

SECTION – B

Question numbers 11 to 22 carry 4 marks each.

Q.11. Let $f : R \rightarrow R$ be defined as $f(x) = 10x + 7$. Find the function $g : R \rightarrow R$ such that $g \circ f = I_R$. 4 marks

OR

A binary operation $*$ on the set $\{0, 1, 2, 3, 4, 5\}$ is defined as

$$a * b = \begin{cases} a + b, & \text{if } a + b < 6 \\ a + b - 6 & \text{if } a + b \geq 6 \end{cases}$$

Show that zero is the identify for this operation and each element ' a ' of the set is invertible with $6 - a$, being the inverse of ' a '.

Q.12. Prove that: 4 marks

$$\tan^{-1} \left[\frac{\sqrt{1+x} - \sqrt{1-x}}{\sqrt{1+x} + \sqrt{1-x}} \right] = \frac{\pi}{4} - \frac{1}{2} \cos^{-1} x, -\frac{1}{\sqrt{2}} \leq x \leq 1.$$

Q.13. Using properties of determinants, solve the following for x : 4 marks

$$\begin{vmatrix} x-2 & 2x-3 & 3x-4 \\ x-4 & 2x-9 & 3x-16 \\ x-8 & 2x-27 & 3x-64 \end{vmatrix} = 0.$$

Q.14. Find the relationship between ' a ' and ' b ' so that the function ' f ' defined by: 4 marks

$$f(x) = \begin{cases} ax + 1, & \text{if } x \leq 3 \\ bx + 3, & \text{if } x > 3 \end{cases} \text{ is continuous at } x = 3.$$

OR

$$\text{If } x^y = e^{x-y}, \text{ show that } \frac{dy}{dx} = \frac{\log x}{\{\log(xe)\}^2}.$$

Q. 15. Prove that: 4 marks

$$y = \frac{4 \sin \theta}{(2 + \cos \theta)} - \theta \text{ is an increasing function in } \left[0, \frac{\pi}{2}\right].$$

Or

If the radius of a sphere is measured as 9 cm with an error of 0.03 cm, then find the approximate error in calculating its surface area.

Q. 16. If: 4 marks

$$x = \tan \left(\frac{1}{a} \log y \right), \text{ show that}$$

$$(1 + x^2) \frac{d^2 y}{dx^2} + (2x - a) \frac{dy}{dx} = 0.$$

Q. 17. Evaluate: 4 marks

$$\int_0^{\pi/2} \frac{x + \sin x}{1 + \cos x} dx.$$

Q. 18. Solve the following differential equation: 4 marks

$$x dy - y dx = \sqrt{x^2 + y^2} dx.$$

Q. 19. Solve the following differential equation: 4 marks

$$(y + 3x^2) \frac{dx}{dy} = x.$$

Q. 20. Using vectors, find the area of the triangle with vertices A (1, 1, 2), B (2,3,5) and (1,5,5). 4 marks

Q. 21. Find the shortest distance between the following lines whose vector equations are: 4 marks

$$\vec{r} = (1 - t)\hat{i} + (t - 2)\hat{j} + (3 - 2t)\hat{k} \text{ and}$$

$$\vec{r} = (s + 1)\hat{i} + (2s - 1)\hat{j} - (2s + 1)\hat{k}.$$

Q. 22. A random variable X has the following probability distribution: 4 marks

x	0	1	2	3	4	5	6	7
$P(X)$	0	K	2k	2k	3k	K^2	$2K^2$	$7K^2 + K$

Determine:

(i) k

(ii) $P(X < 3)$

(iii) $P(X > 6)$

(iv) $P(0 < X < 3)$.

OR

Find the probability of throwing at most 2 sixes in throws of a single die.

SECTION – C

Question numbers 23 to 29 carry 6 marks each.

Q.23. Using matrices, solve the following system of equations: 6 marks

$$4x + 3y + 2z = 60$$

$$x + 2y + 3z = 45$$

$$6x + 2y + 3z = 70$$

Q.24. A window has the shape of a rectangle surmounted by an equilateral triangle if the perimeter of the window is 12 m, find the dimensions of the rectangle that will produce the largest area of the window. *6 marks*

Q.25. Evaluate: *6 marks*

$$\int \frac{6x + 7}{\sqrt{(x + 5)(x + 4)}} dx$$

Q.26. Sketch the graph of $y = |x + 3|$ and evaluate the area under the curve $y = |x + 3|$ above x -axis and between $x = -6$ to $x = 0$. *6 marks*

Q.27. Find the distance of the point $(-1, -5, -10)$, from the point of intersection of the line

$$\vec{r} = (2\hat{i} - \hat{j} + 2\hat{k}) + \lambda(3\hat{i} + 4\hat{j} + 2\hat{k}) \text{ and the plane } \vec{r} \cdot (\hat{i} - \hat{j} + \hat{k} = 5.) \text{ } 6 \text{ marks}$$

Q.28. Given three identical boxes I, II and III each containing two coins. In box I, both coins are gold coins, in box II, both are silver coins and in box III, there is one gold and one silver coin. A person chooses a box at random and takes out a coin. If the coin is of gold, what is the probability that the other coin in the box is also of gold? *6 marks*

Q.29. A merchant plans to sell two types of personal computers—a desktop model and a portable model that will cost Rs25,000 and Rs40,000 respectively. He estimates that the total monthly demand of computers will not exceed 250 units. Determine the number of units of each type of computers which the merchant should stock to get maximum profit if he does not want to invest more than Rs70 lakhs and his profit on the desktop model is Rs4,500 and on the portable model is Rs5,00. Make an L.P.P and solve it graphically. *6 marks*



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