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Subject Code **J-276**

Seat No.

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DATE : 24/06/2026

Time : 11.00 - 2.00

**SUBJECT : MATHEMATICS & STATISTICS
(ARTS & SCIENCE) (40)**

DURATION : 3 Hours

TOTAL PAGES : 8

TOTAL MARKS : 80

General instructions :

The question paper is divided into FOUR sections.

- (i) Section A : Q.1 contains Eight multiple choice type questions, each carrying Two marks.
Q. 2 contains Four very short answer type questions, each carrying One mark.
- (ii) Section B : Q.3 to Q. 14 contain Twelve short answer type questions, each carrying Two marks.
(Attempt any Eight)
- (iii) Section C : Q.15 to Q. 26 contain Twelve short answer type questions, each carrying Three marks.
(Attempt any Eight)
- (iv) Section D : Q.27 to Q. 34 contain Eight long answer type questions, each carrying Four marks.
(Attempt any Five)
- (v) Use of log table is allowed. Use of calculator is not allowed.
- (vi) Figures to the right indicate full marks.
- (vii) Use of graph paper is not necessary. Only rough sketch of graph is expected.
- (viii) For each multiple choice type of question, only the first attempt will be considered for evaluation.
- (ix) Start answer to each section on a new page.

End of Page 1 (P.T.O)

SECTION – A

Q. 1. Select and write the correct answer of the following multiple choice type of questions :

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- (i) If $A = \{1, 2, 3, 4, 5\}$ then which of the following is not true?
- (a) $\exists x \in A$ such that $x + 3 = 8$
- (b) $\exists x \in A$ such that $x + 2 < 9$
- (c) $\forall x \in A, x + 6 \geq 9$
- (d) $\forall x \in A, x + 5 \leq 10$ (2)
- (ii) The value of $\sin \left[\sin^{-1} \left(-\frac{1}{\sqrt{2}} \right) - 3 \sin^{-1} \left(\frac{\sqrt{3}}{2} \right) \right] =$
- (a) $-\frac{1}{\sqrt{2}}$ (b) $\frac{1}{\sqrt{2}}$
- (c) $\frac{\sqrt{3}}{2}$ (d) $-\frac{\sqrt{3}}{2}$ (2)
- (iii) If $\hat{p}, \hat{q}, \hat{r}$ are mutually perpendicular unit vectors and form a right handed triplet then the value of $\hat{p} \cdot (\hat{q} \times \hat{r}) + \hat{q} \cdot (\hat{p} \times \hat{r}) + \hat{r} \cdot (\hat{p} \times \hat{q}) = \dots\dots$
- (a) -2 (b) 0
- (c) 1 (d) 3 (2)
- (iv) The Cartesian equation of the line passing through the points $A(3, 4, -1)$ and $B(2, -1, 3)$ is _____.
- (a) $\frac{x+3}{1} = \frac{y-4}{5} = \frac{z+1}{-4}$ (b) $\frac{x-3}{-1} = \frac{y-4}{-5} = \frac{z+1}{-4}$
- (c) $\frac{x-3}{-1} = \frac{y-4}{-5} = \frac{z+1}{4}$ (d) $\frac{x-3}{-1} = \frac{y-4}{5} = \frac{z+1}{-4}$ (2)

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(v) If $y = \log_x a$ then $\frac{dy}{dx} = \underline{\hspace{2cm}}$.

(a) $\frac{-\log a}{x(\log x)^2}$

(b) $x \log a$

(c) $-\frac{1}{\log_x a}$

(d) $\frac{1}{x \log a}$ (2)

(vi) If $f(x) = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$ and $g(x) = e^{\sin^{-1} x}$ then

$\int f(x) \cdot g(x) dx = \underline{\hspace{2cm}}$.

(a) $e^{\sin^{-1} x} (1 - \sin^{-1} x) + c$

(b) $e^{\sin^{-1} x} (\sin^{-1} x - 1) + c$

(c) $e^{\sin^{-1} x} (\sin^{-1} x + 1) + c$

(d) $e^{\cos^{-1} x} (\cos^{-1} x - 1) + c$ (2)

(vii) The area bounded by the line $y = 2x$, X -axis and the lines $x = -1$, $x = 4$ is _____ sq. units.

(a) 15

(b) 17

(c) 16

(d) 14 (2)

(viii) In a Binomial Distribution, $E(X) = 6$, $\text{Var}(X) = 4.2$ then the value of n is _____

(a) 22

(b) 24

(c) 20

(d) 26 (2)

Q. 2. Answer the following questions :

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(i) Write the dual of $p \wedge t$ (1)

(ii) What is the distance of point $(3, -5, 6)$ from XZ plane? (1)

- (iii) The displacement of a particle at time t is given by

$$S = 3t^2 + 4t + 1. \text{ Find its velocity at time } t. \quad (1)$$

- (iv) Write the order of differential equation

$$\left(\frac{d^2 y}{dx^2} \right)^{\frac{5}{2}} = 3 \sqrt{\frac{dy}{dx}} \quad (1)$$

SECTION – B

Attempt any EIGHT of the following questions :

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- Q. 3.** Construct the switching circuit for the statement $(\sim p \wedge q) \vee (p \wedge \sim r)$. (2)

- Q. 4.** Find the matrix of cofactors of matrix $\begin{bmatrix} 5 & 2 \\ -1 & 6 \end{bmatrix}$. (2)

- Q. 5.** Find the general solution of equation $\cos 5\theta = \frac{1}{2}$. (2)

- Q. 6.** Find the value of k , if $2x + y = 0$ is one of the lines represented by $3x^2 + kxy + 2y^2 = 0$. (2)

- Q. 7.** If $\vec{a}, \vec{b}, \vec{c}$ are the position vectors of points A, B, C respectively and $10\vec{a} = 7\vec{b} + 3\vec{c}$ then find the ratio in which the point C divides the line segment AB . (2)

- Q. 8.** Find the angle between the lines
 $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} - \hat{j} + \hat{k})$
 $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \mu(\hat{i} + 2\hat{j} + \hat{k})$ (2)

- Q. 9.** Test whether the function $f(x) = x - \frac{1}{x}, x \in R, x \neq 0$ is increasing or decreasing. (2)

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Q. 10. Evaluate : $\int_{-1}^1 |x| dx$ (2)

Q. 11. Evaluate : $\int x \log x dx$ (2)

Q. 12. Find the area bounded by curve $x^2 + y = 0$, X - axis and lines $x = 1$ and $x = 4$. (2)

Q. 13. The probability distribution of r.v. X is as follows:

$X = x$	0	1	2	3	4
$P(X = x)$	0.1	k	$2k$	$2k$	k

Find : (i) k (ii) $F(2)$ (2)

Q. 14. Evaluate : $\int \frac{e^x(1+x)}{\cos^2(xe^x)} dx$ (2)

SECTION – C

Attempt any EIGHT of the following questions :

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Q. 15. Using truth table, determine whether statement pattern $[(p \vee q) \wedge \sim p] \wedge \sim q$ is a tautology or a contradiction or a contingency. (3)

Q. 16. Prove that : $\sin^{-1}\left(\frac{3}{5}\right) + \cos^{-1}\left(\frac{12}{13}\right) = \sin^{-1}\left(\frac{56}{65}\right)$ (3)

Q. 17. In $\triangle ABC$, if $a = 10$, $b = 8$, $c = 6$ then find the value of
(i) $\sin\left(\frac{C}{2}\right)$ (ii) $\cos\left(\frac{B}{2}\right)$ (3)

Q. 18. Are the four points $A(1, 2, 1)$, $B(2, -3, 4)$, $C(3, 4, -5)$, $D(2, 3, -2)$ coplanar? Justify your answer. (3)

Q. 19. Find the distance between parallel lines

$$\frac{x}{2} = \frac{y}{-1} = \frac{z}{2} \text{ and}$$

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

Q. 20. Find the vector equation of the plane passing through the points $A(2,1,1)$, $B(0,2,3)$ and $C(4,5,6)$. (3)

Q. 21. If $y = \log \left[\frac{x + \sqrt{x^2 + a^2}}{\sqrt{x^2 + a^2} - x} \right]$, find $\frac{dy}{dx}$. (3)

Q. 22. A wire of length 36 cm is bent to form a rectangle. Find its dimensions, if the area of the rectangle is maximum. (3)

Q. 23. Verify Rolle's theorem for the function $f(x) = x^2 - 5x + 9$, $x \in [1, 4]$ (3)

Q. 24. Solve the differential equation $x \frac{dy}{dx} - \sqrt{x^2 + y^2} = y$ (3)

Q. 25. The following is the p.d.f. of continuous r.v.

$$f(x) = \frac{x}{8}; \quad 0 < x < 4$$

$$= 0, \quad \text{Otherwise}$$

Find (i) expression for c.d.f of X .

(ii) $F(x)$ at 0.5 and 5 (3)

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Q. 26. If the p.m.f of r.v. X be

$$P(X=x) = {}^4C_x \left(\frac{5}{9}\right)^x \left(\frac{4}{9}\right)^{4-x} \quad \text{for } x=0,1,2,3,4$$

$$= 0 \quad ; \quad \text{otherwise}$$

then find $E(X)$ and $\text{Var}(X)$. (3)

SECTION – D

Attempt any FIVE of the following questions :

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Q. 27. Find the inverse of matrix $\begin{bmatrix} -4 & -3 & -3 \\ 1 & 0 & 1 \\ 4 & 4 & 3 \end{bmatrix}$ (4)

Q. 28. Prove that the homogeneous equation of degree two in x and y ,
 $ax^2 + 2hxy + by^2 = 0$ represents a pair of lines passing through
 the origin if $h^2 - ab \geq 0$ (4)

Q. 29. Prove that, if $\vec{a}, \vec{b}, \vec{c}$ are three non coplanar vectors then any vector $\vec{r}$ in
 the space can be uniquely expressed as a linear
 combination of $\vec{a}, \vec{b}, \vec{c}$. (4)

Q. 30. Solve the linear programming problem (L.P.P.) by graphical method.

Minimize : $z = 8x + 10y$

Subject to , $2x + y \geq 7$

$$2x + 3y \geq 15$$

$$x \geq 0$$

$$y \geq 2$$

(4)

Q. 31. If $x = f(t)$ and $y = g(t)$ are differentiable functions of t , so that y is

differentiable function of x and $\frac{dx}{dt} \neq 0$ then prove that $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$.

Hence find $\frac{dy}{dx}$, if $x = \sin t$ $y = \cos t$. (4)

Q. 32. Evaluate : $\int \frac{2}{3+2\sin^2 x + 5\cos^2 x} dx$ (4)

Q. 33. Prove that,

$$\int_{-a}^a f(x) dx = 2 \int_0^a f(x) dx, \text{ if } f(x) \text{ is even}$$

$$= 0, \quad \text{if } f(x) \text{ is odd} \quad (4)$$

Q. 34. A body cools according to Newton's law from 100°C to 60°C in 20 minutes.
The temperature of the surrounding being 20°C .

How long will it take to cool down to 40°C ? (4)

