Oben Univer (DO NOT OPEN TH A	in for uploading. Answer in the website at 2:05 Pr 14 METIM Total I IS QUESTION BOOKLET BEFORE ARE ASKED TO DO SO) PG-EE-July, 2024 SUBJECT : Mathematics	No. of Printed Pages: 21 TIME OR UNTIL YOU Fighter SET-Z
Time : 1¼ Hours Roll No. (in figures)	Max. Marks : 100 (in words)	Sr. No
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- 1. A matrix A such that $A^2 = I$ or (I + A)(I A) = 0 is called :
 - (1) Idempotent

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- (2) Nilpotent
- (3) Involuntory
- (4) None of the above
- 2. If for a square matrix A of order n, $|A \lambda I| = a_0 \lambda^n + a_1 \lambda^{n-1} + \dots + a_n$, then $a_0 A^n + a_1 A^{n-1} + \dots + a_n I$ is equal to :

(1) 0(3) $J_{n \times n}$

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

- **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

 $(2) \cdot n$

- $(3) \pm 1$ (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
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6. Given the function $f(x) = \begin{cases} x^2 & x \le c \\ ax + b & x > c \end{cases}$ is differentiable at x = c. The values of a

and b are respectively :

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

7. If
$$y = \sqrt{x + \sqrt{x + \sqrt{x + \dots + \cos \infty}}}$$
, 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

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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, $\frac{x}{1} = \frac{y}{1} = \frac{z}{1}$ 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)

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

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(4)

(4) $\cot x$

(7.) El Mainennetick/ Mainennetics/ 987-201-21 (7.)

 $\log_e\left(\frac{5}{e^2}\right) \cdot \log_e\left(\frac{5}{e^3}\right)$

(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 :

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$$y^{2} - 2pxy + p^{2}x^{2} - (a^{2}p^{2} + b^{2}) = 0$$
(1) $a^{2}x^{2} + b^{2}y^{2} = 1$
(2) $\frac{x^{2}}{a^{2}} + \frac{y^{2}}{b^{2}} = 1$
(3) $x^{2} + y^{2} = \frac{a^{2}}{b^{2}}$
(4) $x^{2} + y^{2} = a^{2}b^{2}$

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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)

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

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

(1) $\sin x$ (2) $\cos x$

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(3) tan x

 $3\log_e 5$

21. 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

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

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

$$\binom{2}{r} - (x_i + y_j + z_k)$$

(3) xi + yj + zk

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(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 $\iint_{S} \left(\frac{\partial Q}{\partial x} \frac{\partial P}{\partial y}\right) dx \, dy \text{ is equal to :}$
 - (1) $\int (P dx + Q dy)$ (2) $\int (Q dy P dx)$
 - (3) $\int_{c} \frac{\partial x}{\partial y} (P+Q) = 1$

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

(1) a + b + c

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

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

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

(3) 0
(2) $\frac{x^2 + y^2}{x^2 + y^2}$
(4) $\frac{x}{y}$

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- **27.** Which of the following function is not differentiable at x = 0?
 - (2) x + |x|(1) x |x|(4) x^{3} (3) e^{-x}
- A bus & content a grisolone paint provident curse in a region & and Fig. 28. If $f(x) = 3x^3 - 5x^2 + 2x$, then the interval for which f satisfies all the conditions of Roll's theorem is :
 - (2) [-1, 1] (4) [1, 2] (1) [0, 1](day - Park) (3) [-1, 0]
- If Lagrange's theorem is true for the function $f(x) = x^3 3x 2$ in the interval [-2, 3], 29. then the value of c where it is true is :

(0.10) - (4) 1

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

(1) 0

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

30. If the function f(x) = x(x-2) is continuous in $\begin{bmatrix} 0, \frac{3}{2} \end{bmatrix}$ and differentiable in $\begin{pmatrix} 0, \frac{3}{2} \end{pmatrix}$, then the value of 'c' of the mean value theorem is : (1) $\frac{1}{2}$ (2) $\frac{3}{2}$ S. Cex high i $(4) \frac{3}{4}$ (3) $\frac{1}{4}$

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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 = ap
- The length of subnormal to parabola $y^2 = 4ax$ is : 32.
 - (1) 2*a* (2) 4*a* (4) 2*a*√2 (3) *a*√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 : inorone in the automotion of

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- (1) *a* (2) 2a (3) 3*a* (4) 4*a*
- 34. The radius of curvature of the curve $y = a \sin \psi \cos \psi$ is :

(1) *p* (2) 3p(4) 2p (3) 4p **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) $\sin 2u$ 1000 10 / CL (L) (Conversion) ($(4) \frac{1}{2} \sin 2u$ Hourist wrotel and (4 (i) (Building in itel

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(4) Neirner (dollarionic net bounded

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) sinθ

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

(4)

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

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

(1) Monotonic but not bounded - sevent in the choost of curviture parallel "by why as a sec

(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 :

$(1)\left(\frac{3}{2},0\right)$ $(4)\left(\frac{3}{2},1\right)$ $(3)\left(1,\frac{3}{2}\right)$ 40. Series $\left(\frac{2^2}{1^2} - \frac{2}{1}\right)^{-1} + \left(\frac{3^3}{2^3} - \frac{3}{2}\right)^{-2} + \left(\frac{4^4}{3^4} - \frac{4}{3}\right)^{-3} + \dots$ is :

(1) Convergent

(3) Oscillatory finitely

(2) Divergent

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

(4) Oscillatory infinitely

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41. If
$$y = \tan^{-1}\left(\frac{x}{a}\right)$$
, then its *n*th 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
(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 :
 - (2) $(x+y)^{\frac{2}{3}} + (x-y)^{\frac{2}{3}} = a^{\frac{2}{3}}$ (1) $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ (4) $(x+y)^{\frac{2}{3}} - (x-y)^{\frac{2}{3}} = 2a^{\frac{2}{3}}$ (3) $(x+y)^{\frac{2}{3}} + (x-y)^{\frac{2}{3}} = 2a^{\frac{2}{3}}$
- **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) $\frac{b}{2a}$

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46. The minimum value of $\sqrt{x^2 + y^2}$, under the condition $x^2 + xy + y^2 = 1$ is : (2) √2 (1) 1 (4) $\frac{\sqrt{6}}{2}$ (3) √3

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

- x_n n+1 n+2 2n 2n
- (1) Convergent

(3) Oscillatory

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- (2) Divergent
- is count wi (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 $\frac{d^2 y}{dx^2}$ 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 ?

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

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

50. If n is a natural number, then

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

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



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 :

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(1) (a+ b) [21] . (2)] (1)

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- (1) $n \le p$ (3) $n \le 5p$ (2) $n \ge 7p$ (4) n > 5p
- 52. If $F_n = 2^{2^n} + 1$, then $F_0 F_1 \dots F_{n-1}$ is equal to : (1) F_n (2) $F_n + 3$

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

53. If $n = p_1^{a_1}, p_2^{a_2}, \dots, p_t^{a_t}$ be any positive integer where p_1, p_2, \dots, p_t are distinct prime, then Euler's $\phi(n)$ is equal to :

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

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

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

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

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) πa^3 , $4\pi a^2$

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

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

 $\sin^n \theta d\theta$ is equal to : (where n > -1) 57.

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

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

1 + 1 + 1 + 1 + = - (1)

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(1) V. D. J. 4 (2#0²

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

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 $(1) \pi + 1$

(3) $2\pi + 3$

55. White the story of story acoust a interance of dependent and planendication ind 60. 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) $\frac{\Gamma(n)}{n+1}$
(4) $\frac{\Gamma(n+1)}{s^2+1}$



61. 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 $f_{\lambda,k}(x) = \begin{cases} \frac{\lambda^k x^{k-1} e^{-\lambda x}}{1'(k)}, & x > 0 \\ 0, & x < 0 \end{cases}$, 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))

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- (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.

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66. What does this statement mean?

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

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

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

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

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

(1) 1

(3) 2

(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 :

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

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

 $\frac{3}{2} = \frac{3}{2} = \frac{3}$

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, $f(x) = x^{2} + 2x + 1 \text{ on } [1, 2] ?$ (1) $\frac{10}{2}$ (2) $\frac{13}{2}$ (3) $-\frac{13}{2}$ (4) $-\frac{7}{2}$

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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 $\frac{f(b) - f(a)}{f(b)} = \frac{f'(c)}{f(a)}$ $g(b) - g(a) \quad g'(c)$

- 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. the not promition self. (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. PG-EE-July-2024/(Mathematics)(SET-Z)/(A)



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76. Let $R = Z[X]/(x^2 + 1)$ and $\psi : Z(X) \to R$ be the natural quotient map. Which of the (1) The functions f(x) and g(x) for (x)following statements are true ? (2) . he derivative of g'(x) le cipiel of

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- (1) R is isomorphic to a subring of C.
- The functions ((c)) and ? (2) The ideal generated by $\psi(X)$ is a prime ideal in R. (4) There can be wante or charby my (4)
- (3) R has infinitely many prime ideals.
- (4) Only (1) and (3) are true.
- equals : 77. The number of ring homomorphisms from f:Z[x, y]. $(x^3 + x^2 + x + 1)$

 $(2) 2^{18}$

(4) 2⁹

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(G) If & has I, with the month of the

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(3) 1

 $(1) 2^{6}$

- The total number of non-isomorphic groups of order 122 is : 78. FUNCTION VEDVS THE DESIGNATION STUDY STUDY
 - (2) 1 $(1)^{2}$
 - (4) 4 (3) 61 an unitrop de the open and C (v A) is ban der and internação set de 1903 é é 1914.
- 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? (is all an diff is all (a.).
 - (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.

The number of generators of a cyclic group of order 10 is : the bill and and a (C). 80.

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- 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
 - (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
 (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) -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

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

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- (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 θ'_{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
- **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

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

(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 :

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

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

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The value of integral $\iint_R y \, dx \, dy$ where R is the region bounded by the parabolas **91**. $y^2 = 4x$ 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) $\frac{\pi}{2}$ (4) $\frac{4\pi}{15}$ (3) $\frac{4\pi}{5}$ (2) $\frac{\pi}{5}$

"IL CHARLEY TOLL ALS SIL **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) $x^2 + y^2 - 2y = 0$ $(4) \quad x^2 + y^2 + 2y - 1 = 0$ (3) $x^2 + y^2 + \frac{2}{\sqrt{3}}y + 1 = 0$

94. $\lim_{z \to 2e} \frac{\pi i}{3} \frac{z^3 + 8}{z^4 + 4z^2 + 16} =$ one to table is moving and Sublet A. 12

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(2) Parabolic (1) Elliptic (4) None of these (3) Hyperbolic

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

(2) $\frac{1}{8}(3-i\sqrt{3})$ (1) $\frac{3-i\sqrt{3}}{2}$ (4) $\frac{1}{4}(3+i\sqrt{3})$ $(3) \quad \frac{3+i\sqrt{3}}{2}$

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

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

(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

(3) 3

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 :

(4) 2

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

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

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

1. All questions are compulsory.

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

- 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 $l(x) = \{f \in C(x, R) | f(x) = 0\}$. 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.

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- 6. 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.

7. 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
- 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 $1 \le |H| \le 6$. Which one of the following options is *correct*?

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- (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

- 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 :
 - $(1) n \le p \qquad (2) n \ge 7p$
 - (3) $n \le 5p$ (4) $n \ge 5p$
- **12.** If $F_n = 2^{2^n} + 1$, then $F_0 F_1 \dots F_{n-1}$ is equal to : (1) F_n (2) $F_n + 3$
 - (3) $F_n = 2$ (4) $F_n + 4$
- **13.** If $n = p_1^{a_1}, p_2^{a_2}, \dots, p_i^{a_i}$ be any positive integer where p_1, p_2, \dots, p_i are distinct prime, then Euler's $\phi(n)$ is equal to :
 - (1) $n\left(1-\frac{1}{p_1}\right)\left(1-\frac{1}{p_2}\right)\dots\left(1-\frac{1}{p_t}\right)$
 - (2) $n. p_1 p_2.... p_n$

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

- (4) $n\left(1+\frac{1}{p_1}\right)\left(1+\frac{1}{p_2}\right)\dots\left(1+\frac{1}{p_t}\right)$
- **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) πa^3 , $4\pi a^2$

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

$$(1) \frac{|\underline{m}|\underline{n}|}{|\underline{m}+\underline{n}-1|} \qquad (2) \frac{|\underline{m}-\underline{n}|\underline{n}-\underline{n}|}{|\underline{m}+\underline{n}-\underline{n}|} \qquad (3) \frac{|\underline{m}+\underline{n}|\underline{n}+\underline{n}|}{|\underline{m}+\underline{n}|} \qquad (4) \frac{|\underline{m}+\underline{n}|\underline{n}+\underline{n}|}{|\underline{m}+\underline{n}-\underline{2}|}$$

$$(1) \sqrt{\pi} \cdot \frac{\Gamma(\underline{n}+\underline{1})}{\Gamma(\underline{n}+\underline{2})} \qquad (2) \frac{\Gamma(\underline{n}+\underline{1})}{\Gamma(\underline{n}-\underline{1})} \qquad (3) \frac{\pi}{2} \frac{\Gamma(\underline{n}+\underline{1})}{\Gamma(\underline{n}-\underline{1})} \qquad (4) \frac{\pi}{2} \cdot \frac{\Gamma(\underline{n}+\underline{1})}{\Gamma(\underline{n}+\underline{2})}$$

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

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

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) 2*a* (3) 3*a* (4) 4*a*

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

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

28. Sequence $\left(1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \frac{1}{5}, -\frac{1}{6}, \dots\right)$ 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) $\left(\frac{3}{2}, 1\right)$ (5) $\left(1, \frac{3}{2}\right)^{-1}$ (6) $\left(2^{3}, 2^{3}\right)^{-2}$ (7) $\left(1^{4}, 1^{3}\right)^{-3}$

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

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

$$dx = \sin(x + y) + \cos(x + y)$$
(1) $c e^{x} = \tan\left(\frac{x + y}{2}\right) + 1$
(2) $c e^{x} = \tan(x + y) + 1$
(3) $c e^{x} = \tan\left(\frac{x + y}{2}\right) - 1$
(4) $c e^{x} = \tan(x + y) - 1$

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 :

$$(D^{2} - 5D + 6)y = 5^{x} \qquad \left[D \equiv \frac{d}{dx} \right]$$
(1) $5^{x} \log_{e} 5$ (2) $\frac{5^{x}}{2\log_{e} 5}$ (3) $\frac{5^{x}}{3\log_{e} 5}$ (4) $\frac{5^{x}}{\log_{e} \left(\frac{5}{e^{2}}\right) \cdot \log_{e} \left(\frac{5}{e^{3}}\right)}$

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

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

$$\lim_{z \to 2e} \frac{\pi i}{3} \frac{z^3 + 8}{z^4 + 4z^2 + 16} = \dots$$
(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)
$$\sin^{-1}\left(\frac{T^2}{2R}\right)$$
 (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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 - 51. Let X has a two parameter gamma distribution with parameters λ , k ($\lambda > 0$ is the scale and parameter > 0 is the shape parameter) with density function $f_{\lambda,k}(x) = \begin{cases} \frac{\lambda^k x^{k-1} e^{-\lambda x}}{\Gamma(k)} , & x > 0\\ 0 & x < 0 \end{cases}$, 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() Ł int a = 1, b = 2, c = 3; printf ("%d", a + = (a + = 3, 5, a)) } (2) 9(3) 12 (1) 6(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
- Which of the following statement is *not* true? 55.
 - (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) $\frac{10}{2}$ (2) $\frac{13}{2}$ (3) $-\frac{13}{2}$ (4) $-\frac{7}{2}$

- 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

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- **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 $\frac{\theta}{2}$ with P + R. The magnitude of this resultant is :
 - (1) $2R\sin\frac{\theta}{2}$ (2) $2R\cos\frac{\theta}{2}$ (3) $R\sin\frac{\theta}{2}$ (4) $3R\cos\frac{\theta}{2}$
- **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 *n*th 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

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

(4) Hyperbola

- (1) Parabola (2) Circle
- (3) Ellipse

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- **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) $\frac{b}{2a}$

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- 76. The minimum value of $\sqrt{x^2 + y^2}$, under the condition $x^2 + xy + y^2 = 1$ is : (1) 1
 - (1) 1 (2) $\sqrt{2}$ (3) $\sqrt{3}$ (4) $\frac{\sqrt{6}}{2}$
- **77.** The sequence $\{x_n\}$ where :

(3) Oscillatory

- $x_n = \frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{2n}$ is : (1) Convergent (2) Divergent
 - (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 $\frac{d^2 y}{dx^2}$ 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 ?

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

80. If *n* is a natural number, then

$$\frac{\sum_{r=1}^{n} r^{3}}{\sum_{r=1}^{n} r(r+1)}$$
 is equal to :
(2) $\frac{3}{2} \frac{n+1}{2}$ (3) $\frac{3}{2} \frac{n}{2}$

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

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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 :

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- (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
 - $\iint_{S} \left(\frac{\partial Q}{\partial x} \frac{\partial P}{\partial y} \right) dx \, dy \text{ is equal to :}$ (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 $\int (axi + byj + czk) \cdot \hat{n} ds$ is :
 - (1) a + b + c(2) $\frac{4}{3}(a + b + c)$ (3) $\frac{4}{2}\pi(a + c + b)$ (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

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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|(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 :

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- (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) $\sqrt{\frac{7}{3}}$
 - (3) $\sqrt{\frac{3}{7}}$ (4) 1
- **90.** If the function f(x) = x(x-2) is continuous in $\begin{bmatrix} 0, \frac{3}{2} \end{bmatrix}$ and differentiable in $\begin{pmatrix} 0, \frac{3}{2} \end{pmatrix}$, then the value of 'c' of the mean value theorem is :

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

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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, $|A - \lambda I| = a_0 \lambda^n + a_1 \lambda^{n-1} + \dots + a_n$, then $a_0 A^n + a_1 A^{n-1} + \dots + a_n I$ 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*?
 - $(1) \quad r_A + r_B = p$
 - (2) $r_A + r_B \leq n$
 - $(3) \quad r_A + r_B > n$
 - $(4) \quad r_A + r_B = n + p$

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

- (1) $2c, -c^2$ (3) $c, -c^2$ (2) $c^2, 2c$ (4) $-c^2, 2c$
- 97. If $y = \sqrt{x + \sqrt{x + \sqrt{x + \dots + \cos \infty}}}$, 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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Name	Date of Birth	
Father's Name	Mother's Name	
Date of Examination		

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If
$$y = \tan^{-1}\left(\frac{x}{a}\right)$$
, then its *n*th 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) $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ (2) $(x+y)^{\frac{2}{3}} + (x-y)^{\frac{2}{3}} = a^{\frac{2}{3}}$ (3) $(x+y)^{\frac{2}{3}} + (x-y)^{\frac{2}{3}} = 2a^{\frac{2}{3}}$ (4) $(x+y)^{\frac{2}{3}} - (x-y)^{\frac{2}{3}} = 2a^{\frac{2}{3}}$

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

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8.

- (1) 1 (2) $\sqrt{2}$ (3) $\sqrt{3}$ (4) $\frac{\sqrt{6}}{2}$
- 7. The sequence $\{x_n\}$ where :
 - $x_{n} = \frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{2n} \text{ is :}$ (1) Convergent
 (2) Divergent
 (3) Oscillatory
 (4) None of the above
 If $x = a(\cos \theta + \theta \sin \theta), y = a(\sin \theta \theta \sin \theta)$, then the value of $\frac{d^{2}y}{dx^{2}}$ 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 ?

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

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- (1) $\frac{x}{r} + \frac{y}{r} + \frac{z}{r}$ (3) xi + yj + zk(2) $\frac{1}{r}(xi + yj + zk)$ (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 $\iint_{C} \left(\frac{\partial Q}{\partial x} \frac{\partial P}{\partial y} \right) dx \, dy \text{ is equal to :}$
 - (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 $\int (axi + byj + czk) \cdot \hat{n} ds$ 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
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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 :

С

- (1) [0, 1] (2) [-1, 1]
- $(3) \ [-1,0] \tag{4} \ [1,2]$
- 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) $\sqrt{\frac{7}{3}}$
 - (3) $\sqrt{\frac{3}{7}}$ (4) 1

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

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

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4

(1) Idempotent

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- (2) Nilpotent
- (3) Involuntory
- (4) None of the above
- 22. If for a square matrix A of order n, $|A \lambda I| = a_0 \lambda^n + a_1 \lambda^{n-1} + \dots + a_n$, then $a_0 A^n + a_1 A^{n-1} + \dots + a_n I$ 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) $r_A + r_B \leq n$
 - $(3) r_A + r_B > n$
 - $(4) \quad r_A + r_B = n + p$

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

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

and b are respectively :

(1) $2c, -c^2$ (2) $c^2, 2c$ $(4) - c^2, 2c$ (3) $c_{1} - c^{2}$

27. If $y = \sqrt{x + \sqrt{x + \sqrt{x + \dots + \cos \infty}}}$, then $\frac{dy}{dx}$ is equal to : $(2) - \frac{1}{2}$ (1) x^3

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

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

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

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

- (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
- The curve $y^2(2a-x) = x^3$ has : 30.
 - (1) Node
 - (2) Cusp
 - (3) Conjugate point
 - (4) None of these

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

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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 :

С

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

С

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 $f_{\lambda,k}(x) = \begin{cases} \frac{\lambda^k x^{k-1} e^{-\lambda x}}{\Gamma(k)} &, x > 0\\ 0 & x < 0 \end{cases}$, 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) $\left(\frac{\lambda+k}{s+\lambda}\right)^{k-1}$

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.

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

- (2) while (3) switch (4) do while (1) for
- 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 $\int_{1}^{1} x \, dx$ 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

- (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) $\frac{10}{2}$ (2) $\frac{13}{2}$ (3) $\frac{-13}{2}$ (4) $-\frac{7}{2}$

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) 2*a* (2) 4*a*
- $(3) a\sqrt{2} \qquad (4) 2a\sqrt{2}$

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) 2*a* (3) 3*a* (4) 4*a*
- 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 $u = \tan^{-1} \frac{x^3 + y^3 + x^2 y - xy^2}{x^2 - xy + y^2}$, 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)
$$\frac{1}{2}\sin 2u$$

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56. 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) $\frac{1}{r}$

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

- (1) a + b(3) a or b(2) a - b(4) $\sqrt{a^2 + b^2}$
- **58.** Sequence $\left(1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \frac{1}{5}, -\frac{1}{6}, \dots\right)$ 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) $\left(\frac{3}{2}, 0\right)$ (3) $\left(1, \frac{3}{2}\right)$ (4) $\left(\frac{3}{2}, 1\right)$
- **60.** Series $\left(\frac{2^2}{1^2} \frac{2}{1}\right)^{-1} + \left(\frac{3^3}{2^3} \frac{3}{2}\right)^{-2} + \left(\frac{4^4}{3^4} \frac{4}{3}\right)^{-3} + \dots$ is :
 - (1) Convergent

(2) Divergent

(3) Oscillatory finitely

(4) Oscillatory infinitely

- (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 $l(x) = \{f \in C(x, R) | f(x) = 0\}$. 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.

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- 66. 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.

67. 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
- **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

C

- Using Gauss Elimination method, the solution of equations 2x y + 3z = 9, x + y + z = 6, 71. 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
- While solving the equation $x^2 3x + 1 = 0$ using Newton-Raphson method the initial 72. 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
- For a fixed $C \in R$, let $\alpha = \int (9x^2 5Cx^4) dx$. If the value of this integral obtained by 73. 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
 - (4) 0.76 (3) 0.12

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

- (2) $\frac{-1}{x_1 x_0}$ (1) -1(4) $\frac{1}{x_2 - x_1}$ (3) 1
- Which of the following is termed as an action of pull or push of a body at rest or 75. motion?
 - (2) Momentum (1) Torque (4) Force
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(3) Work

- **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 $\frac{\theta}{2}$ with P + R. The magnitude of this resultant is :
 - (1) $2R\sin\frac{\theta}{2}$ (2) $2R\cos\frac{\theta}{2}$ (3) $R\sin\frac{\theta}{2}$ (4) $3R\cos\frac{\theta}{2}$
- **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)

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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) $ce^{x} = \tan(x+y) - 1$

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 :

$$(D^{2} - 5D + 6)y = 5^{x} \qquad \left[D \equiv \frac{d}{dx}\right]$$
(1) $5^{x} \log_{e} 5$
(2) $\frac{5^{x}}{2\log_{e} 5}$
(3) $\frac{5^{x}}{3\log_{e} 5}$
(4) $\frac{5^{x}}{\log_{e}\left(\frac{5}{e^{2}}\right) \cdot \log_{e}\left(\frac{5}{e^{3}}\right)}$

x

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

$$\sin^{2} x \frac{d^{2} y}{dx^{2}} = 2y$$
(1) $\sin x$ (2) $\cos x$ (3) $\tan x$ (4) $\cot x$

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88.

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- **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) $n \ge 7p$
 - $(3) n \le 5p \qquad (4) n > 5p$
- 92. If $F_n = 2^{2^n} + 1$, then $F_0 F_1 \dots F_{n-1}$ is equal to : (1) F_n (2) $F_n + 3$ (3) $F_n - 2$ (4) $F_n + 4$
- **93.** If $n = p_1^{a_1}, p_2^{a_2}, \dots, p_t^{a_t}$ be any positive integer where p_1, p_2, \dots, p_t are distinct prime, then Euler's $\phi(n)$ is equal to :
 - (1) $n\left(1-\frac{1}{p_1}\right)\left(1-\frac{1}{p_2}\right)\dots\left(1-\frac{1}{p_t}\right)$
 - (2) $n.p_1 p_2....p_n$
 - (3) $n(p_1+1)(p_2+2)....(p_t+t)$
 - (4) $n\left(1+\frac{1}{p_1}\right)\left(1+\frac{1}{p_2}\right)....\left(1+\frac{1}{p_t}\right)$
- 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) πa^3 , $4\pi a^2$

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

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

97.
$$\int_{0}^{\frac{\pi}{2}} \sin^{n} \theta \, d\theta \text{ is equal to : (where } n \ge -1)}$$

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

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

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.
$$\underset{n \to \infty}{L_{r=1}} \frac{1}{n} \sqrt{\frac{n+r}{n-r}} =$$
(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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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)

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

1. All questions are compulsory.

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

If
$$y = \tan^{-1}\left(\frac{x}{a}\right)$$
, then its *n*th 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) $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ (2) $(x+y)^{\frac{2}{3}} + (x-y)^{\frac{2}{3}} = a^{\frac{2}{3}}$ (3) $(x+y)^{\frac{2}{3}} + (x-y)^{\frac{2}{3}} = 2a^{\frac{2}{3}}$ (4) $(x+y)^{\frac{2}{3}} - (x-y)^{\frac{2}{3}} = 2a^{\frac{2}{3}}$

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

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P. T. O.

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8.

- (1) 1 (2) $\sqrt{2}$ (3) $\sqrt{3}$ (4) $\frac{\sqrt{6}}{2}$
- 7. The sequence $\{x_n\}$ where :
 - $x_{n} = \frac{1}{n+1} + \frac{1}{n+2} + \dots + \frac{1}{2n} \text{ is :}$ (1) Convergent
 (2) Divergent
 (3) Oscillatory
 (4) None of the above
 If $x = a(\cos \theta + \theta \sin \theta), y = a(\sin \theta \theta \sin \theta)$, then the value of $\frac{d^{2}y}{dx^{2}}$ 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 ?

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

С

- (1) $\frac{x}{r} + \frac{y}{r} + \frac{z}{r}$ (3) xi + yj + zk(2) $\frac{1}{r}(xi + yj + zk)$ (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 $\iint \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right) dx dy \text{ is equal to :}$
 - (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 $\int (axi + byj + czk) \cdot \hat{n} ds$ 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
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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 :

С

- (1) [0, 1] (2) [-1, 1]
- $(3) \ [-1,0] \tag{4} \ [1,2]$
- 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) $\sqrt{\frac{7}{3}}$
 - (3) $\sqrt{\frac{3}{7}}$ (4) 1

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

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

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(1) Idempotent

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- (2) Nilpotent
- (3) Involuntory
- (4) None of the above
- 22. If for a square matrix A of order n, $|A \lambda I| = a_0 \lambda^n + a_1 \lambda^{n-1} + \dots + a_n$, then $a_0 A^n + a_1 A^{n-1} + \dots + a_n I$ 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) $r_A + r_B \leq n$
 - $(3) r_A + r_B > n$
 - $(4) \quad r_A + r_B = n + p$

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

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

and b are respectively :

(1) $2c, -c^2$ (2) $c^2, 2c$ $(4) - c^2, 2c$ (3) $c_{1} - c^{2}$

27. If $y = \sqrt{x + \sqrt{x + \sqrt{x + \dots + \cos \infty}}}$, then $\frac{dy}{dx}$ is equal to : $(2) - \frac{1}{2}$ (1) x^3

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

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

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

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

- (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
- The curve $y^2(2a-x) = x^3$ has : 30.
 - (1) Node
 - (2) Cusp
 - (3) Conjugate point
 - (4) None of these

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

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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 :

С

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

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 $f_{\lambda,k}(x) = \begin{cases} \frac{\lambda^k x^{k-1} e^{-\lambda x}}{\Gamma(k)} &, x > 0\\ 0 & x < 0 \end{cases}$, 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) $\left(\frac{\lambda+k}{s+\lambda}\right)^{k-1}$

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.

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

- (2) while (3) switch (4) do while (1) for
- 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 $\int_{1}^{1} x \, dx$ 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

- (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) $\frac{10}{2}$ (2) $\frac{13}{2}$ (3) $\frac{-13}{2}$ (4) $-\frac{7}{2}$

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) 2*a* (2) 4*a*
- $(3) a\sqrt{2} \qquad (4) 2a\sqrt{2}$

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 $u = \tan^{-1} \frac{x^3 + y^3 + x^2 y - xy^2}{x^2 - xy + y^2}$, 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)
$$\frac{1}{2}\sin 2u$$

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56. 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) $\frac{1}{r}$

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

- (1) a + b(3) a or b(2) a - b(4) $\sqrt{a^2 + b^2}$
- **58.** Sequence $\left(1, -\frac{1}{2}, \frac{1}{3}, -\frac{1}{4}, \frac{1}{5}, -\frac{1}{6}, \dots\right)$ 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) $\left(\frac{3}{2}, 0\right)$ (3) $\left(1, \frac{3}{2}\right)$ (4) $\left(\frac{3}{2}, 1\right)$
- **60.** Series $\left(\frac{2^2}{1^2} \frac{2}{1}\right)^{-1} + \left(\frac{3^3}{2^3} \frac{3}{2}\right)^{-2} + \left(\frac{4^4}{3^4} \frac{4}{3}\right)^{-3} + \dots$ is :
 - (1) Convergent

(2) Divergent

(3) Oscillatory finitely

(4) Oscillatory infinitely

- (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 $l(x) = \{f \in C(x, R) | f(x) = 0\}$. 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.

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- 66. 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.

67. 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
- **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

C

- Using Gauss Elimination method, the solution of equations 2x y + 3z = 9, x + y + z = 6, 71. 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
- While solving the equation $x^2 3x + 1 = 0$ using Newton-Raphson method the initial 72. 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
- For a fixed $C \in R$, let $\alpha = \int (9x^2 5Cx^4) dx$. If the value of this integral obtained by 73. 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
 - (4) 0.76 (3) 0.12

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

- (2) $\frac{-1}{x_1 x_0}$ (1) -1(4) $\frac{1}{x_2 - x_1}$ (3) 1
- Which of the following is termed as an action of pull or push of a body at rest or 75. motion?
 - (2) Momentum (1) Torque (4) Force
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(3) Work

- **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 $\frac{\theta}{2}$ with P + R. The magnitude of this resultant is :
 - (1) $2R\sin\frac{\theta}{2}$ (2) $2R\cos\frac{\theta}{2}$ (3) $R\sin\frac{\theta}{2}$ (4) $3R\cos\frac{\theta}{2}$
- **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)

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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) $ce^{x} = \tan(x+y) - 1$

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 :

$$(D^{2} - 5D + 6)y = 5^{x} \qquad \left[D \equiv \frac{d}{dx}\right]$$
(1) $5^{x} \log_{e} 5$
(2) $\frac{5^{x}}{2\log_{e} 5}$
(3) $\frac{5^{x}}{3\log_{e} 5}$
(4) $\frac{5^{x}}{\log_{e}\left(\frac{5}{e^{2}}\right) \cdot \log_{e}\left(\frac{5}{e^{3}}\right)}$

x

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

$$\sin^{2} x \frac{d^{2} y}{dx^{2}} = 2y$$
(1) $\sin x$ (2) $\cos x$ (3) $\tan x$ (4) $\cot x$

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88.

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- **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) $n \ge 7p$
 - $(3) n \le 5p \qquad (4) n > 5p$
- 92. If $F_n = 2^{2^n} + 1$, then $F_0 F_1 \dots F_{n-1}$ is equal to : (1) F_n (2) $F_n + 3$ (3) $F_n - 2$ (4) $F_n + 4$
- **93.** If $n = p_1^{a_1}, p_2^{a_2}, \dots, p_t^{a_t}$ be any positive integer where p_1, p_2, \dots, p_t are distinct prime, then Euler's $\phi(n)$ is equal to :
 - (1) $n\left(1-\frac{1}{p_1}\right)\left(1-\frac{1}{p_2}\right)\dots\left(1-\frac{1}{p_t}\right)$
 - (2) $n.p_1 p_2....p_n$
 - (3) $n(p_1+1)(p_2+2)....(p_t+t)$
 - (4) $n\left(1+\frac{1}{p_1}\right)\left(1+\frac{1}{p_2}\right)....\left(1+\frac{1}{p_t}\right)$
- 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) πa^3 , $4\pi a^2$

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

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

97.
$$\int_{0}^{\frac{\pi}{2}} \sin^{n} \theta \, d\theta \text{ is equal to : (where } n \ge -1)}$$

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

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

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.
$$\underset{n \to \infty}{L_{r=1}} \frac{1}{n} \sqrt{\frac{n+r}{n-r}} =$$
(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) $\frac{\Gamma(n+1)}{s^2+1}$

Answer keys of M	.Sc.(Mathematics)/M.S	Sc.(Mathematics) und	er SFS entrance exam	dated 15.07.2024
Q. NO.	A	В	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
15	3	2	3	3
10	1	4	2	4
10	2	3	1	1
10	<u> </u>	2	2	1
19	4	1	<u> </u>	4
20	4	2	3	2
21	4	1	1	2
22	2	2	2	1
23	1	2	2	1
24	3	2	3	4
25	1	3	4	4
26	3	4	L	1
27	2	4	3	1
28	1	2	1	1
29	2	1	1	2
30	4	1	2	2
31	3	3	2	2
32	1	4	3	3
33	2	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

Allswel keys of iv	.Sc.(Wathematics)/W.	Sc. (Wathematics) und	er SFS entrance exam	ualeu 15.07.2024
Q. NO.	A	В	С	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
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59	2	2	1	2
60	1	4	1	4
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62	4	4	2	1
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64	4	3	4	4
65	2	4	4	3
66	3	1	4	2
67	3	2	1	1
68	2	1	1	3
69	2	3	2	2
70	Δ	4	3	4
70	2	3	3	2
71	2	1	4	4
72		2	2	1
75	1	1	3	<u>_</u>
74	4		S	2
75	4			2
76	4	2	2	2
//	1	1	2	
78	1	3	1	2
79	2	2	3	Δ
80	3	4	4	4
81	3	4	3	3
82	4	2	4	1
83	2	1	1	2
84	3	3	2	3
85	4	1	3	4
86	1	3	3	1
87	2	2	1	3
88	1	11	2	1
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

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