a necessary condition for Cauchy's Mean Value Theorem ?

(1) The functions, $f(x)$ and $g(x)$ be continuous in $[a, b]$

(2) The derivative of $g'(x)$ be equal to 0

(3) The functions $f(x)$ and $g(x)$ be derivable in (a, b)

(4) There exists a value $c \in (a, b)$ such that $\frac{f(b)-f(a)}{g(b)-g(a)} = \frac{f'(c)}{g'(c)}$

72. A group (G, $*$) is said to be abelian if ....

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

(2) $x*y=y*x$

(3) $x+y=x$

(4) $x*y=x*y$

73. Which of the following is ***not*** necessarily a property of a group ?

(1) Commutatively

(2) Associativity

(3) Existence of inverse for every element

(4) Existence of identity

74. Let $x = (0, 1)$ be the open unit interval and $C(x, R)$ be the ring of continuous functions from x to R. For any $x \in (0, 1)$, let $l(x) = \{f \in C(x, R) \mid f(x) = 0\}$. Then which of the following ***true*** ?

(1) $l(x)$ is a prime ideal.

(2) $l(x)$ is a maximal ideal.

(3) Every maximal ideal of $C(x, R)$ is equal to $l(x)$ for some $x \in x$.

(4) Only (1) and (2) are true.

75. Let R be a commutative ring with unity. Which of the following is ***true*** ?

(1) If R has finitely many prime ideals, then R is a field.

(2) If R has infinitely many ideals, then R is finite.

(3) If R is a P.I.D., then every subring of R with unity is a P.I.D.

(4) If R is an integral domain which has finitely many ideals, then R is a field.

76. Let $R = Z[X]/(x^2 + 1)$ and $\psi : Z(X) \rightarrow R$ be the natural quotient map. Which of the following statements are ***true*** ?

(1) R is isomorphic to a subring of C.

(2) The ideal generated by $\psi(X)$ is a prime ideal in R.

(3) R has infinitely many prime ideals.

(4) Only (1) and (3) are true.

77. The number of ring homomorphisms from $f : Z[x, y] \longrightarrow \frac{F[X]}{(x^3 + x^2 + x + 1)}$ equals :

(1) 2^6

(2) 2^{18}

(3) 1

(4) 2^9

78. The total number of non-isomorphic groups of order 122 is :

(1) 2

(2) 1

(3) 61

(4) 4

79. Let G be a group order 6 and H be a subgroup of G such that $1 < |H| < 6$. Which one of the following options is ***correct*** ?

(1) G is always cyclic, but H may not be cyclic.

(2) G may not be cyclic, but H is always cyclic.

(3) Both G and H are always cyclic.

(4) Both G and H may not be cyclic.

80. The number of generators of a cyclic group of order 10 is :

(1) 2

(2) 3

(3) 4

(4) 5

A

81. Using Gauss Elimination method, the solution of equations $2x - y + 3z = 9, x + y + z = 6, x - y + z = 2$ is :

(1) $x = -13, y = 1, z = -8$

(2) $x = 13, y = 1, z = -8$

(3) $x = -13, y = 4, z = 15$

(4) $x = 5, y = 14, z = 5$

82. While solving the equation $x^2 - 3x + 1 = 0$ using Newton-Raphson method the initial guess of the root is as 1, then the value of the root will be :

(1) 1.5 (2) 1

(3) 0.5 (4) 0

83. For a fixed $C \in R$, let $\alpha = \int_0^2 (9x^2 - 5Cx^4)\, dx$. If the value of this integral obtained by using the Trapezoidal rule is equal to α, then the value of C (rounded off 2 decimal places) is :

(1) 0.5 (2) 0.24

(3) 0.12 (4) 0.76

84. If $f(x) = x^2$, then the second order divided difference for the points x_0, x_1, x_2 will be :

(1) -1 (2) $\frac{-1}{x_1 - x_0}$

(3) 1 (4) $\frac{1}{x_2 - x_1}$

85. Which of the following is termed as an action of pull or push of a body at rest or motion ?

(1) Torque (2) Momentum

(3) Work (4) Force

86. What is the relationship between each force, if three concurrent forces acting on a body according to Lami's theorem ?

(1) Directly proportional to the sine of the angle between the other two forces

(2) Inversely proportional to the cosine of the angle between the other two forces

(3) Directly proportional to the cosine of the angle between the other two forces

(4) Inversely proportional to the tangent of the angle between the other two forces

87. The resultant R of forces P and Q makes an angle θ with the line of action of P. P is now replaced by $P + R$, Q remaining unchanged such that the resultant makes an angle $\theta/2$ with $P + R$. The magnitude of this resultant is :

(1) $2R\sin\theta/2$ (2) $2R\cos\theta/2$ (3) $R\sin\theta/2$ (4) $3R\cos\theta/2$

88. Forces of 6, 8, 12 gm wt act along BC, CA, AB, the sides of a triangle of lengths 3, 4, 5 cms respectively. The resultant of these forces acting parallel to AB is :

(1) 2 gm wt (2) 3 gm wt

(3) 3.5 gm wt (4) 4 gm wt

89. The sides of a uniform triangular lamina are 5, 6, 9 cms. in length, the perpendicular distance of its centre of gravity from the shortest side is :

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

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

90. A force of 30 kg acting at an angle of 30° with the horizontal is about to drag a body of weight 60 kg lying on the floor. The co-efficient of friction is :

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

(3) $\mu = \sqrt{3}$ (4) $\mu = \frac{1}{\sqrt{3}}$

91. The value of integral $\iint_R y\,dx\,dy$ where R is the region bounded by the parabolas $y^2 = 4x$ and $x^2 = 4y$ is :

(1) $\frac{32}{5}$ (2) $\frac{48}{5}$

(3) $\frac{16}{5}$ (4) $\frac{16\sqrt{2}}{5}$

92. The value of $\iiint_{x^2+y^2+z^2 \le 1} (x^2 + y^2 + z^2)\,dx\,dy\,dz$ is :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{5}$ (3) $\frac{4\pi}{5}$ (4) $\frac{4\pi}{15}$

93. The locus of z when amp $\left(\frac{z-1}{z+1}\right) = \frac{\pi}{3}$ is :

(1) $x^2 + y^2 - \left(\frac{2}{\sqrt{3}}\right)y - 1 = 0$ (2) $x^2 + y^2 - 2y = 0$

(3) $x^2 + y^2 + \frac{2}{\sqrt{3}}y + 1 = 0$ (4) $x^2 + y^2 + 2y - 1 = 0$

94. $\lim_{z \to 2e^{\frac{\pi i}{3}}} \frac{z^3 + 8}{z^4 + 4z^2 + 16} =$ ....

(1) $\frac{3 - i\sqrt{3}}{2}$ (2) $\frac{1}{8}(3 - i\sqrt{3})$

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

95. The bilinear transformation $w = \frac{3z - 4}{z - 1}$ is :

(1) Elliptic (2) Parabolic

(3) Hyperbolic (4) None of these

96. The circle of convergence of power series $\sum_{n=1}^{\infty}\left(\frac{2i}{z+i+1}\right)^n$ is :

(1) $|z+i|<2$

(2) $|z+i|>2$

(3) $|z+i+1|>2$

(4) $|z+i+1|<2$

97. If $f(z)=\frac{z^3+3z+1}{z-3}$ and path of integration is a circle with centre at the origin and radius r, the Cauchy theorem is applicable when r equals :

(1) 5

(2) 4

(3) 3

(4) 2

98. A particle moves in a curve so that its tangential and normal accelerations are equal and the angular velocities of the tangent is constant. The path of the particle is given by :

(1) $s=Ae^{\psi}+B$ where $A=\frac{C}{w}$, B and C are constants

(2) $s=2A\log v+\log C$

(3) $s=Ae^{\psi}+B\log C$

(4) $s=A\log\psi+Be^{\psi}+C$

99. A particle is moving with S.H.M. of amplitude a. Its velocity at any point x is :

(1) $v=\sqrt{u(a^2-x^2)}$

(2) $u=u(a^2-x^2)$

(3) $v=\sqrt{u(a^2+x^2)}$

(4) $v=u(a^2+x^2)$

100. If the time of the flight of a bullet over a horizontal range R is T, the angle of projection is :

(1) $\sin^{-1}\left(T^2/2R\right)$

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

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

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

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B

SET-Z

PG-EE-July, 2024

SUBJECT : Mathematics

10206

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)

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(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.
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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SEAL

1. Which of the following is ***not*** a necessary condition for Cauchy's Mean Value Theorem ?

(1) The functions, $f(x)$ and $g(x)$ be continuous in $[a, b]$

(2) The derivative of $g'(x)$ be equal to 0

(3) The functions $f(x)$ and $g(x)$ be derivable in (a, b)

(4) There exists a value $c \in (a, b)$ such that $\frac{f(b)-f(a)}{g(b)-g(a)} = \frac{f'(c)}{g'(c)}$

2. A group (G, $*$) is said to be abelian if ....

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

(2) $x * y = y * x$

(3) $x + y = x$

(4) $x * y = x * y$

3. Which of the following is ***not*** necessarily a property of a group ?

(1) Commutatively

(2) Associativity

(3) Existence of inverse for every element

(4) Existence of identity

4. Let $x = (0, 1)$ be the open unit interval and $C(x, R)$ be the ring of continuous functions from x to R. For any $x \in (0, 1)$, let $l(x) = \{f \in C(x, R) \mid f(x) = 0\}$. Then which of the following ***true*** ?

(1) $l(x)$ is a prime ideal.

(2) $l(x)$ is a maximal ideal.

(3) Every maximal ideal of $C(x, R)$ is equal to $l(x)$ for some $x \in x$.

(4) Only (1) and (2) are true.

5. Let R be a commutative ring with unity. Which of the following is ***true*** ?

(1) If R has finitely many prime ideals, then R is a field.

(2) If R has infinitely many ideals, then R is finite.

(3) If R is a P.I.D., then every subring of R with unity is a P.I.D.

(4) If R is an integral domain which has finitely many ideals, then R is a field.

6. Let $R = Z[X]/(x^2 + 1)$ and $\psi : Z(X) \rightarrow R$ be the natural quotient map. Which of the following statements are ***true*** ?

(1) R is isomorphic to a subring of C.

(2) The ideal generated by $\psi(X)$ is a prime ideal in R.

(3) R has infinitely many prime ideals.

(4) Only (1) and (3) are true.

7. The number of ring homomorphisms from $f : Z[x, y] \longrightarrow \dfrac{F[X]}{(x^3 + x^2 + x + 1)}$ equals :

(1) 2^6

(2) 2^{18}

(3) 1

(4) 2^9

8. The total number of non-isomorphic groups of order 122 is :

(1) 2

(2) 1

(3) 61

(4) 4

9. Let G be a group order 6 and H be a subgroup of G such that $1 < |H| < 6$. Which one of the following options is ***correct*** ?

(1) G is always cyclic, but H may not be cyclic.

(2) G may not be cyclic, but H is always cyclic.

(3) Both G and H are always cyclic.

(4) Both G and H may not be cyclic.

10. The number of generators of a cyclic group of order 10 is :

(1) 2

(2) 3

(3) 4

(4) 5

11. If a and b are any two positive integers with $a > b$ and n is the number of divisions in Euclid's algorithm, and if p is the number of digits in b then :

(1) $n \le p$ (2) $n > 7p$

(3) $n \le 5p$ (4) $n > 5p$

12. If $F_n = 2^{2^n} + 1$, then $F_0 F_1 \,........\, F_{n-1}$ is equal to :

(1) F_n (2) $F_n + 3$

(3) $F_n - 2$ (4) $F_n + 4$

13. If $n = p_1^{a1} . p_2^{a2} \,........\, p_t^{a_t}$ be any positive integer where $p_1, p_2, ..., p_t$ are distinct prime, then Euler's $\phi(n)$ is equal to :

(1) $n\left(1-\dfrac{1}{p_1}\right)\left(1-\dfrac{1}{p_2}\right)........\left(1-\dfrac{1}{p_t}\right)$

(2) $n . p_1 \, p_2 \,........\, p_n$

(3) $n(p_1 + 1)(p_2 + 2)......(p_t + t)$

(4) $n\left(1+\dfrac{1}{p_1}\right)\left(1+\dfrac{1}{p_2}\right)..........\left(1+\dfrac{1}{p_t}\right)$

14. Using Euler method, the general solution of the equation $21x + 13y = 1791$ is :

(1) $x = -t, y = 141 + 12t$ (2) $x = -2t, y = 141 + 13t$

(3) $x = 4t, y = -141 + 13t$ (4) $x = -2t, y = 122 + 13t$

15. A square of side a revolves about a line through a corner and perpendicular to the diagonal through that corner, then the volume and area of the surface of the solid generated are :

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

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

16. If both m and n are positive integers, then $B(m, n)$ is equal to :

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

17. $\int_0^{\pi/2} \sin^n \theta \, d\theta$ is equal to : (where $n > -1$)

(1) $\sqrt{\pi} \cdot \frac{\Gamma(n+1)}{\Gamma(n+2)}$

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

(3) $\frac{\pi}{2} \frac{\Gamma\left(\frac{n+1}{2}\right)}{\Gamma\left(\frac{n-1}{2}\right)}$

(4) $\frac{\pi}{2} \cdot \frac{\Gamma\left(\frac{n+1}{2}\right)}{\Gamma\left(\frac{n+2}{2}\right)}$

18. Area of the curve $r^2 = a^2 \cos^2 \theta + b^2 \sin^2 \theta$ is :

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

19. $\underset{n \to \infty}{Lt} \sum_{r=1}^{n-1} \frac{1}{n} \sqrt{\frac{n+r}{n-r}} =$

(1) $\pi + 1$

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

(3) $2\pi + 3$

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

20. If $f(t) = e^{-t} t^n$, then its Laplace Transform $F(s)$ is :

(1) $\frac{\Gamma(n+1)}{(s+1)^{n+1}}$

(2) $\frac{1}{s^2 + 1}$

(3) $\frac{\Gamma(n)}{s^{n+1}}$

(4) $\frac{\Gamma(n+1)}{s^2 + 1}$

21. The pedal equation of the curve $x^2 + y^2 = 2ax$ is :

(1) $r^2 = ap$

(2) $r^2 = \frac{a}{p}$

(3) $r^2 = 2ap$

(4) $r^2 = ap^2$

22. The length of subnormal to parabola $y^2 = 4ax$ is :

(1) $2a$

(2) $4a$

(3) $a\sqrt{2}$

(4) $2a\sqrt{2}$

23. For the curve $y = a\log\left(\sec\frac{x}{a}\right)$, the chord of curvature parallel to y-axis is equal to :

(1) a

(2) $2a$

(3) $3a$

(4) $4a$

24. The radius of curvature of the curve $y = a\sin\psi\cos\psi$ is :

(1) p

(2) $3p$

(3) $4p$

(4) $2p$

25. If $u = \tan^{-1}\frac{x^3 + y^3 + x^2y - xy^2}{x^2 - xy + y^2}$, then the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(1) 0

(2) $\sin u$

(3) $\sin 2u$

(4) $\frac{1}{2}\sin 2u$

26. If $x = r\cos\theta$ and $y = r\sin\theta$, then $\frac{\partial(r, \theta)}{\partial(x, y)}$ is :

(1) r

(2) $r\sin\theta$

(3) $\frac{r}{\sin\theta}$

(4) $\frac{1}{r}$

27. If $a > 0$, $b > 0$, then the maximum value of $a\cos\theta + b\sin\theta$ is :

(1) $a + b$

(2) $a - b$

(3) a or b

(4) $\sqrt{a^2 + b^2}$

28. Sequence $\left(1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \frac{1}{5}, -\frac{1}{6}, \ldots\ldots\ldots\right)$ is :

(1) Monotonic but not bounded

(2) Bounded but not monotonic

(3) Monotonic and bounded

(4) Neither monotonic nor bounded

29. Maxima and Minima value of the set $S = \left\{1 + \frac{(-1)^n}{n} ; n \in N\right\}$ are :

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

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

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

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

30. Series $\left(\frac{2^2}{1^2} - \frac{2}{1}\right)^{-1} + \left(\frac{3^3}{2^3} - \frac{3}{2}\right)^{-2} + \left(\frac{4^4}{3^4} - \frac{4}{3}\right)^{-3} + \ldots\ldots\ldots$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory finitely

(4) Oscillatory infinitely

31. The centre and radius of the sphere $7x^2 + 7y^2 + 7z^2 - 6x - 3y - 2z = 0$ are respectively :

(1) $\left(\frac{6}{7}, \frac{3}{7}, \frac{2}{7}\right), \frac{1}{4}$

(2) $\left(\frac{3}{7}, \frac{3}{14}, \frac{2}{7}\right), \frac{1}{2}$

(3) $\left(\frac{3}{7}, \frac{3}{14}, \frac{1}{7}\right), \frac{1}{2}$

(4) $\left(\frac{6}{7}, \frac{3}{7}, \frac{2}{7}\right), \frac{1}{2}$

32. The equation of the plane that bisects the line joining the points (1, 2, 3); (3, 4, 5) at right angles is :

(1) $x + y + z = 0$

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

(3) $x - y + z = 0$

(4) $x + y + z - 9 = 0$

33. The equations of a straight line through the point (3, 1, – 6) and parallel to each of the planes $x + y + 2z - 4 = 0$ and $2x - 3y + z + 5 = 0$ are :

(1) $\frac{x-3}{7} = \frac{y-1}{3} = \frac{z+6}{-5}$

(2) $\frac{x+4}{3} = \frac{y-1}{3} = \frac{z-6}{5}$

(3) $\frac{x-3}{7} = \frac{y+1}{3} = \frac{z-6}{-5}$

(4) None of the above

34. The equation of the cylinder whose generators are parallel to the line, $\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$ and whose guiding curve is the ellipse $x^2 + 2y^2 = 1, z = 0$ is :

(1) $3(x^2 + 2y^2 + z^2) - 2xz = 0$

(2) $3(x^2 + 2y^2 + z^2) - 2xz + 8yz - 3 = 0$

(3) $x^2 + y^2 + z^2 - 2xz - 8yz + 3 = 0$

(4) None of the above

35. The vertex of the cone $4x^2 - y^2 + 2z^2 + 2xy - 3yz + 12x - 11y + 6z + 4 = 0$ is :

(1) (1, 2, 3)

(2) (1, 3, 4)

(3) (–1, –2, –3)

(4) (1, 2, –3)

36. The integrating factor of the differential equation $x(x-1)\frac{dy}{dx} = (x-2)y + x^3(2x-1)$ is :

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

37. The solution of the following differential equation is :

$\frac{dy}{dx} = \sin(x+y) + \cos(x+y)$

(1) $ce^x = \tan\left(\frac{x+y}{2}\right)+1$ (2) $ce^x = \tan(x+y)+1$

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

38. Singular solution of the following D. E. is :

$y^2 - 2pxy + p^2x^2 - (a^2p^2 + b^2) = 0$

(1) $a^2x^2 + b^2y^2 = 1$ (2) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

(3) $x^2 + y^2 = \frac{a^2}{b^2}$ (4) $x^2 + y^2 = a^2b^2$

39. The P. I. of the following D. E. is :

$(D^2 - 5D + 6)y = 5^x$ $\left[D \equiv \frac{d}{dx}\right]$

(1) $5^x \log_e 5$ (2) $\frac{5^x}{2\log_e 5}$ (3) $\frac{5^x}{3\log_e 5}$ (4) $\frac{5^x}{\log_e\left(\frac{5}{e^2}\right).\log_e\left(\frac{5}{e^3}\right)}$

40. Integrating factor of the following D. E. is :

$\sin^2 x \frac{d^2y}{dx^2} = 2y$

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

41. The value of integral $\iint_R y\,dx\,dy$ where R is the region bounded by the parabolas $y^2 = 4x$ and $x^2 = 4y$ is :

(1) $\frac{32}{5}$ (2) $\frac{48}{5}$

(3) $\frac{16}{5}$ (4) $\frac{16\sqrt{2}}{5}$

42. The value of $\iiint_{x^2+y^2+z^2\le 1}(x^2+y^2+z^2)\,dx\,dy\,dz$ is :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{5}$ (3) $\frac{4\pi}{5}$ (4) $\frac{4\pi}{15}$

43. The locus of z when amp $\left(\frac{z-1}{z+1}\right)=\frac{\pi}{3}$ is :

(1) $x^2+y^2-\left(\frac{2}{\sqrt{3}}\right)y-1=0$ (2) $x^2+y^2-2y=0$

(3) $x^2+y^2+\frac{2}{\sqrt{3}}y+1=0$ (4) $x^2+y^2+2y-1=0$

44. $\lim\limits_{z\to 2e^{\frac{\pi i}{3}}} \frac{z^3+8}{z^4+4z^2+16} =$ ....

(1) $\frac{3-i\sqrt{3}}{2}$ (2) $\frac{1}{8}(3-i\sqrt{3})$

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

45. The bilinear transformation $w=\frac{3z-4}{z-1}$ is :

(1) Elliptic (2) Parabolic

(3) Hyperbolic (4) None of these

46. The circle of convergence of power series $\sum_{n=1}^{\infty}\left(\frac{2i}{z+i+1}\right)^n$ is :

(1) $|z+i|<2$

(2) $|z+i|>2$

(3) $|z+i+1|>2$

(4) $|z+i+1|<2$

47. If $f(z)=\frac{z^3+3z+1}{z-3}$ and path of integration is a circle with centre at the origin and radius r, the Cauchy theorem is applicable when r equals :

(1) 5

(2) 4

(3) 3

(4) 2

48. A particle moves in a curve so that its tangential and normal accelerations are equal and the angular velocities of the tangent is constant. The path of the particle is given by :

(1) $s=Ae^{\psi}+B$ where $A=\frac{C}{w}$, B and C are constants

(2) $s=2A\log v+\log C$

(3) $s=Ae^{\psi}+B\log C$

(4) $s=A\log\psi+Be^{\psi}+C$

49. A particle is moving with S.H.M. of amplitude a. Its velocity at any point x is :

(1) $v=\sqrt{u(a^2-x^2)}$

(2) $u=u(a^2-x^2)$

(3) $v=\sqrt{u(a^2+x^2)}$

(4) $v=u(a^2+x^2)$

50. If the time of the flight of a bullet over a horizontal range R is T, the angle of projection is :

(1) $\sin^{-1}\left(T^2/2R\right)$

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

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

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

51. Let X has a two parameter gamma distribution with parameters λ, k ($\lambda > 0$ is the scale parameter and $k > 0$ is the shape parameter) with density function

$$f_{\lambda,k}(x) = \begin{cases} \dfrac{\lambda^k x^{k-1} e^{-\lambda x}}{\Gamma(k)} & , x > 0 \\ 0 & , x < 0 \end{cases}$$, then its L.T. $f^*(s)$ is given by :

(1) $\frac{1}{(s+1)^2}$ (2) $\left(\frac{\lambda}{s+\lambda}\right)^k$ (3) $\left(\frac{s+\lambda}{\lambda}\right)^k$ (4) $\left(\frac{\lambda+k}{s+\lambda}\right)^{k-1}$

52. What will be the output of the program :

```
main ( )
{
int a = 1, b = 2, c = 3 ;
printf ("%d", a + = (a + = 3, 5, a))
}
```

(1) 6 (2) 9 (3) 12 (4) 8

53. Which of the following comment is correct when a macro definition includes arguments ?

(1) The opening parenthesis should immediately follow the macro name.

(2) There should be at least one blank between the macro name and the opening parenthesis.

(3) There should be only one blank between the macro name and the opening parenthesis.

(4) All the above comments are correct.

54. Which one of the following is a loop construct that will always be executed once ?

(1) for (2) while (3) switch (4) do while

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

(1) A pointer to an int and a pointer to a double are of the same size.

(2) A pointer must point to a data item on the heap (free store).

(3) A pointer can be reassigned to point to another data item.

(4) A pointer can point to an array.

56. What does this statement mean ?

$x -= y + 1$;

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

57. Value of $\int \cos^2 x \sin^2 x \, dx$ is :

(1) $\frac{1}{8}\left[x - \frac{\cos 2x}{2}\right]$
(2) $\frac{1}{4}\left[x - \frac{\cos 2x}{2}\right]$
(3) $\frac{1}{8}\left[x - \frac{\sin 2x}{2}\right]$
(4) $\frac{1}{4}\left[x - \frac{\sin 2x}{2}\right]$

58. If $f(x) = x$, $x \in [0, 1]$ and f is R-integrable on $[0, 1]$, then $\int_0^1 x\,dx$ is equal to :

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

59. The sum of n terms of a series is $S_n = \frac{n^2 x}{1 + n^4 x^2}$, then for this series which statement is ***true*** ?

(1) Converges uniformly.
(2) Does not converge uniformly.
(3) Converges uniformly only in the interval (0, 1).
(4) Each term is continuous in an interval (a, b).

60. Find the value of c which satisfies the mean value theorem for the given function, $f(x) = x^2 + 2x + 1$ on $[1, 2]$?

(1) $10/2$
(2) $13/2$
(3) $-13/2$
(4) $-7/2$

61. Using Gauss Elimination method, the solution of equations $2x - y + 3z = 9, x + y + z = 6, x - y + z = 2$ is :

(1) $x = -13, y = 1, z = -8$

(2) $x = 13, y = 1, z = -8$

(3) $x = -13, y = 4, z = 15$

(4) $x = 5, y = 14, z = 5$

62. While solving the equation $x^2 - 3x + 1 = 0$ using Newton-Raphson method the initial guess of the root is as 1, then the value of the root will be :

(1) 1.5

(2) 1

(3) 0.5

(4) 0

63. For a fixed $C \in R$, let $\alpha = \int_0^2 (9x^2 - 5Cx^4)\,dx$. If the value of this integral obtained by using the Trapezoidal rule is equal to α, then the value of C (rounded off 2 decimal places) is :

(1) 0.5

(2) 0.24

(3) 0.12

(4) 0.76

64. If $f(x) = x^2$, then the second order divided difference for the points x_0, x_1, x_2 will be :

(1) -1

(2) $\frac{-1}{x_1 - x_0}$

(3) 1

(4) $\frac{1}{x_2 - x_1}$

65. Which of the following is termed as an action of pull or push of a body at rest or motion ?

(1) Torque

(2) Momentum

(3) Work

(4) Force

66. What is the relationship between each force, if three concurrent forces acting on a body according to Lami's theorem ?

(1) Directly proportional to the sine of the angle between the other two forces

(2) Inversely proportional to the cosine of the angle between the other two forces

(3) Directly proportional to the cosine of the angle between the other two forces

(4) Inversely proportional to the tangent of the angle between the other two forces

67. The resultant R of forces P and Q makes an angle θ with the line of action of P. P is now replaced by $P + R$, Q remaining unchanged such that the resultant makes an angle $\theta/2$ with $P + R$. The magnitude of this resultant is :

(1) $2R\sin\theta/2$ (2) $2R\cos\theta/2$ (3) $R\sin\theta/2$ (4) $3R\cos\theta/2$

68. Forces of 6, 8, 12 gm wt act along BC, CA, AB, the sides of a triangle of lengths 3, 4, 5 cms respectively. The resultant of these forces acting parallel to AB is :

(1) 2 gm wt (2) 3 gm wt

(3) 3.5 gm wt (4) 4 gm wt

69. The sides of a uniform triangular lamina are 5, 6, 9 cms. in length, the perpendicular distance of its centre of gravity from the shortest side is :

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

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

70. A force of 30 kg acting at an angle of 30° with the horizontal is about to drag a body of weight 60 kg lying on the floor. The co-efficient of friction is :

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

(3) $\mu = \sqrt{3}$ (4) $\mu = \frac{1}{\sqrt{3}}$

71. If $y = \tan^{-1}\left(\frac{x}{a}\right)$, then its nth derivative y_n is :

(1) $\frac{(-1)^{n-1}(n-1)!}{a^n}\sin^n\theta\cos n\theta$

(2) $\frac{(-1)^{n-1}(n-1)!}{a^n}\tan^n\theta\cos n\theta$

(3) $\frac{(-1)^{n-1}(n-1)!}{a^n}\sin^n\theta\sin n\theta$

(4) $\frac{(-1)^{n-1}(n-1)!}{a^n}\cos^n\theta\cos n\theta$

where $\theta = \tan^{-1}\left(\frac{a}{x}\right)$.

72. If $u = \phi(x - y, y - z, z - x)$, then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$ is equal to :

(1) 0

(2) 1

(3) u

(4) xyz

73. If α is a paramcter, then envelop of the family of lines $x\cos\alpha + y\sin\alpha = a$ is :

(1) Parabola

(2) Circle

(3) Ellipse

(4) Hyperbola

74. The evolute of curve $2xy = a^2$ is :

(1) $x^{2/3} + y^{2/3} = a^{2/3}$

(2) $(x+y)^{2/3} + (x-y)^{2/3} = a^{2/3}$

(3) $(x+y)^{2/3} + (x-y)^{2/3} = 2a^{2/3}$

(4) $(x+y)^{2/3} - (x-y)^{2/3} = 2a^{2/3}$

75. Maximum curvature of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is :

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

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

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

(4) $\frac{b}{2a}$

76. The minimum value of $\sqrt{x^2+y^2}$, under the condition $x^2+xy+y^2=1$ is :

(1) 1

(2) $\sqrt{2}$

(3) $\sqrt{3}$

(4) $\frac{\sqrt{6}}{2}$

77. The sequence $\{x_n\}$ where :

$x_n = \frac{1}{n+1} + \frac{1}{n+2} + \ldots\ldots\ldots + \frac{1}{2n}$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory

(4) None of the above

78. If $x = a(\cos\theta + \theta\sin\theta)$, $y = a(\sin\theta - \theta\sin\theta)$, then the value of $\frac{d^2y}{dx^2}$ at $\theta = \pi$ is :

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

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

(3) $-\frac{1}{a\pi}$

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

79. What is the degree and order of the following differential equation ?

$$\left(\frac{d^3y}{dx^3}\right)^{2/3} - 3\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 4y = 1$$

(1) 3, 3

(2) $2/3$, 3

(3) 3, 2

(4) 2, 3

80. If n is a natural number, then

$$\frac{\sum_{r=1}^{n} r^3}{\sum_{r=1}^{n} r(r+1)} \text{ is equal to :}$$

(1) $\frac{3}{2}\cdot\frac{n}{n+1}$

(2) $\frac{3}{2}\cdot\frac{n+1}{n+2}$

(3) $\frac{3}{2}\cdot\frac{n}{n+4}$

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

81. If $r = a\cos t\, i + a\sin t\, j + tk$, then the value of $\left|\frac{d^2r}{dt^2}\right|$ is :

(1) $-a\cos t\, i - a\sin t\, j$
(2) $\sqrt{(a^2\cos^2 t + a^2\sin^2 t) + t}$
(3) $a\cos t + a\sin t$
(4) a

82. If $r = xi + yj + zk$, then grad r is :

(1) $\frac{x}{r} + \frac{y}{r} + \frac{z}{r}$
(2) $\frac{1}{r}(xi + yj + zk)$
(3) $xi + yj + zk$
(4) None of the above

83. If c is a regular closed curse in xy-plane, enclosing a region S and $P(x, y)$ and $Q(x, y)$ be two continuously differentiable functions in the region S i.e. inside and on c, then $\iint_S \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right) dx\, dy$ is equal to :

(1) $\int_c (P\,dx + Q\,dy)$
(2) $\int_c (Q\,dy - P\,dx)$
(3) $\int_c \frac{\partial x}{\partial y}(P + Q)$
(4) $\int_c \frac{\partial^2}{\partial y^2}(P\,dx + Q\,dy)$

84. The value of $\int_s (axi + byj + czk).\hat{n}\, ds$ is :

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

85. If $f(t) = ti - 3j + 2tk$, $g(t) = i - 2j + 2k$ and $h(t) = 3i + tj - k$, then the value of $\int_1^2 f.(g \times h)\, dt$ is :

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

86. If $u = \tan^{-1}\left(\frac{y}{x}\right)$, then $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$ is equal to :

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

(3) 0 (4) $\frac{x}{y}$

87. Which of the following function is not differentiable at $x = 0$?

(1) $x\,|x|$ (2) $x + |x|$

(3) e^{-x} (4) x^3

88. If $f(x) = 3x^3 - 5x^2 + 2x$, then the interval for which f satisfies all the conditions of Roll's theorem is :

(1) [0, 1] (2) [–1, 1]

(3) [–1, 0] (4) [1, 2]

89. If Lagrange's theorem is true for the function $f(x) = x^3 - 3x - 2$ in the interval [–2, 3], then the value of c where it is true is :

(1) 0 (2) $\sqrt{7/3}$

(3) $\sqrt{\frac{3}{7}}$ (4) 1

90. If the function $f(x) = x(x - 2)$ is continuous in $\left[0, \frac{3}{2}\right]$ and differentiable in $\left(0, \frac{3}{2}\right)$, then the value of $'c'$ of the mean value theorem is :

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

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

91. A matrix A such that $A^2 = I$ or $(I + A)(I - A) = 0$ is called :

(1) Idempotent

(2) Nilpotent

(3) Involuntory

(4) None of the above

92. If for a square matrix A of order n, $| A - \lambda I | = a_0\lambda^n + a_1\lambda^{n-1} + ... + a_n$, then $a_0 A^n + a_1 A^{n-1} + ... + a_n I$ is equal to :

(1) 0

(2) I_n

(3) $J_{n \times n}$

(4) $I_n A^{-1}$

93. If A is an $m \times n$ matrix of rank r_A and B is an $n \times p$ matrix of rank r_B such that $AB = 0$, then which of the following is ***true*** ?

(1) $r_A + r_B = p$

(2) $r_A + r_B \leq n$

(3) $r_A + r_B > n$

(4) $r_A + r_B = n + p$

94. A square matrix A of order n is such that $A'A = I = AA'$, then $| A |$ is equal to :

(1) 1

(2) n

(3) ± 1

(4) $n - 1$

95. The canonical form of a Quadratic Form is $-21y_1^2 - \frac{2}{7}y_2^2$. The rank and the index of this Q. F. are 2 and 0 respectively, then the nature of this Q. F. is :

(1) Positive definite

(2) Negative definite

(3) Semi-positive definite

(4) Semi-negative definite

96. Given the function $f(x) = \begin{cases} x^2 & , \quad x \le c \\ ax + b & , \quad x > c \end{cases}$ is differentiable at $x = c$. The values of a and b are respectively :

(1) $2c, -c^2$

(2) $c^2, 2c$

(3) $c, -c^2$

(4) $-c^2, 2c$

97. If $y = \sqrt{x + \sqrt{x + \sqrt{x + \ldots\ldots \text{ to } \infty}}}$, then $\frac{dy}{dx}$ is equal to :

(1) x^3

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

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

(4) $\frac{x}{1-2y}$

98. The radius of curvature at the vertex of the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$ is :

(1) $4a$

(2) $a + \sin\theta$

(3) $2a$

(4) $2a + 3$

99. The asymptotes of the curve $(x^2 - y^2)(x + 2y + 1) + x + y + 1 = 0$ are :

(1) $y = \pm x \,;\, x + 2y + 1 = 0$

(2) $y = \pm x \,;\, x + y + 1 = 0$

(3) $y = x \,;\, x + 2y + 1 = 0 \,;\, x + y + 1 = 0$

(4) $y = -x \,;\, x + 2y + 1 = 0 \,;\, x + y + 1 = 0$

100. The curve $y^2(2a - x) = x^3$ has :

(1) Node

(2) Cusp

(3) Conjugate point

(4) None of these

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SET-Z

PG-EE-July, 2024

SUBJECT : Mathematics

Sr. No. 10255

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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SEAL

1. If $y = \tan^{-1}\left(\frac{x}{a}\right)$, then its nth derivative y_n is :

(1) $\frac{(-1)^{n-1}(n-1)!}{a^n}\sin^n\theta\cos n\theta$

(2) $\frac{(-1)^{n-1}(n-1)!}{a^n}\tan^n\theta\cos n\theta$

(3) $\frac{(-1)^{n-1}(n-1)!}{a^n}\sin^n\theta\sin n\theta$

(4) $\frac{(-1)^{n-1}(n-1)!}{a^n}\cos^n\theta\cos n\theta$

where $\theta = \tan^{-1}\left(\frac{a}{x}\right)$.

2. If $u = \phi(x-y, y-z, z-x)$, then $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}$ is equal to :

(1) 0

(2) 1

(3) u

(4) xyz

3. If α is a parameter, then envelop of the family of lines $x\cos\alpha + y\sin\alpha = a$ is :

(1) Parabola

(2) Circle

(3) Ellipse

(4) Hyperbola

4. The evolute of curve $2xy = a^2$ is :

(1) $x^{2/3} + y^{2/3} = a^{2/3}$

(2) $(x+y)^{2/3} + (x-y)^{2/3} = a^{2/3}$

(3) $(x+y)^{2/3} + (x-y)^{2/3} = 2a^{2/3}$

(4) $(x+y)^{2/3} - (x-y)^{2/3} = 2a^{2/3}$

5. Maximum curvature of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is :

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

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

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

(4) $\frac{b}{2a}$

6. The minimum value of $\sqrt{x^2+y^2}$, under the condition $x^2+xy+y^2=1$ is :

(1) 1

(2) $\sqrt{2}$

(3) $\sqrt{3}$

(4) $\frac{\sqrt{6}}{2}$

7. The sequence $\{x_n\}$ where :

$x_n = \frac{1}{n+1} + \frac{1}{n+2} + \ldots\ldots\ldots + \frac{1}{2n}$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory

(4) None of the above

8. If $x = a(\cos\theta + \theta\sin\theta)$, $y = a(\sin\theta - \theta\sin\theta)$, then the value of $\frac{d^2y}{dx^2}$ at $\theta = \pi$ is :

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

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

(3) $-\frac{1}{a\pi}$

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

9. What is the degree and order of the following differential equation ?

$$\left(\frac{d^3y}{dx^3}\right)^{2/3} - 3\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 4y = 1$$

(1) 3, 3

(2) $2/3$, 3

(3) 3, 2

(4) 2, 3

10. If n is a natural number, then

$$\frac{\sum_{r=1}^{n} r^3}{\sum_{r=1}^{n} r(r+1)}$$ is equal to :

(1) $\frac{3}{2}\cdot\frac{n}{n+1}$

(2) $\frac{3}{2}\cdot\frac{n+1}{n+2}$

(3) $\frac{3}{2}\cdot\frac{n}{n+4}$

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

11. If $r = a\cos t\, i + a\sin t\, j + tk$, then the value of $\left|\frac{d^2r}{dt^2}\right|$ is :

(1) $-a\cos t\, i - a\sin t\, j$ (2) $\sqrt{(a^2\cos^2 t + a^2\sin^2 t) + t}$

(3) $a\cos t + a\sin t$ (4) a

12. If $r = xi + yj + zk$, then grad r is :

(1) $\frac{x}{r} + \frac{y}{r} + \frac{z}{r}$ (2) $\frac{1}{r}(xi + yj + zk)$

(3) $xi + yj + zk$ (4) None of the above

13. If c is a regular closed curse in xy-plane, enclosing a region S and $P(x, y)$ and $Q(x, y)$ be two continuously differentiable functions in the region S i.e. inside and on c, then $\iint_S \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right) dx\, dy$ is equal to :

(1) $\int_c (P\,dx + Q\,dy)$ (2) $\int_c (Q\,dy - P\,dx)$

(3) $\int_c \frac{\partial x}{\partial y}(P + Q)$ (4) $\int_c \frac{\partial^2}{\partial y^2}(P\,dx + Q\,dy)$

14. The value of $\int_s (axi + byj + czk).\hat{n}\, ds$ is :

(1) $a + b + c$ (2) $\frac{4}{3}(a + b + c)$

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

15. If $f(t) = ti - 3j + 2tk$, $g(t) = i - 2j + 2k$ and $h(t) = 3i + tj - k$, then the value of $\int_1^2 f.(g \times h)\, dt$ is :

(1) 0 (2) 1

(3) 2 (4) 3

16. If $u = \tan^{-1}\left(\frac{y}{x}\right)$, then $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$ is equal to :

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

(2) $\frac{x}{x^2 + y^2}$

(3) 0

(4) $\frac{x}{y}$

17. Which of the following function is not differentiable at $x = 0$?

(1) $x\,|\,x\,|$

(2) $x + |\,x\,|$

(3) e^{-x}

(4) x^3

18. If $f(x) = 3x^3 - 5x^2 + 2x$, then the interval for which f satisfies all the conditions of Roll's theorem is :

(1) [0, 1]

(2) [–1, 1]

(3) [–1, 0]

(4) [1, 2]

19. If Lagrange's theorem is true for the function $f(x) = x^3 - 3x - 2$ in the interval [–2, 3], then the value of c where it is true is :

(1) 0

(2) $\sqrt{7/3}$

(3) $\sqrt{\frac{3}{7}}$

(4) 1

20. If the function $f(x) = x(x - 2)$ is continuous in $\left[0, \frac{3}{2}\right]$ and differentiable in $\left(0, \frac{3}{2}\right)$, then the value of '$c$' of the mean value theorem is :

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

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

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

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

21. A matrix A such that $A^2 = I$ or $(I + A)(I - A) = 0$ is called :

(1) Idempotent

(2) Nilpotent

(3) Involuntory

(4) None of the above

22. If for a square matrix A of order n, $|A - \lambda I| = a_0\lambda^n + a_1\lambda^{n-1} + \dots\dots\dots + a_n$, then $a_0 A^n + a_1 A^{n-1} + \dots\dots\dots + a_n I$ is equal to :

(1) 0 (2) I_n

(3) $J_{n \times n}$ (4) $I_n A^{-1}$

23. If A is an $m \times n$ matrix of rank r_A and B is an $n \times p$ matrix of rank r_B such that $AB = 0$, then which of the following is ***true*** ?

(1) $r_A + r_B = p$

(2) $r_A + r_B \leq n$

(3) $r_A + r_B > n$

(4) $r_A + r_B = n + p$

24. A square matrix A of order n is such that $A'A = I = AA'$, then $|A|$ is equal to :

(1) 1 (2) n

(3) ± 1 (4) $n - 1$

25. The canonical form of a Quadratic Form is $-21y_1^2 - \frac{2}{7}y_2^2$. The rank and the index of this Q. F. are 2 and 0 respectively, then the nature of this Q. F. is :

(1) Positive definite

(2) Negative definite

(3) Semi-positive definite

(4) Semi-negative definite

26. Given the function $f(x)=\begin{cases} x^2 & , \quad x \le c \\ ax+b & , \quad x > c \end{cases}$ is differentiable at $x = c$. The values of a and b are respectively :

(1) $2c, -c^2$ (2) $c^2, 2c$

(3) $c, -c^2$ (4) $-c^2, 2c$

27. If $y=\sqrt{x+\sqrt{x+\sqrt{x+\ldots\ldots \text{ to } \infty}}}$, then $\frac{dy}{dx}$ is equal to :

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

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

28. The radius of curvature at the vertex of the cycloid $x=a(\theta+\sin\theta)$, $y=a(1-\cos\theta)$ is :

(1) $4a$ (2) $a+\sin\theta$

(3) $2a$ (4) $2a+3$

29. The asymptotes of the curve $(x^2-y^2)(x+2y+1)+x+y+1=0$ are :

(1) $y=\pm x\,;\, x+2y+1=0$

(2) $y=\pm x\,;\, x+y+1=0$

(3) $y=x\,;\, x+2y+1=0\,;\, x+y+1=0$

(4) $y=-x\,;\, x+2y+1=0\,;\, x+y+1=0$

30. The curve $y^2(2a-x)=x^3$ has :

(1) Node

(2) Cusp

(3) Conjugate point

(4) None of these

31. The value of integral $\iint_R y\,dx\,dy$ where R is the region bounded by the parabolas $y^2 = 4x$ and $x^2 = 4y$ is :

(1) $\frac{32}{5}$ (2) $\frac{48}{5}$

(3) $\frac{16}{5}$ (4) $\frac{16\sqrt{2}}{5}$

32. The value of $\iiint_{x^2+y^2+z^2 \le 1} (x^2 + y^2 + z^2)\,dx\,dy\,dz$ is :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{5}$ (3) $\frac{4\pi}{5}$ (4) $\frac{4\pi}{15}$

33. The locus of z when amp $\left(\frac{z-1}{z+1}\right) = \frac{\pi}{3}$ is :

(1) $x^2 + y^2 - \left(\frac{2}{\sqrt{3}}\right)y - 1 = 0$ (2) $x^2 + y^2 - 2y = 0$

(3) $x^2 + y^2 + \frac{2}{\sqrt{3}}y + 1 = 0$ (4) $x^2 + y^2 + 2y - 1 = 0$

34. $\lim\limits_{z \to 2e^{\frac{\pi i}{3}}} \frac{z^3 + 8}{z^4 + 4z^2 + 16} = \ldots\ldots\ldots\ldots$

(1) $\frac{3 - i\sqrt{3}}{2}$ (2) $\frac{1}{8}(3 - i\sqrt{3})$

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

35. The bilinear transformation $w = \frac{3z - 4}{z - 1}$ is :

(1) Elliptic (2) Parabolic

(3) Hyperbolic (4) None of these

36. The circle of convergence of power series $\sum_{n=1}^{\infty}\left(\frac{2i}{z+i+1}\right)^n$ is :

(1) $|z+i|<2$

(2) $|z+i|>2$

(3) $|z+i+1|>2$

(4) $|z+i+1|<2$

37. If $f(z)=\frac{z^3+3z+1}{z-3}$ and path of integration is a circle with centre at the origin and radius r, the Cauchy theorem is applicable when r equals :

(1) 5

(2) 4

(3) 3

(4) 2

38. A particle moves in a curve so that its tangential and normal accelerations are equal and the angular velocities of the tangent is constant. The path of the particle is given by :

(1) $s = Ae^{\psi} + B$ where $A = \frac{C}{w}$, B and C are constants

(2) $s = 2A \log v + \log C$

(3) $s = Ae^{\psi} + B \log C$

(4) $s = A \log \psi + Be^{\psi} + C$

39. A particle is moving with S.H.M. of amplitude a. Its velocity at any point x is :

(1) $v=\sqrt{u(a^2-x^2)}$

(2) $u=u(a^2-x^2)$

(3) $v=\sqrt{u(a^2+x^2)}$

(4) $v=u(a^2+x^2)$

40. If the time of the flight of a bullet over a horizontal range R is T, the angle of projection is :

(1) $\sin^{-1}\left(T^2/2R\right)$

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

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

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

41. Let X has a two parameter gamma distribution with parameters λ, k ($\lambda > 0$ is the scale parameter and $k > 0$ is the shape parameter) with density function

$$f_{\lambda,k}(x) = \begin{cases} \dfrac{\lambda^k x^{k-1} e^{-\lambda x}}{\Gamma(k)} & , \quad x > 0 \\ 0 & , \quad x < 0 \end{cases}$$

, then its L.T. $f^*(s)$ is given by :

(1) $\dfrac{1}{(s+1)^2}$ (2) $\left(\dfrac{\lambda}{s+\lambda}\right)^k$ (3) $\left(\dfrac{s+\lambda}{\lambda}\right)^k$ (4) $\left(\dfrac{\lambda+k}{s+\lambda}\right)^{k-1}$

42. What will be the output of the program :

```
main ( )
{
int a = 1, b = 2, c = 3 ;
printf ("%d", a + = (a + = 3, 5, a))
}
```

(1) 6 (2) 9 (3) 12 (4) 8

43. Which of the following comment is correct when a macro definition includes arguments ?

(1) The opening parenthesis should immediately follow the macro name.

(2) There should be at least one blank between the macro name and the opening parenthesis.

(3) There should be only one blank between the macro name and the opening parenthesis.

(4) All the above comments are correct.

44. Which one of the following is a loop construct that will always be executed once ?

(1) for (2) while (3) switch (4) do while

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

(1) A pointer to an int and a pointer to a double are of the same size.

(2) A pointer must point to a data item on the heap (free store).

(3) A pointer can be reassigned to point to another data item.

(4) A pointer can point to an array.

46. What does this statement mean ?

$x -= y + 1$;

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

(3) $x = x - y - 1$ (4) $x = x + y - 1$

47. Value of $\int \cos^2 x \sin^2 x \, dx$ is :

(1) $\frac{1}{8}\left[x - \frac{\cos 2x}{2}\right]$ (2) $\frac{1}{4}\left[x - \frac{\cos 2x}{2}\right]$

(3) $\frac{1}{8}\left[x - \frac{\sin 2x}{2}\right]$ (4) $\frac{1}{4}\left[x - \frac{\sin 2x}{2}\right]$

48. If $f(x) = x, x \in [0, 1]$ and f is R-integrable on [0, 1], then $\int_0^1 x \, dx$ is equal to :

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

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

49. The sum of n terms of a series is $S_n = \frac{n^2 x}{1 + n^4 x^2}$, then for this series which statement is ***true*** ?

(1) Converges uniformly.

(2) Does not converge uniformly.

(3) Converges uniformly only in the interval (0, 1).

(4) Each term is continuous in an interval (a, b).

50. Find the value of c which satisfies the mean value theorem for the given function, $f(x) = x^2 + 2x + 1$ on [1, 2] ?

(1) $10/2$ (2) $13/2$ (3) $-13/2$ (4) $-7/2$

51. The pedal equation of the curve $x^2 + y^2 = 2ax$ is :

(1) $r^2 = ap$

(2) $r^2 = \frac{a}{p}$

(3) $r^2 = 2ap$

(4) $r^2 = ap^2$

52. The length of subnormal to parabola $y^2 = 4ax$ is :

(1) $2a$

(2) $4a$

(3) $a\sqrt{2}$

(4) $2a\sqrt{2}$

53. For the curve $y = a\log\left(\sec\frac{x}{a}\right)$, the chord of curvature parallel to y-axis is equal to :

(1) a

(2) $2a$

(3) $3a$

(4) $4a$

54. The radius of curvature of the curve $y = a\sin\psi\cos\psi$ is :

(1) p

(2) $3p$

(3) $4p$

(4) $2p$

55. If $u = \tan^{-1}\frac{x^3 + y^3 + x^2y - xy^2}{x^2 - xy + y^2}$, then the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(1) 0

(2) $\sin u$

(3) $\sin 2u$

(4) $\frac{1}{2}\sin 2u$

56. If $x = r\cos\theta$ and $y = r\sin\theta$, then $\dfrac{\partial(r, \theta)}{\partial(x, y)}$ is :

(1) r

(2) $r\sin\theta$

(3) $\dfrac{r}{\sin\theta}$

(4) $\dfrac{1}{r}$

57. If $a > 0$, $b > 0$, then the maximum value of $a\cos\theta + b\sin\theta$ is :

(1) $a + b$

(2) $a - b$

(3) a or b

(4) $\sqrt{a^2 + b^2}$

58. Sequence $\left(1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \frac{1}{5}, -\frac{1}{6}, \ldots\ldots\ldots\right)$ is :

(1) Monotonic but not bounded

(2) Bounded but not monotonic

(3) Monotonic and bounded

(4) Neither monotonic nor bounded

59. Maxima and Minima value of the set $S = \left\{1 + \frac{(-1)^n}{n} ; n \in N\right\}$ are :

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

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

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

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

60. Series $\left(\frac{2^2}{1^2} - \frac{2}{1}\right)^{-1} + \left(\frac{3^3}{2^3} - \frac{3}{2}\right)^{-2} + \left(\frac{4^4}{3^4} - \frac{4}{3}\right)^{-3} + \ldots\ldots\ldots$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory finitely

(4) Oscillatory infinitely

61. Which of the following is ***not*** a necessary condition for Cauchy's Mean Value Theorem ?

(1) The functions, $f(x)$ and $g(x)$ be continuous in $[a, b]$

(2) The derivative of $g'(x)$ be equal to 0

(3) The functions $f(x)$ and $g(x)$ be derivable in (a, b)

(4) There exists a value $c \in (a, b)$ such that $\frac{f(b)-f(a)}{g(b)-g(a)} = \frac{f'(c)}{g'(c)}$.

62. A group (G, $*$) is said to be abelian if ....

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

(2) $x*y=y*x$

(3) $x+y=x$

(4) $x*y=x*y$

63. Which of the following is ***not*** necessarily a property of a group ?

(1) Commutatively

(2) Associativity

(3) Existence of inverse for every element

(4) Existence of identity

64. Let $x = (0, 1)$ be the open unit interval and $C(x, R)$ be the ring of continuous functions from x to R. For any $x \in (0, 1)$, let $l(x) = \{f \in C(x, R) \mid f(x) = 0\}$. Then which of the following ***true*** ?

(1) $l(x)$ is a prime ideal.

(2) $l(x)$ is a maximal ideal.

(3) Every maximal ideal of $C(x, R)$ is equal to $l(x)$ for some $x \in x$.

(4) Only (1) and (2) are true.

65. Let R be a commutative ring with unity. Which of the following is ***true*** ?

(1) If R has finitely many prime ideals, then R is a field.

(2) If R has infinitely many ideals, then R is finite.

(3) If R is a P.I.D., then every subring of R with unity is a P.I.D.

(4) If R is an integral domain which has finitely many ideals, then R is a field.

66. Let $R = Z[X]/(x^2 + 1)$ and $\psi : Z(X) \to R$ be the natural quotient map. Which of the following statements are ***true*** ?

(1) R is isomorphic to a subring of C.

(2) The ideal generated by $\psi(X)$ is a prime ideal in R.

(3) R has infinitely many prime ideals.

(4) Only (1) and (3) are true.

67. The number of ring homomorphisms from $f : Z[x, y] \longrightarrow \dfrac{F[X]}{(x^3 + x^2 + x + 1)}$ equals :

(1) 2^6 (2) 2^{18}

(3) 1 (4) 2^9

68. The total number of non-isomorphic groups of order 122 is :

(1) 2 (2) 1

(3) 61 (4) 4

69. Let G be a group order 6 and H be a subgroup of G such that $1 < | H | < 6$. Which one of the following options is ***correct*** ?

(1) G is always cyclic, but H may not be cyclic.

(2) G may not be cyclic, but H is always cyclic.

(3) Both G and H are always cyclic.

(4) Both G and H may not be cyclic.

70. The number of generators of a cyclic group of order 10 is :

(1) 2 (2) 3

(3) 4 (4) 5

71. Using Gauss Elimination method, the solution of equations $2x - y + 3z = 9$, $x + y + z = 6$, $x - y + z = 2$ is :

(1) $x = -13, y = 1, z = -8$

(2) $x = 13, y = 1, z = -8$

(3) $x = -13, y = 4, z = 15$

(4) $x = 5, y = 14, z = 5$

72. While solving the equation $x^2 - 3x + 1 = 0$ using Newton-Raphson method the initial guess of the root is as 1, then the value of the root will be :

(1) 1.5 (2) 1

(3) 0.5 (4) 0

73. For a fixed $C \in R$, let $\alpha = \int_0^2 (9x^2 - 5Cx^4)\, dx$. If the value of this integral obtained by using the Trapezoidal rule is equal to α, then the value of C (rounded off 2 decimal places) is :

(1) 0.5 (2) 0.24

(3) 0.12 (4) 0.76

74. If $f(x) = x^2$, then the second order divided difference for the points x_0, x_1, x_2 will be :

(1) -1 (2) $\frac{-1}{x_1 - x_0}$

(3) 1 (4) $\frac{1}{x_2 - x_1}$

75. Which of the following is termed as an action of pull or push of a body at rest or motion ?

(1) Torque (2) Momentum

(3) Work (4) Force

76. What is the relationship between each force, if three concurrent forces acting on a body according to Lami's theorem ?

(1) Directly proportional to the sine of the angle between the other two forces

(2) Inversely proportional to the cosine of the angle between the other two forces

(3) Directly proportional to the cosine of the angle between the other two forces

(4) Inversely proportional to the tangent of the angle between the other two forces

77. The resultant R of forces P and Q makes an angle θ with the line of action of P. P is now replaced by $P + R$, Q remaining unchanged such that the resultant makes an angle $\theta/2$ with $P + R$. The magnitude of this resultant is :

(1) $2R\sin\theta/2$ (2) $2R\cos\theta/2$ (3) $R\sin\theta/2$ (4) $3R\cos\theta/2$

78. Forces of 6, 8, 12 gm wt act along BC, CA, AB, the sides of a triangle of lengths 3, 4, 5 cms respectively. The resultant of these forces acting parallel to AB is :

(1) 2 gm wt (2) 3 gm wt

(3) 3.5 gm wt (4) 4 gm wt

79. The sides of a uniform triangular lamina are 5, 6, 9 cms. in length, the perpendicular distance of its centre of gravity from the shortest side is :

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

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

80. A force of 30 kg acting at an angle of 30° with the horizontal is about to drag a body of weight 60 kg lying on the floor. The co-efficient of friction is :

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

(3) $\mu = \sqrt{3}$ (4) $\mu = \frac{1}{\sqrt{3}}$

81. The centre and radius of the sphere $7x^2+7y^2+7z^2-6x-3y-2z=0$ are respectively :

(1) $\left(\frac{6}{7},\frac{3}{7},\frac{2}{7}\right),\frac{1}{4}$

(2) $\left(\frac{3}{7},\frac{3}{14},\frac{2}{7}\right),\frac{1}{2}$

(3) $\left(\frac{3}{7},\frac{3}{14},\frac{1}{7}\right),\frac{1}{2}$

(4) $\left(\frac{6}{7},\frac{3}{7},\frac{2}{7}\right),\frac{1}{2}$

82. The equation of the plane that bisects the line joining the points (1, 2, 3); (3, 4, 5) at right angles is :

(1) $x+y+z=0$

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

(3) $x-y+z=0$

(4) $x+y+z-9=0$

83. The equations of a straight line through the point (3, 1, – 6) and parallel to each of the planes $x+y+2z-4=0$ and $2x-3y+z+5=0$ are :

(1) $\frac{x-3}{7}=\frac{y-1}{3}=\frac{z+6}{-5}$

(2) $\frac{x+4}{3}=\frac{y-1}{3}=\frac{z-6}{5}$

(3) $\frac{x-3}{7}=\frac{y+1}{3}=\frac{z-6}{-5}$

(4) None of the above

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

(1) $3(x^2+2y^2+z^2)-2xz=0$

(2) $3(x^2+2y^2+z^2)-2xz+8yz-3=0$

(3) $x^2+y^2+z^2-2xz-8yz+3=0$

(4) None of the above

85. The vertex of the cone $4x^2-y^2+2z^2+2xy-3yz+12x-11y+6z+4=0$ is :

(1) (1, 2, 3)

(2) (1, 3, 4)

(3) (–1, –2, –3)

(4) (1, 2, –3)

86. The integrating factor of the differential equation $x(x-1)\frac{dy}{dx}=(x-2)y+x^3(2x-1)$ is :

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

87. The solution of the following differential equation is :

$\frac{dy}{dx}=\sin(x+y)+\cos(x+y)$.

(1) $ce^x=\tan\left(\frac{x+y}{2}\right)+1$ (2) $ce^x=\tan(x+y)+1$

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

88. Singular solution of the following D. E. is :

$y^2-2pxy+p^2x^2-(a^2p^2+b^2)=0$

(1) $a^2x^2+b^2y^2=1$ (2) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

(3) $x^2+y^2=\frac{a^2}{b^2}$ (4) $x^2+y^2=a^2b^2$

89. The P. I. of the following D. E. is :

$(D^2-5D+6)y=5^x$ $\left[D\equiv\frac{d}{dx}\right]$

(1) $5^x\log_e 5$ (2) $\frac{5^x}{2\log_e 5}$ (3) $\frac{5^x}{3\log_e 5}$ (4) $\frac{5^x}{\log_e\left(\frac{5}{e^2}\right).\log_e\left(\frac{5}{e^3}\right)}$

90. Integrating factor of the following D. E. is :

$\sin^2 x\frac{d^2y}{dx^2}=2y$

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

91. If a and b are any two positive integers with $a > b$ and n is the number of divisions in Euclid's algorithm, and if p is the number of digits in b then :

(1) $n \leq p$

(2) $n \geq 7p$

(3) $n \leq 5p$

(4) $n > 5p$

92. If $F_n = 2^{2^n} + 1$, then $F_0 F_1 \ldots\ldots\ldots F_{n-1}$ is equal to :

(1) F_n

(2) $F_n + 3$

(3) $F_n - 2$

(4) $F_n + 4$

93. If $n = p_1^{a1}, p_2^{a2} \ldots\ldots\ldots p_t^{at}$ be any positive integer where $p_1, p_2, \ldots\ldots\ldots, p_t$ are distinct prime, then Euler's $\phi(n)$ is equal to :

(1) $n\left(1-\frac{1}{p_1}\right)\left(1-\frac{1}{p_2}\right)\ldots\ldots\ldots\left(1-\frac{1}{p_t}\right)$

(2) $n.p_1 \, p_2 \ldots\ldots\ldots p_n$

(3) $n(p_1+1)(p_2+2)\ldots\ldots(p_t+t)$

(4) $n\left(1+\frac{1}{p_1}\right)\left(1+\frac{1}{p_2}\right)\ldots\ldots\ldots\left(1+\frac{1}{p_t}\right)$

94. Using Euler method, the general solution of the equation $21x + 13y = 1791$ is :

(1) $x = -t, y = 141 + 12t$

(2) $x = -2t, y = 141 + 13t$

(3) $x = 4t, y = -141 + 13t$

(4) $x = -2t, y = 122 + 13t$

95. A square of side a revolves about a line through a corner and perpendicular to the diagonal through that corner, then the volume and area of the surface of the solid generated are :

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

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

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

(4) $\pi a^3, 4\pi a^2$

96. If both m and n are positive integers, then $B(m, n)$ is equal to :

(1) $\frac{\lfloor m \, \lfloor n}{\lfloor m+n-1}$ (2) $\frac{\lfloor m-1 \, \lfloor n-1}{\lfloor m+n-1}$ (3) $\frac{\lfloor m+1 \, \lfloor n+1}{\lfloor m+n}$ (4) $\frac{\lfloor m+1 \, \lfloor n+1}{\lfloor m+n-2}$

97. $\int_0^{\pi/2} \sin^n \theta \, d\theta$ is equal to : (where $n > -1$)

(1) $\sqrt{\pi} . \frac{\Gamma(n+1)}{\Gamma(n+2)}$

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

(3) $\frac{\pi}{2} \frac{\Gamma\left(\frac{n+1}{2}\right)}{\Gamma\left(\frac{n-1}{2}\right)}$

(4) $\frac{\pi}{2} . \frac{\Gamma\left(\frac{n+1}{2}\right)}{\Gamma\left(\frac{n+2}{2}\right)}$

98. Area of the curve $r^2 = a^2 \cos^2 \theta + b^2 \sin^2 \theta$ is :

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

99. $\underset{n \to \infty}{Lt} \sum_{r=1}^{n-1} \frac{1}{n} \sqrt{\frac{n+r}{n-r}} =$

(1) $\pi + 1$

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

(3) $2\pi + 3$

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

100. If $f(t) = e^{-t} t^n$, then its Laplace Transform $F(s)$ is :

(1) $\frac{\Gamma(n+1)}{(s+1)^{n+1}}$

(2) $\frac{1}{s^2+1}$

(3) $\frac{\Gamma(n)}{s^{n+1}}$

(4) $\frac{\Gamma(n+1)}{s^2+1}$

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C

SET-Z

PG-EE-July, 2024

SUBJECT : Mathematics

Sr. No. 10255

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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SEAL

1. If $y = \tan^{-1}\left(\frac{x}{a}\right)$, then its nth derivative y_n is :

(1) $\frac{(-1)^{n-1}(n-1)!}{a^n}\sin^n\theta\cos n\theta$

(2) $\frac{(-1)^{n-1}(n-1)!}{a^n}\tan^n\theta\cos n\theta$

(3) $\frac{(-1)^{n-1}(n-1)!}{a^n}\sin^n\theta\sin n\theta$

(4) $\frac{(-1)^{n-1}(n-1)!}{a^n}\cos^n\theta\cos n\theta$

where $\theta = \tan^{-1}\left(\frac{a}{x}\right)$.

2. If $u = \phi(x-y, y-z, z-x)$, then $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}$ is equal to :

(1) 0

(2) 1

(3) u

(4) xyz

3. If α is a parameter, then envelop of the family of lines $x\cos\alpha + y\sin\alpha = a$ is :

(1) Parabola

(2) Circle

(3) Ellipse

(4) Hyperbola

4. The evolute of curve $2xy = a^2$ is :

(1) $x^{2/3}+y^{2/3}=a^{2/3}$

(2) $(x+y)^{2/3}+(x-y)^{2/3}=a^{2/3}$

(3) $(x+y)^{2/3}+(x-y)^{2/3}=2a^{2/3}$

(4) $(x+y)^{2/3}-(x-y)^{2/3}=2a^{2/3}$

5. Maximum curvature of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is :

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

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

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

(4) $\frac{b}{2a}$

6. The minimum value of $\sqrt{x^2+y^2}$, under the condition $x^2+xy+y^2=1$ is :

(1) 1

(2) $\sqrt{2}$

(3) $\sqrt{3}$

(4) $\frac{\sqrt{6}}{2}$

7. The sequence $\{x_n\}$ where :

$x_n = \frac{1}{n+1}+\frac{1}{n+2}+........+\frac{1}{2n}$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory

(4) None of the above

8. If $x = a(\cos\theta + \theta\sin\theta)$, $y = a(\sin\theta - \theta\sin\theta)$, then the value of $\frac{d^2y}{dx^2}$ at $\theta = \pi$ is :

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

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

(3) $-\frac{1}{a\pi}$

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

9. What is the degree and order of the following differential equation ?

$$\left(\frac{d^3y}{dx^3}\right)^{2/3} - 3\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 4y = 1$$

(1) 3, 3

(2) $2/3$, 3

(3) 3, 2

(4) 2, 3

10. If n is a natural number, then

$$\frac{\sum_{r=1}^{n} r^3}{\sum_{r=1}^{n} r(r+1)} \text{ is equal to :}$$

(1) $\frac{3}{2}\cdot\frac{n}{n+1}$

(2) $\frac{3}{2}\cdot\frac{n+1}{n+2}$

(3) $\frac{3}{2}\cdot\frac{n}{n+4}$

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

11. If $r = a\cos t\, i + a\sin t\, j + tk$, then the value of $\left|\frac{d^2r}{dt^2}\right|$ is :

(1) $-a\cos t\, i - a\sin t\, j$

(2) $\sqrt{(a^2\cos^2 t + a^2\sin^2 t) + t}$

(3) $a\cos t + a\sin t$

(4) a

12. If $r = xi + yj + zk$, then grad r is :

(1) $\frac{x}{r} + \frac{y}{r} + \frac{z}{r}$

(2) $\frac{1}{r}(xi + yj + zk)$

(3) $xi + yj + zk$

(4) None of the above

13. If c is a regular closed curse in xy-plane, enclosing a region S and $P(x, y)$ and $Q(x, y)$ be two continuously differentiable functions in the region S i.e. inside and on c, then $\iint_S \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right) dx\, dy$ is equal to :

(1) $\int_c (P\,dx + Q\,dy)$

(2) $\int_c (Q\,dy - P\,dx)$

(3) $\int_c \frac{\partial x}{\partial y}(P + Q)$

(4) $\int_c \frac{\partial^2}{\partial y^2}(P\,dx + Q\,dy)$

14. The value of $\int_s (axi + byj + czk).\hat{n}\,ds$ is :

(1) $a + b + c$

(2) $\frac{4}{3}(a + b + c)$

(3) $\frac{4}{3}\pi(a + c + b)$

(4) $a^2 + b^2 + c^2$

15. If $f(t) = ti - 3j + 2tk$, $g(t) = i - 2j + 2k$ and $h(t) = 3i + tj - k$, then the value of $\int_1^2 f.(g \times h)\,dt$ is :

(1) 0

(2) 1

(3) 2

(4) 3

16. If $u = \tan^{-1}\left(\frac{y}{x}\right)$, then $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$ is equal to :

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

(2) $\frac{x}{x^2 + y^2}$

(3) 0

(4) $\frac{x}{y}$

17. Which of the following function is not differentiable at $x = 0$?

(1) $x\,|\,x\,|$

(2) $x + |\,x\,|$

(3) e^{-x}

(4) x^3

18. If $f(x) = 3x^3 - 5x^2 + 2x$, then the interval for which f satisfies all the conditions of Roll's theorem is :

(1) [0, 1]

(2) [–1, 1]

(3) [–1, 0]

(4) [1, 2]

19. If Lagrange's theorem is true for the function $f(x) = x^3 - 3x - 2$ in the interval [–2, 3], then the value of c where it is true is :

(1) 0

(2) $\sqrt{7/3}$

(3) $\sqrt{\frac{3}{7}}$

(4) 1

20. If the function $f(x) = x(x - 2)$ is continuous in $\left[0, \frac{3}{2}\right]$ and differentiable in $\left(0, \frac{3}{2}\right)$, then the value of '$c$' of the mean value theorem is :

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

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

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

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

21. A matrix A such that $A^2 = I$ or $(I + A)(I - A) = 0$ is called :

(1) Idempotent

(2) Nilpotent

(3) Involuntory

(4) None of the above

22. If for a square matrix A of order n, $|A - \lambda I| = a_0\lambda^n + a_1\lambda^{n-1} + \dots\dots\dots + a_n$, then $a_0A^n + a_1A^{n-1} + \dots\dots\dots + a_nI$ is equal to :

(1) 0 (2) I_n

(3) $J_{n \times n}$ (4) I_nA^{-1}

23. If A is an $m \times n$ matrix of rank r_A and B is an $n \times p$ matrix of rank r_B such that $AB = 0$, then which of the following is ***true*** ?

(1) $r_A + r_B = p$

(2) $r_A + r_B \leq n$

(3) $r_A + r_B > n$

(4) $r_A + r_B = n + p$

24. A square matrix A of order n is such that $A'A = I = AA'$, then $|A|$ is equal to :

(1) 1 (2) n

(3) ± 1 (4) $n - 1$

25. The canonical form of a Quadratic Form is $-21y_1^2 - \frac{2}{7}y_2^2$. The rank and the index of this Q. F. are 2 and 0 respectively, then the nature of this Q. F. is :

(1) Positive definite

(2) Negative definite

(3) Semi-positive definite

(4) Semi-negative definite

26. Given the function $f(x)=\begin{cases} x^2 & , \quad x \le c \\ ax+b & , \quad x > c \end{cases}$ is differentiable at $x = c$. The values of a and b are respectively :

(1) $2c, -c^2$ (2) $c^2, 2c$

(3) $c, -c^2$ (4) $-c^2, 2c$

27. If $y=\sqrt{x+\sqrt{x+\sqrt{x+\ldots\ldots \text{ to } \infty}}}$, then $\frac{dy}{dx}$ is equal to :

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

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

28. The radius of curvature at the vertex of the cycloid $x=a(\theta+\sin\theta)$, $y=a(1-\cos\theta)$ is :

(1) $4a$ (2) $a+\sin\theta$

(3) $2a$ (4) $2a+3$

29. The asymptotes of the curve $(x^2-y^2)(x+2y+1)+x+y+1=0$ are :

(1) $y=\pm x\ ;\ x+2y+1=0$

(2) $y=\pm x\ ;\ x+y+1=0$

(3) $y=x\ ;\ x+2y+1=0\ ;\ x+y+1=0$

(4) $y=-x\ ;\ x+2y+1=0\ ;\ x+y+1=0$

30. The curve $y^2(2a-x)=x^3$ has :

(1) Node

(2) Cusp

(3) Conjugate point

(4) None of these

31. The value of integral $\iint_R y\,dx\,dy$ where R is the region bounded by the parabolas $y^2 = 4x$ and $x^2 = 4y$ is :

(1) $\frac{32}{5}$ (2) $\frac{48}{5}$

(3) $\frac{16}{5}$ (4) $\frac{16\sqrt{2}}{5}$

32. The value of $\iiint_{x^2+y^2+z^2\le 1} (x^2 + y^2 + z^2)\,dx\,dy\,dz$ is :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{5}$ (3) $\frac{4\pi}{5}$ (4) $\frac{4\pi}{15}$

33. The locus of z when $\text{amp}\left(\frac{z-1}{z+1}\right) = \frac{\pi}{3}$ is :

(1) $x^2 + y^2 - \left(\frac{2}{\sqrt{3}}\right)y - 1 = 0$ (2) $x^2 + y^2 - 2y = 0$

(3) $x^2 + y^2 + \frac{2}{\sqrt{3}}y + 1 = 0$ (4) $x^2 + y^2 + 2y - 1 = 0$

34. $\lim_{z \to 2e^{\frac{\pi i}{3}}} \frac{z^3 + 8}{z^4 + 4z^2 + 16} = \text{.............}$

(1) $\frac{3 - i\sqrt{3}}{2}$ (2) $\frac{1}{8}(3 - i\sqrt{3})$

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

35. The bilinear transformation $w = \frac{3z - 4}{z - 1}$ is :

(1) Elliptic (2) Parabolic

(3) Hyperbolic (4) None of these

36. The circle of convergence of power series $\sum_{n=1}^{\infty}\left(\frac{2i}{z+i+1}\right)^n$ is :

(1) $|z+i|<2$
(2) $|z+i|>2$
(3) $|z+i+1|>2$
(4) $|z+i+1|<2$

37. If $f(z)=\frac{z^3+3z+1}{z-3}$ and path of integration is a circle with centre at the origin and radius r, the Cauchy theorem is applicable when r equals :

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

38. A particle moves in a curve so that its tangential and normal accelerations are equal and the angular velocities of the tangent is constant. The path of the particle is given by :

(1) $s=Ae^{\psi}+B$ where $A=\frac{C}{w}$, B and C are constants

(2) $s=2A\log v+\log C$

(3) $s=Ae^{\psi}+B\log C$

(4) $s=A\log\psi+Be^{\psi}+C$

39. A particle is moving with S.H.M. of amplitude a. Its velocity at any point x is :

(1) $v=\sqrt{u(a^2-x^2)}$
(2) $u=u(a^2-x^2)$
(3) $v=\sqrt{u(a^2+x^2)}$
(4) $v=u(a^2+x^2)$

40. If the time of the flight of a bullet over a horizontal range R is T, the angle of projection is :

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

41. Let X has a two parameter gamma distribution with parameters λ, k ($\lambda > 0$ is the scale parameter and $k > 0$ is the shape parameter) with density function

$$f_{\lambda,k}(x) = \begin{cases} \dfrac{\lambda^k x^{k-1} e^{-\lambda x}}{\Gamma(k)} & , \quad x > 0 \\ 0 & , \quad x < 0 \end{cases}$$

, then its L.T. $f^*(s)$ is given by :

(1) $\dfrac{1}{(s+1)^2}$ (2) $\left(\dfrac{\lambda}{s+\lambda}\right)^k$ (3) $\left(\dfrac{s+\lambda}{\lambda}\right)^k$ (4) $\left(\dfrac{\lambda+k}{s+\lambda}\right)^{k-1}$

42. What will be the output of the program :

```
main ( )
{
int a = 1, b = 2, c = 3 ;
printf ("%d", a + = (a + = 3, 5, a))
}
```

(1) 6 (2) 9 (3) 12 (4) 8

43. Which of the following comment is correct when a macro definition includes arguments ?

(1) The opening parenthesis should immediately follow the macro name.

(2) There should be at least one blank between the macro name and the opening parenthesis.

(3) There should be only one blank between the macro name and the opening parenthesis.

(4) All the above comments are correct.

44. Which one of the following is a loop construct that will always be executed once ?

(1) for (2) while (3) switch (4) do while

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

(1) A pointer to an int and a pointer to a double are of the same size.

(2) A pointer must point to a data item on the heap (free store).

(3) A pointer can be reassigned to point to another data item.

(4) A pointer can point to an array.

46. What does this statement mean ?

$x -= y + 1$;

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

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

(3) $x = x - y - 1$

(4) $x = x + y - 1$

47. Value of $\int \cos^2 x \sin^2 x \, dx$ is :

(1) $\frac{1}{8}\left[x - \frac{\cos 2x}{2}\right]$

(2) $\frac{1}{4}\left[x - \frac{\cos 2x}{2}\right]$

(3) $\frac{1}{8}\left[x - \frac{\sin 2x}{2}\right]$

(4) $\frac{1}{4}\left[x - \frac{\sin 2x}{2}\right]$

48. If $f(x) = x, x \in [0, 1]$ and f is R-integrable on $[0, 1]$, then $\int_0^1 x \, dx$ is equal to :

(1) 1

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

(3) 2

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

49. The sum of n terms of a series is $S_n = \frac{n^2 x}{1 + n^4 x^2}$, then for this series which statement is ***true*** ?

(1) Converges uniformly.

(2) Does not converge uniformly.

(3) Converges uniformly only in the interval (0, 1).

(4) Each term is continuous in an interval (a, b).

50. Find the value of c which satisfies the mean value theorem for the given function, $f(x) = x^2 + 2x + 1$ on $[1, 2]$?

(1) $10/2$

(2) $13/2$

(3) $-13/2$

(4) $-7/2$

51. The pedal equation of the curve $x^2 + y^2 = 2ax$ is :

(1) $r^2 = ap$

(2) $r^2 = \frac{a}{p}$

(3) $r^2 = 2ap$

(4) $r^2 = ap^2$

52. The length of subnormal to parabola $y^2 = 4ax$ is :

(1) $2a$ (2) $4a$

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

53. For the curve $y = a\log\left(\sec\frac{x}{a}\right)$, the chord of curvature parallel to y-axis is equal to :

(1) a (2) $2a$

(3) $3a$ (4) $4a$

54. The radius of curvature of the curve $y = a\sin\psi\cos\psi$ is :

(1) p (2) $3p$

(3) $4p$ (4) $2p$

55. If $u = \tan^{-1}\frac{x^3 + y^3 + x^2y - xy^2}{x^2 - xy + y^2}$, then the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(1) 0

(2) $\sin u$

(3) $\sin 2u$

(4) $\frac{1}{2}\sin 2u$

56. If $x = r\cos\theta$ and $y = r\sin\theta$, then $\dfrac{\partial(r, \theta)}{\partial(x, y)}$ is :

(1) r

(2) $r\sin\theta$

(3) $\dfrac{r}{\sin\theta}$

(4) $\dfrac{1}{r}$

57. If $a > 0$, $b > 0$, then the maximum value of $a\cos\theta + b\sin\theta$ is :

(1) $a + b$

(2) $a - b$

(3) a or b

(4) $\sqrt{a^2 + b^2}$

58. Sequence $\left(1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \frac{1}{5}, -\frac{1}{6}, \ldots\ldots\ldots\right)$ is :

(1) Monotonic but not bounded

(2) Bounded but not monotonic

(3) Monotonic and bounded

(4) Neither monotonic nor bounded

59. Maxima and Minima value of the set $S = \left\{1 + \frac{(-1)^n}{n}\ ; n \in N\right\}$ are :

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

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

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

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

60. Series $\left(\frac{2^2}{1^2} - \frac{2}{1}\right)^{-1} + \left(\frac{3^3}{2^3} - \frac{3}{2}\right)^{-2} + \left(\frac{4^4}{3^4} - \frac{4}{3}\right)^{-3} + \ldots\ldots\ldots$ is :

(1) Convergent

(2) Divergent

(3) Oscillatory finitely

(4) Oscillatory infinitely

61. Which of the following is ***not*** a necessary condition for Cauchy's Mean Value Theorem ?

(1) The functions, $f(x)$ and $g(x)$ be continuous in $[a, b]$

(2) The derivative of $g'(x)$ be equal to 0

(3) The functions $f(x)$ and $g(x)$ be derivable in (a, b)

(4) There exists a value $c \in (a, b)$ such that $\frac{f(b)-f(a)}{g(b)-g(a)} = \frac{f'(c)}{g'(c)}$.

62. A group (G, $*$) is said to be abelian if ....

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

(2) $x * y = y * x$

(3) $x + y = x$

(4) $x * y = x * y$

63. Which of the following is ***not*** necessarily a property of a group ?

(1) Commutatively

(2) Associativity

(3) Existence of inverse for every element

(4) Existence of identity

64. Let $x = (0, 1)$ be the open unit interval and $C(x, R)$ be the ring of continuous functions from x to R. For any $x \in (0, 1)$, let $l(x) = \{f \in C(x, R) \mid f(x) = 0\}$. Then which of the following ***true*** ?

(1) $l(x)$ is a prime ideal.

(2) $l(x)$ is a maximal ideal.

(3) Every maximal ideal of $C(x, R)$ is equal to $l(x)$ for some $x \in x$.

(4) Only (1) and (2) are true.

65. Let R be a commutative ring with unity. Which of the following is ***true*** ?

(1) If R has finitely many prime ideals, then R is a field.

(2) If R has infinitely many ideals, then R is finite.

(3) If R is a P.I.D., then every subring of R with unity is a P.I.D.

(4) If R is an integral domain which has finitely many ideals, then R is a field.

66. Let $R = Z[X]/(x^2 + 1)$ and $\psi : Z(X) \to R$ be the natural quotient map. Which of the following statements are ***true*** ?

(1) R is isomorphic to a subring of C.

(2) The ideal generated by $\psi(X)$ is a prime ideal in R.

(3) R has infinitely many prime ideals.

(4) Only (1) and (3) are true.

67. The number of ring homomorphisms from $f : Z[x, y] \longrightarrow \dfrac{F[X]}{(x^3 + x^2 + x + 1)}$ equals :

(1) 2^6

(2) 2^{18}

(3) 1

(4) 2^9

68. The total number of non-isomorphic groups of order 122 is :

(1) 2

(2) 1

(3) 61

(4) 4

69. Let G be a group order 6 and H be a subgroup of G such that $1 < |H| < 6$. Which one of the following options is ***correct*** ?

(1) G is always cyclic, but H may not be cyclic.

(2) G may not be cyclic, but H is always cyclic.

(3) Both G and H are always cyclic.

(4) Both G and H may not be cyclic.

70. The number of generators of a cyclic group of order 10 is :

(1) 2

(2) 3

(3) 4

(4) 5

71. Using Gauss Elimination method, the solution of equations $2x-y+3z=9$, $x+y+z=6$, $x-y+z=2$ is :

(1) $x=-13, y=1, z=-8$

(2) $x=13, y=1, z=-8$

(3) $x=-13, y=4, z=15$

(4) $x=5, y=14, z=5$

72. While solving the equation $x^2-3x+1=0$ using Newton-Raphson method the initial guess of the root is as 1, then the value of the root will be :

(1) 1.5 (2) 1

(3) 0.5 (4) 0

73. For a fixed $C \in R$, let $\alpha = \int_0^2 (9x^2-5Cx^4)\,dx$. If the value of this integral obtained by using the Trapezoidal rule is equal to α, then the value of C (rounded off 2 decimal places) is :

(1) 0.5 (2) 0.24

(3) 0.12 (4) 0.76

74. If $f(x)=x^2$, then the second order divided difference for the points x_0, x_1, x_2 will be :

(1) -1 (2) $\frac{-1}{x_1-x_0}$

(3) 1 (4) $\frac{1}{x_2-x_1}$

75. Which of the following is termed as an action of pull or push of a body at rest or motion ?

(1) Torque (2) Momentum

(3) Work (4) Force

76. What is the relationship between each force, if three concurrent forces acting on a body according to Lami's theorem ?

(1) Directly proportional to the sine of the angle between the other two forces

(2) Inversely proportional to the cosine of the angle between the other two forces

(3) Directly proportional to the cosine of the angle between the other two forces

(4) Inversely proportional to the tangent of the angle between the other two forces

77. The resultant R of forces P and Q makes an angle θ with the line of action of P. P is now replaced by $P+R$, Q remaining unchanged such that the resultant makes an angle $\theta/2$ with $P+R$. The magnitude of this resultant is :

(1) $2R\sin\theta/2$ (2) $2R\cos\theta/2$ (3) $R\sin\theta/2$ (4) $3R\cos\theta/2$

78. Forces of 6, 8, 12 gm wt act along BC, CA, AB, the sides of a triangle of lengths 3, 4, 5 cms respectively. The resultant of these forces acting parallel to AB is :

(1) 2 gm wt (2) 3 gm wt

(3) 3.5 gm wt (4) 4 gm wt

79. The sides of a uniform triangular lamina are 5, 6, 9 cms. in length, the perpendicular distance of its centre of gravity from the shortest side is :

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

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

80. A force of 30 kg acting at an angle of 30° with the horizontal is about to drag a body of weight 60 kg lying on the floor. The co-efficient of friction is :

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

(3) $\mu=\sqrt{3}$ (4) $\mu=\frac{1}{\sqrt{3}}$

81. The centre and radius of the sphere $7x^2+7y^2+7z^2-6x-3y-2z=0$ are respectively :

(1) $\left(\frac{6}{7},\frac{3}{7},\frac{2}{7}\right),\frac{1}{4}$

(2) $\left(\frac{3}{7},\frac{3}{14},\frac{2}{7}\right),\frac{1}{2}$

(3) $\left(\frac{3}{7},\frac{3}{14},\frac{1}{7}\right),\frac{1}{2}$

(4) $\left(\frac{6}{7},\frac{3}{7},\frac{2}{7}\right),\frac{1}{2}$

82. The equation of the plane that bisects the line joining the points (1, 2, 3); (3, 4, 5) at right angles is :

(1) $x+y+z=0$

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

(3) $x-y+z=0$

(4) $x+y+z-9=0$

83. The equations of a straight line through the point (3, 1, – 6) and parallel to each of the planes $x+y+2z-4=0$ and $2x-3y+z+5=0$ are :

(1) $\frac{x-3}{7}=\frac{y-1}{3}=\frac{z+6}{-5}$

(2) $\frac{x+4}{3}=\frac{y-1}{3}=\frac{z-6}{5}$

(3) $\frac{x-3}{7}=\frac{y+1}{3}=\frac{z-6}{-5}$

(4) None of the above

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

(1) $3(x^2+2y^2+z^2)-2xz=0$

(2) $3(x^2+2y^2+z^2)-2xz+8yz-3=0$

(3) $x^2+y^2+z^2-2xz-8yz+3=0$

(4) None of the above

85. The vertex of the cone $4x^2-y^2+2z^2+2xy-3yz+12x-11y+6z+4=0$ is :

(1) (1, 2, 3)

(2) (1, 3, 4)

(3) (–1, –2, –3)

(4) (1, 2, –3)

86. The integrating factor of the differential equation $x(x-1)\frac{dy}{dx} = (x-2)y + x^3(2x-1)$ is :

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

87. The solution of the following differential equation is :

$\frac{dy}{dx} = \sin(x+y) + \cos(x+y)$.

(1) $ce^x = \tan\left(\frac{x+y}{2}\right) + 1$ (2) $ce^x = \tan(x+y) + 1$

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

88. Singular solution of the following D. E. is :

$y^2 - 2pxy + p^2x^2 - (a^2p^2 + b^2) = 0$

(1) $a^2x^2 + b^2y^2 = 1$ (2) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

(3) $x^2 + y^2 = \frac{a^2}{b^2}$ (4) $x^2 + y^2 = a^2b^2$

89. The P. I. of the following D. E. is :

$(D^2 - 5D + 6)y = 5^x$ $\left[D \equiv \frac{d}{dx}\right]$

(1) $5^x \log_e 5$ (2) $\frac{5^x}{2\log_e 5}$ (3) $\frac{5^x}{3\log_e 5}$ (4) $\frac{5^x}{\log_e\left(\frac{5}{e^2}\right).\log_e\left(\frac{5}{e^3}\right)}$

90. Integrating factor of the following D. E. is :

$\sin^2 x \frac{d^2y}{dx^2} = 2y$

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

91. If a and b are any two positive integers with $a > b$ and n is the number of divisions in Euclid's algorithm, and if p is the number of digits in b then :

(1) $n \le p$ (2) $n \ge 7p$

(3) $n \le 5p$ (4) $n > 5p$

92. If $F_n = 2^{2^n} + 1$, then $F_0 F_1 \ldots\ldots F_{n-1}$ is equal to :

(1) F_n (2) $F_n + 3$

(3) $F_n - 2$ (4) $F_n + 4$

93. If $n = p_1^{a1}, p_2^{a2} \ldots\ldots p_t^{at}$ be any positive integer where $p_1, p_2, \ldots\ldots, p_t$ are distinct prime, then Euler's $\phi(n)$ is equal to :

(1) $n\left(1-\frac{1}{p_1}\right)\left(1-\frac{1}{p_2}\right)\ldots\ldots\left(1-\frac{1}{p_t}\right)$

(2) $n.p_1 p_2 \ldots\ldots p_n$

(3) $n(p_1+1)(p_2+2)\ldots\ldots(p_t+t)$

(4) $n\left(1+\frac{1}{p_1}\right)\left(1+\frac{1}{p_2}\right)\ldots\ldots\left(1+\frac{1}{p_t}\right)$

94. Using Euler method, the general solution of the equation $21x + 13y = 1791$ is :

(1) $x = -t, y = 141 + 12t$ (2) $x = -2t, y = 141 + 13t$

(3) $x = 4t, y = -141 + 13t$ (4) $x = -2t, y = 122 + 13t$

95. A square of side a revolves about a line through a corner and perpendicular to the diagonal through that corner, then the volume and area of the surface of the solid generated are :

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

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

96. If both m and n are positive integers, then $B(m, n)$ is equal to :

(1) $\dfrac{\lfloor m \lfloor n}{\lfloor m+n-1}$ (2) $\dfrac{\lfloor m-1 \lfloor n-1}{\lfloor m+n-1}$ (3) $\dfrac{\lfloor m+1 \lfloor n+1}{\lfloor m+n}$ (4) $\dfrac{\lfloor m+1 \lfloor n+1}{\lfloor m+n-2}$

97. $\int_0^{\pi/2} \sin^n \theta \, d\theta$ is equal to : (where $n > -1$)

(1) $\sqrt{\pi}.\dfrac{\Gamma(n+1)}{\Gamma(n+2)}$

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

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

(4) $\dfrac{\pi}{2}.\dfrac{\Gamma\left(\frac{n+1}{2}\right)}{\Gamma\left(\frac{n+2}{2}\right)}$

98. Area of the curve $r^2 = a^2 \cos^2 \theta + b^2 \sin^2 \theta$ is :

(1) $(a+b)\dfrac{\pi}{2}$ (2) $2\pi(a^2+b^2)$ (3) $(a^2+b^2)\dfrac{\pi}{2}$ (4) $4\pi(a^2+b^2)$

99. $\underset{n\to\infty}{Lt} \sum_{r=1}^{n-1} \dfrac{1}{n}\sqrt{\dfrac{n+r}{n-r}} =$

(1) $\pi + 1$

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

(3) $2\pi + 3$

(4) $\dfrac{4}{3}\left(\dfrac{\pi}{2}+1\right)$

100. If $f(t) = e^{-t}t^n$, then its Laplace Transform $F(s)$ is :

(1) $\dfrac{\Gamma(n+1)}{(s+1)^{n+1}}$

(2) $\dfrac{1}{s^2+1}$

(3) $\dfrac{\Gamma(n)}{s^{n+1}}$

(4) $\dfrac{\Gamma(n+1)}{s^2+1}$

Answer keys of M.Sc.(Mathematics)/M.Sc.(Mathematics) under SFS entrance exam dated 15.07.2024				
Q. NO.	A	B	C	D
1	3	2	3	3
2	1	2	1	4
3	2	1	2	1
4	3	4	4	2
5	4	4	3	3
6	1	4	2	3
7	3	1	1	1
8	1	1	3	2
9	1	2	2	4
10	2	3	4	4
11	3	3	4	2
12	4	3	2	3
13	1	1	1	1
14	2	2	3	2
15	3	1	1	2
16	3	2	3	3
17	1	4	2	4
18	2	3	1	1
19	4	2	2	1
20	4	1	4	4
21	4	3	3	2
22	2	1	1	2
23	1	2	2	1
24	3	2	3	4
25	1	3	4	4
26	3	4	1	4
27	2	4	3	1
28	1	2	1	1
29	2	1	1	2
30	4	1	2	3
31	3	3	2	3
32	1	4	3	3
33	2	1	1	1
34	2	2	2	2
35	3	3	2	1
36	4	3	3	2
37	4	1	4	4
38	2	2	1	3
39	1	4	1	2
40	1	4	4	1
41	3	2	2	3
42	1	3	4	1
43	2	1	1	2
44	4	2	4	2
45	3	2	2	3
46	2	3	3	4
47	1	4	3	4
48	3	1	2	2
49	2	1	2	1
50	4	4	4	1

Answer keys of M.Sc.(Mathematics)/M.Sc.(Mathematics) under SFS entrance exam dated 15.07.2024				
Q. NO.	A	B	C	D
51	3	2	3	4
52	3	4	1	2
53	1	1	2	1
54	2	4	2	3
55	1	2	3	1
56	2	3	4	3
57	4	3	4	2
58	3	2	2	1
59	2	2	1	2
60	1	4	1	4
61	2	3	2	3
62	4	4	2	1
63	1	2	1	2
64	4	3	4	4
65	2	4	4	3
66	3	1	4	2
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71	2	3	3	2
72	2	1	4	4
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74	4	4	3	4
75	4	3	4	2
76	4	2	1	3
77	1	1	2	3
78	1	3	1	2
79	2	2	3	2
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89	3	2	4	1
90	4	4	4	2
91	2	3	3	3
92	3	1	3	4
93	1	2	1	2
94	2	3	2	3
95	2	4	1	4
96	3	1	2	1
97	4	3	4	2
98	1	1	3	1
99	1	1	2	3
100	4	2	1	4

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