



Time : 3 Hours

**MATHEMATICS &  
STATISTICS**

Subject Code

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Total No. of Questions : 36 (Printed Pages : 8)

Maximum Marks : 80

- INSTRUCTIONS :**
- (i) The question paper consists of 36 questions.
  - (ii) All questions are compulsory.
  - (iii) Question Numbers 1 to 8 are multiple choice type questions of 1 mark each.
  - (iv) Question Numbers 9 to 16 are very short answer type questions of 1 mark each.
  - (v) Question Numbers 17 to 22 are short answer type-I questions of 2 marks each.
  - (vi) Question Numbers 23 to 28 are short answer type-II questions of 3 marks each.
  - (vii) Question Numbers 29 to 34 are long answer type-I questions of 4 marks each.
  - (viii) Question Numbers 35 to 36 are long answer type-II questions of 5 marks each.
  - (ix) There is no overall choice. However, an internal choice has been provided in *two* questions of 4 marks each and *two* questions of 5 marks each.
  - (x) Use of calculator is *not* permitted.
  - (xi) Log table will be supplied on request.
  - (xii) Graph should be drawn on the answer paper only.

1. A square matrix A is called a Singular matrix if .....

- $|A| = 1$
- $|A| = 0$
- $|A| = -1$
- $|A| \neq 1$

2. Let R be a relation on the set  $A = \{1, 2, 3, 4\}$  given by  $R = \{(1, 1), (2, 2), (3, 3), (4, 4), (1, 3), (3, 1)\}$ , then R is .....

- Reflexive and symmetric but not Transitive
- Symmetric and Transitive but not Reflexive
- Reflexive and Transitive but not symmetric
- Equivalence relation

3. If A and B are square matrices of the same order where A' represent transpose of A, then  $(AB)' = \dots\dots\dots$

- $A'B'$
- $-A'B'$
- $B'A'$
- $-B'A'$

4. If  $y = \sec^3 x$ , then  $\frac{dy}{dx} = \dots\dots\dots$

- $\sec^3 x \tan^3 x$
- $3 \sec^2 x \tan x$
- $3 \sec^2 x$
- $3 \sec^3 x \tan x$

5. The degree of the differential equation  $\left(\frac{d^2y}{dx^2}\right)^3 + 5\left(\frac{dy}{dx}\right)^4 + y = 0$  is .....
- 2
  - 3
  - 4
  - Not defined
6. If A and B are two events such that  $P(A) = 0.8$ ,  $P(B) = 0.5$  and  $P(A \cap B) = 0.32$ , then  $P(B|A) = \dots\dots\dots$
- 0.4
  - 0.04
  - 0.34
  - 0.98
7. A bill of Rs. 3,000 due 8 months hence is discounted now with interest 7% p.a., then the Banker's Discount on the bill is .....
- 700
  - 210
  - 140
  - 1400
8. An annuity in which payments start after the lapse of specified number of payment periods is called .....
- Sinking Fund
  - Ordinary Annuity
  - Annuity Due
  - Deferred Annuity
9. If the points (3, -1), (5, 3) and (-1, K) are collinear then find the value of K using determinants.

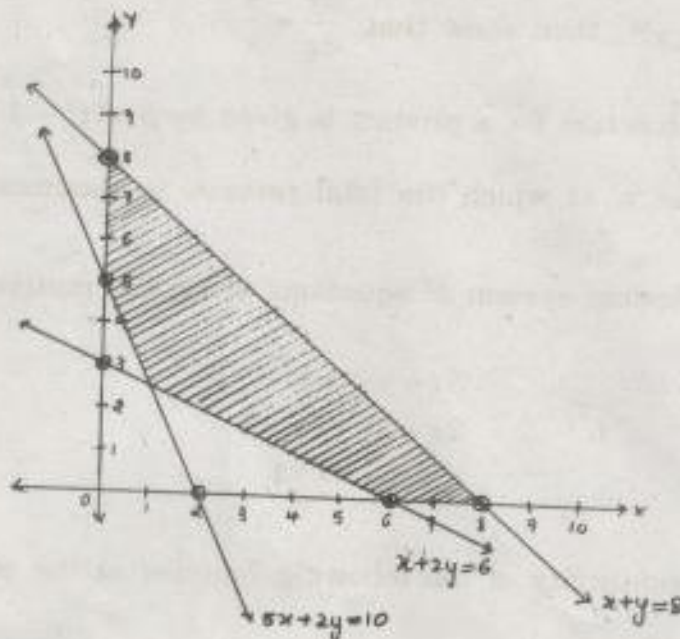


10. If  $f$  and  $g$  are two real functions defined as  $f(x) = 3x - 1$  and  $g(x) = x^2$ , then find  $f \circ g(x)$ .
11. If  $y = \log x$ , then find  $\frac{d^2y}{dx^2}$ .
12. Find  $\int \left( \sqrt{x} - \frac{1}{\sqrt{x}} \right)^2 dx$ .
13. Two cards are drawn successively without replacement from a well shuffled deck of 52 playing cards. What is the probability that both cards are red?
14. Define Banker's Gain.
15. If average cost of producing  $x$  units of a commodity is  $AC = 9x + 25 + \frac{12}{x}$ , then find the total cost function.
16. Define Sacrificing Ratio.
17. Find  $x$  and  $y$  if :

$$\left\{ 2 \begin{bmatrix} 2 & -1 & 3 \\ 1 & 0 & 1 \end{bmatrix} - \begin{bmatrix} 3 & -3 & 4 \\ 2 & 1 & 1 \end{bmatrix} \right\} \begin{bmatrix} 3 \\ -2 \\ 1 \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix}$$

18. On the set  $Q$  of rational numbers, define a binary operation  $*$  by  $a * b = \frac{a+b}{3}$ ,  $a, b \in Q$ . Determine whether  $*$  is commutative and associative.
19. Find  $\int x^2 \log x dx$ .
20. Form the differential equation by eliminating constants  $A$  and  $B$  from  $y = A e^{3x} + B e^{-3x}$ .

21. Write the constraints for the following shaded region :



22. The fixed cost of a product is Rs. 25,000 and the cost of production of a unit is Rs. 400. If the sale of  $x$  units of the product is  $1900x + 100x^2$ , then find the break even values.
23. If  $A = \begin{bmatrix} 3 & -5 \\ -4 & 2 \end{bmatrix}$ , then show that  $A^2 - 5A - 14I = 0$  and hence find  $A^{-1}$ .
24. If  $x = e^t (\sin t + \cos t)$  and  $y = e^t (\sin t - \cos t)$  then show that  $\frac{dy}{dx} = \tan t$ .
25. Evaluate :  $\int_{\pi/6}^{\pi/3} \frac{\sqrt{\sin x}}{\sqrt{\sin x + \sqrt{\cos x}}} dx$ .

26. Solve the differential equation  $x^2 \frac{dy}{dx} = xy - y^2$ .
27. If  $x^3 y^5 = (x + y)^8$ , then show that  $\frac{dy}{dx} = \frac{y}{x}$ .
28. The demand function for a product is given by  $p = x^2 - 15x + 48$ . Find the level of output 'x' at which the total revenue is maximum.
29. Solve the following system of equations using the matrix method :

$$3x - y + z = 5$$

$$2x - 2y + 3z = 5$$

$$x + y - z = -1$$

30. Discuss the continuity of the following function at the point  $x = 0$  :

$$f(x) = \frac{e^{6x} - 1}{\sin 2x} \quad ; x < 0$$

$$= 7 - \cos x \quad ; x = 0$$

$$= \frac{\log(1+3x)}{(\sqrt{1+2x}-1)} \quad ; x > 0$$

31. Solve the following linear programming problem graphically :

Minimise  $Z = 3x + 9y$

Subject to the constraints  $x + 3y \leq 60$

$$x + y \geq 10$$

$$x - y \leq 0$$

$$x \geq 0, y \geq 0$$

32. In a bolt factory, three machines A, B and C are manufacturing 25%, 35% and 40% of the bolts. In a day's production, it is found that 5%, 4% and 2% of the bolts manufactured by machines A, B and C respectively are defective. A bolt is chosen at random from the production and is found to be defective. What is the probability that it is manufactured by A ?

Or

Ravi and Kartik appear in an interview for 2 vacancies of the same post.

33. The probability of Ravi's selection is  $\frac{1}{7}$  and that of Kartik's selection is  $\frac{1}{5}$ . What is the probability that :

- (i) both of them will be selected
- (ii) only one of them will be selected
- (iii) none of them will be selected
- (iv) at least one of them will be selected.

34. A bill was drawn on July 20, 2021 at 3 months after sight and was accepted after presentation on August 1, 2021. It was discounted on August 23, 2021 at 5% p.a. interest to realise Rs. 7,920. Find the face value of the bill.

34. Find  $\int \frac{1-4x}{(x-1)(x+2)(x-3)} dx$ .

Or

Find  $\int \frac{\sec^2 x}{\tan^2 x - 3 \tan x + 2} dx$ .



35. A, B and C engaged in a business and made investment and withdrawal of capital as follows :

A put in Rs. 35,000 on April 1st, 2017 and added Rs. 5,000 on August 1st, 2017. B put in Rs. 25,000 on April 1st, 2017 and added Rs. 5,000 on October 1st, 2017. C put in Rs. 40,000 on April 1st, 2017 and withdrew Rs. 10,000 on September 1st, 2017. The profit for the year ending March 31st, 2018 is Rs. 2,40,000. Find each partner's share if the profits are to be divided on the basis of adjusted capital investment ratio.

Or

X, Y and Z contributed Rs. 42,000, Rs. 30,000 and Rs. 54,000 respectively.

They agreed to pay  $\frac{2}{5}$ th of the profit to Y as manager and to divide the remaining profit in the proportion to their capital. At the end of the year, Y received Rs. 1,90,000. What was the total profit and how much did X and Z receive ?

36. Find the present value of an annuity of Rs. 500 payable at the end of each year for 8 years, if money is worth 5% p.a. compounded annually. (Use log table).

Or

What amount should be deposited in a bank at the beginning of each quarter for 10 years in order to accumulate Rs. 30,800, if money is worth 8% p.a. compounded quaterly. (use log table).