Time : 1½ Hours **FIRST-TERM** **MATHEMATICS**

Subject Code

H	4	7	5	4

Total No. of Questions : 40 (Printed Pages : 16) Maximum Marks : 40

INSTRUCTIONS : (*i*) The question paper consists of 40 questions.

(*ii*) *All* questions are compulsory.

(*iii*) All questions are of Multiple Choice Type and carry *one* mark each.

(*iv*) For each question select only one correct option from the alternatives given.

(*v*) Use of calculator is not allowed.

1. The matrix $A = [a_{ij}]$ of order 2×2 whose elements are given by $a_{ij} = 2i - j$ is ....

(A) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

(B) $\begin{bmatrix} 1 & 0 \\ 3 & 2 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 0 \\ 2 & 3 \end{bmatrix}$

(D) $\begin{bmatrix} 1 & 0 \\ -3 & 2 \end{bmatrix}$

2. Matrices A and B will be inverses of each other if and only if ....

(A) AB = BA

(B) AB = BA = O

(C) AB = O and BA = I

(D) AB = BA = I

3. If $A = \begin{bmatrix} 3 & -5 \\ -4 & 2 \end{bmatrix}$, $A^2 - 5A$ is ....

(A) an identity matrix

(B) a row matrix

(C) a scalar matrix

(D) a zero matrix

4. For a skew symmetric matrix, all the diagonal elements are ....

(A) non-zero

(B) negative numbers

(C) positive numbers

(D) zero

5. If A is a square matrix such that $A^2 = I$, then $A^3 + (A + I)^2 - 9A - I^2 = ...$.

(A) $-6A + I$

(B) $-6A$

(C) $6A + I$

(D) $-6A - I$

6. A, B, C are 3 matrices such that the order of A is 4 × 3 and the order of B is 4 × 5 and the order of C is 7 × 3. Then the order of $(A^T B)^T C^T$ is ....

(A) 5 × 3

(B) 4 × 5

(C) 5 × 7

(D) 4 × 3

7. The value of $\begin{vmatrix} 1 & 1 & 1 \\ 11 & 10 & 9 \\ 101 & 100 & 99 \end{vmatrix}$ is ....

(A) 1

(B) –1

(C) 2

(D) 0

8. Given that A is a square matrix of order 3 and $|A| = -2$, then $|\text{Adj } A|$ is equal to ....

(A) 4

(B) –2

(C) –4

(D) 2

9. The determinant which is equal to $\begin{vmatrix} 4 & 3 \\ -5 & 1 \end{vmatrix}$ is ....

(A) $\begin{vmatrix} 3 & 1 \\ 2 & -1 \end{vmatrix}$

(B) $\begin{vmatrix} 6 & -5 \\ 5 & 1 \end{vmatrix}$

(C) $\begin{vmatrix} -6 & 5 \\ -5 & 1 \end{vmatrix}$

(D) $\begin{vmatrix} 3 & 4 \\ 1 & -5 \end{vmatrix}$

10. If A = $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$, such that $ad - bc \neq 0$, then A^{-1} = ...

(A) $\frac{1}{ad - bc} \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

(B) $\frac{1}{ad - bc} \begin{bmatrix} -d & b \\ c & -a \end{bmatrix}$

(C) $\frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

(D) $\frac{1}{ad - bc} \begin{bmatrix} d & b \\ c & a \end{bmatrix}$

11. If R is a relation in the set $\{a, b, c, d\}$ given by

$R = \{(a,a),(b,b),(c,c),(d,d),(a,d),(a,b),(d,b)\}$, then ....

(A) R is reflexive and symmetric but not transitive

(B) R is reflexive and transitive but not symmetric

(C) R is symmetric and transitive but not reflexive

(D) R is an equivalence relation

12. The function $f: \mathbf{N} \rightarrow \mathbf{N}$ defined by $f(x) = x^3 + 12$ is ....

(A) bijective

(B) injective but not surjective

(C) surjective but not injective

(D) neither injective nor surjective

13. * is a binary operation on **R** defined by $a * b = a$, $a, b \in \mathbf{R}$, then ....

(A) * is commutative but not associative

(B) * is both commutative and associative

(C) * is neither commutative nor associative

(D) * is associative but not commutative

14. $f : \mathbf{R} \rightarrow \mathbf{R}$ is defined by $f(x) = \cos x$ and $g : \mathbf{R} \rightarrow \mathbf{R}$ is defined by $g(x) = x^2$. Then $(gof)(x) =$ ....

(A) $\cos(x^2)$

(B) $\cos^2 x$

(C) $x^2 \cos x$

(D) $x \cos x$

15. Let $\mathbf{R} - \left\{ -4/3 \right\} \to \mathbf{R}$ be a function defined by $f(x) = \dfrac{4x}{3x+4}$, $x \neq \dfrac{-4}{3}$. The inverse of f is the map g : Range of $f \to \mathbf{R} - \left\{ \dfrac{-4}{3} \right\}$ given by :

(A) $g(y) = \dfrac{3y}{3-4y}$

(B) $g(y) = \dfrac{4y}{3-4y}$

(C) $g(y) = \dfrac{3y}{4-3y}$

(D) $g(y) = \dfrac{4y}{4-3y}$

16. If f is a real function such that $f(x) = \dfrac{\sin^{-1} 3x}{4x}$, $x \neq 0$ is continuous at $x = 0$, then $f(0) =$ ....

(A) $\dfrac{4}{3}$

(B) $\dfrac{3}{4}$

(C) $\dfrac{-3}{4}$

(D) $\dfrac{-4}{3}$

17. The value of 'm' for which the real function f where

$$f(x) = \begin{cases} 5x - 4 & , 0 < x \leq 1 \\ 4x^2 + 3mx & , 1 < x < 2 \end{cases}$$

is continuous at every point in its domain is ....

(A) 7

(B) 0

(C) 1

(D) –1

18. To make the real function f continuous at $x = 2$, where

$$f(x) = \begin{cases} 2x & \text{if} \quad x < 2 \\ k & \text{if} \quad x = 2 \\ x^2 & \text{if} \quad x > 2 \end{cases}$$

the value of k should be ....

(A) 2

(B) –2

(C) 4

(D) –4

19. $f : \mathbf{R} \to \mathbf{R}$ defined by

$$f(x) = \frac{a^x - a^{-x}}{x}, \qquad x \neq 0$$

$$= 3k \quad , \qquad x = 0$$

is continuous at $x = 0$. Then $k =$ ....

(A) $\frac{2}{3} \log a$

(B) $\frac{-2}{3} \log a$

(C) $\frac{3}{2} \log a$

(D) $\frac{-3}{2} \log a$

20. If $y = x^2 \log x$, then $\frac{d^2y}{dx^2}$ = ...

(A) $2 \log x$

(B) $3 + 2 \log x$

(C) $2 + 2 \log x$

(D) $3 + \log x$

21. If $x + e^x = y + e^y$, then $\frac{dy}{dx}$ = ...

(A) $\frac{1+e^x}{1+e^y}$

(B) $\frac{1+e^y}{1+e^x}$

(C) $1 + e^x - e^y$

(D) $\frac{1-e^x}{1-e^y}$

22. If $y = e^{\log x^4}$, then $\frac{dy}{dx}$ at $x = -1$ is ....

(A) e

(B) $-e$

(C) 4

(D) -4

23. If $x = a\,(1 - \cos t)$, $y = a\,(t + \sin t)$ where 't' is the parameter and 'a' is a constant, then $\left(\frac{dy}{dx}\right)_{t=\pi/2} =$ ....

(A) -1

(B) 1

(C) $\pi/2$

(D) $-\pi/2$

24. If $y = (\sin x)^{\cos x}$, then $\frac{dy}{dx} =$ ....

(A) $(\sin x)^{\cos x}\,[\sin x \cot x - \sin x \log(\sin x)]$

(B) $(\cos x)^{\sin x}\,[\cos x \cot x - \sin x \log(\sin x)]$

(C) $(\sin x)^{\cos x}\,[\cos x \cot x - \sin x \log(\sin x)]$

(D) $(\sin x)^{\cos x}\,[\cos x \cot x - \cos x \log(\sin x)]$

25. The derivative of $y = \sec^2(x^3)$ with respect to x is ....

(A) $6x^2 \sec^2(x^3) \tan(x^3)$

(B) $6x^2 \sec(x) \tan(x)$

(C) $2x \sec(x^3) \tan(x^3)$

(D) $6x^2 \sec(x^3) \tan(x^3)$

26. If $x \in [-1, 1]$, then $\sin^{-1}(-x) =$ ....

(A) $\sin^{-1} x$

(B) $-\sin^{-1} x$

(C) $\pi - \sin^{-1} x$

(D) $\operatorname{cosec}^{-1} x$

27. $\tan^{-1}\frac{2}{11}+\tan^{-1}\frac{7}{24}$ = ...

(A) $\tan^{-1}(1)$

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

(C) $\tan^{-1}\left(\frac{3}{4}\right)$

(D) $\tan^{-1}\left(\frac{2}{3}\right)$

28. If $y=\cos^{-1}x$, then ....

(A) $x\in[-1,1];\ y\in[0,\pi]$

(B) $x\in\mathbf{R};\ y\in\left[\frac{-\pi}{2},\frac{\pi}{2}\right]$

(C) $x\in[-1,1];\ y\in\left[\frac{-\pi}{2},\frac{\pi}{2}\right]$

(D) $x\in\mathbf{R}-[-1,1];\ y\in[0,\pi]-\left\{\frac{\pi}{2}\right\}$

29. The value of $\sec^2\left[\tan^{-1}\left(\frac{5}{11}\right)\right]$ is ....

(A) $\frac{25}{121}$

(B) $\frac{96}{121}$

(C) $\frac{146}{121}$

(D) $\frac{121}{146}$

30. The value of p for which the vectors $\vec{a} = 3\hat{i} + 2\hat{j} + 9\hat{k}$ and $\vec{b} = \hat{i} + p\hat{j} + 3\hat{k}$ are parallel vectors is ....

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

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

(C) 2

(D) 3

31. If $\vec{a}$ and $\vec{b}$ are two unit vectors and θ is the angle between them, then $\vec{a} + \vec{b}$ is a unit vector if θ = ...

(A) $\frac{\pi}{4}$

(B) $\frac{\pi}{3}$

(C) $\frac{\pi}{2}$

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

32. If $\hat{i}, \hat{j}$ and $\hat{k}$ are the three unit vectors, then the vector represented by $\left(\hat{i} \times \hat{j}\right) \times \hat{i} + \left(\hat{j} \times \hat{k}\right) \times \hat{j} + \left(\hat{k} \times \hat{i}\right) \times \hat{k}$ = ...

(A) $\hat{i} + \hat{j} + \hat{k}$

(B) $\hat{i} - \hat{j} + \hat{k}$

(C) $\hat{i} + \hat{j} - \hat{k}$

(D) $\hat{i} - \hat{j} - \hat{k}$

33. The value of λ so that the vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$, $\vec{c} = 3\hat{i} + \lambda\hat{j} + 5\hat{k}$ are complanar is ....

(A) –1

(B) –2

(C) –3

(D) –4

34. Let $\vec{r}$ be the position vector of an arbitrary point $p(x, y, z)$. The Cartesian form of the equation of the line passing through two points (x_1, y_1, z_1) and (x_2, y_2, z_2) is ....

(A) $\dfrac{x - x_1}{x_2 - x_1} = \dfrac{y - y_1}{y_2 - y_1} = \dfrac{z - z_1}{z_2 - z_1}$

(B) $\dfrac{x - x_1}{x_2 + x_1} = \dfrac{y - y_1}{y_2 + y_1} = \dfrac{z - z_1}{z_2 + z_1}$

(C) $\dfrac{x + x_1}{x_2 + x_1} = \dfrac{y + y_1}{y_2 + y_1} = \dfrac{z + z_1}{z_2 + z_1}$

(D) $\dfrac{x + x_1}{x_2 - x_1} = \dfrac{y + y_1}{y_2 - y_1} = \dfrac{z + z_1}{z_2 - z_1}$

35. The line $\dfrac{x - x_1}{a} = \dfrac{y - y_1}{b} = \dfrac{z - z_1}{c}$ is at right angles to the plane $Ax + By + Cz + D = 0$ if ....

(A) $aA + bB + cC = 0$

(B) $aA + bB + cC = 1$

(C) $aA = bB = cC$

(D) $\dfrac{a}{A} = \dfrac{b}{B} = \dfrac{c}{C}$

36. The distance of the plane $2x + 3y - 6z + 2 = 0$ from the origin is ....

(A) 2

(B) 14

(C) $\frac{2}{7}$

(D) $\frac{2}{\sqrt{23}}$

37. The equation of the plane passing through the intersection of the planes $x + 2y - 5z + 1 = 0$ and $2x - y + 3z - 11 = 0$ and also through the origin is ....

(A) $13x + 21y - 52z = 0$

(B) $13x - 21y - 52z = 0$

(C) $13x + 21y + 52z = 0$

(D) $13x + 21y - 52z = \frac{1}{11}$

38. The direction cosines of the normal to the plane $2x + 3y - z = 5$ are :

(A) 2, 3, –1

(B) $\frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}, \frac{-1}{\sqrt{14}}$

(C) 2, 3, 1

(D) $\frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}, \frac{1}{\sqrt{14}}$

39. The angle between the line $\vec{r} = \left(\hat{i} + 2\hat{j} - \hat{k}\right) + \lambda\left(\hat{i} - \hat{j} + \hat{k}\right)$ and the plane $\vec{r} \cdot \left(2\hat{i} - \hat{j} + \hat{k}\right) = 6$ is ....

(A) $\sin^{-1}\left(\frac{2\sqrt{2}}{3}\right)$

(B) $\sin^{-1}\left(\frac{\sqrt{2}}{3}\right)$

(C) $\cos^{-1}\left(\frac{2}{3}\right)$

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

40. The equation of the plane through the point (–1, –1, 1) which is parallel to the plane $\bar{r} \cdot \left(\hat{i} + \hat{j} + \hat{k}\right) = 0$ is ....

(A) $\vec{r} \cdot \left(\hat{i} + \hat{j} + \hat{k}\right) + 1 = 0$

(B) $\vec{r} \cdot \left(\hat{i} + \hat{j} + \hat{k}\right) - 1 = 0$

(C) $\vec{r} \cdot \left(\hat{i} + \hat{j} + \hat{k}\right) + 3 = 0$

(D) $\vec{r} \cdot \left(\hat{i} + \hat{j} + \hat{k}\right) - 3 = 0$

Space For Rough Work

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