

2025

FUNDAMENTALS OF BUSINESS MATHEMATICS

Full marks: 80

Time: 3 hours

General Instructions:

- i) Approximately 15 minutes is allotted to read the question paper and revise the answers.
- ii) The question paper consists of 28 questions. All questions are compulsory.
- iii) Questions 1 to 10 carry 1 mark each.
- iv) Questions 11 to 18 carry 2 marks each.
- v) Questions 19 to 23 carry 4 marks each.
- vi) Questions 24 to 26 carry 6 marks each.
- vii) Questions 27 and 28 carry 8 marks each.
- viii) Internal choice has been provided in 6 marks and 8 marks questions.

N.B: Check that all pages of the question paper is complete as indicated on the top left side.

Choose the correct answer from the given alternatives in questions 1 to 10.

1. Which of the following is not a set? 1
 - a) The collection of whole number less than 200
 - b) The collection of boys in your class
 - c) The collection of talented actors in Hollywood
 - d) The collection of all books written by Tulsian.

2. If $\begin{vmatrix} 2x & 5 \\ 8 & x \end{vmatrix} = \begin{vmatrix} 6 & -2 \\ 7 & 3 \end{vmatrix}$, then the value of x is _____. 1
 - a) 3
 - b) ± 3
 - c) ± 6
 - d) ± 7 .

3. Which of the following is the formula for calculating the inverse of a matrix? 1
 - a) $\frac{2}{|A|} \times \text{adj}A$
 - b) $\frac{1}{|A|} \times \text{adj}A$
 - c) $-\frac{1}{|A|} \times \text{adj}A$
 - d) $\frac{1}{|2A|} \times \text{adj}A$.

4. The inverse of a matrix $A = \begin{bmatrix} 9 & 2 \\ 4 & 1 \end{bmatrix}$ is _____. 1
 - a) $\begin{bmatrix} 9 & 2 \\ 4 & 1 \end{bmatrix}$
 - b) $\begin{bmatrix} -9 & 2 \\ 4 & -1 \end{bmatrix}$
 - c) $\begin{bmatrix} 1 & -2 \\ -4 & 9 \end{bmatrix}$
 - d) None of the above.

5. Sacrificing ratio=_____. 1
 - a) New ratio - Old ratio
 - b) Old ratio - New ratio
 - c) New ratio + Old ratio
 - d) None of the above.

6. For the purpose of calculation of bill of exchange, it is customary to take the leap year consisting of _____. 1
 - a) 365 days
 - b) 366 days
 - c) 364 days
 - d) None of the above.

7. Days of grace calculated in average due date is _____. 1
 - a) Not considered
 - b) Must be considered
 - c) Should not be ignored
 - d) None of the above.

8. In order to obtain income of ₹ 1,000 from 5% stock at 110, one must make an investment of _____. 1
 - a) ₹20,000
 - b) ₹22,000
 - c) ₹11,000
 - d) ₹10,000.

9. Minimize $Z=4x+6y$, $x+y \geq 1$, $x \geq 0$, $y \geq 0$ is _____. 1
 - a) 10
 - b) 12
 - c) 8
 - d) 4.

10. If 8 litres of water is mixed with x litres of milk and water is 10% of the mixture, then the value of x is _____. 1
 - a) 80 litres
 - b) 72 litres
 - c) 70 litres
 - d) 10 litres.

11. A and B are two sets having 3 elements in common, if $n(A)=4$ and $n(B)=5$, find: $n(A \times B)$ and $n\{(A \times B) \cap (B \times A)\}$. 2

12. Let $A = \{-1, 0, 1, 2\}$ $B = \{-2, -1, 0, 1, 7\}$ show that the function $f: A \rightarrow B: f(x) = x^3 - 1$ is one-one into. 2

13. In a business A, B and C makes a profit of ₹ 20,000 at the end of each year. If the capital of A: capital of B = 2:3 and capital of B: capital of C = 2:5, find their profits. 2

14. If the banker gained on a sum due in 4 months at 3% is ₹ 20. Find the true discount. 2

15. How much stock can be purchased by investing ₹ 4,640 in 5% stock at 110% and brokerage $\frac{1}{8}\%$ and stamp duty 5%? What is the annual income? 2

16. If a person invests a certain sum in 5% stock at ₹ 90 and an equal sum in 8% stock at ₹120. If his income from the later source exceeds his income from the former by ₹ 62. How much does he invest? 2
 17. Write one advantage and one limitation of linear programming. 2
 18. In a 35litre mixture of milk and water there is 60% milk. How much of milk should be added to make the water 35% of the total? 2
 19. If $A = \{-1, 0, 2, 5, 6, 11\}$, $B = \{-2, -1, 0, 18, 108\}$ and $f(x) = x^2 - x - 2$, then examine if $f(A) = B$. 4
 20. A, B and C started a business sharing profits/losses in the ratio of their capitals. The proportion of capital between A and B is 2:3 and that between B and C is 5:6. At the end of the year C received ₹ 6,000 more than B. Find the share of profit of each partner. 4
 21. A bill was drawn on 20th July 2023 at 3 months after sight and was accepted on presentation on 1st August 2023. It was discounted on 23rd August 2023 at 5% per annum. Interest realised was ₹ 792. Find the value of the bill. 4
 22. A man sells ₹ 3,500 stock in 4% at $102\frac{5}{8}$ and invest the proceed in 3% stock at $74\frac{7}{8}$. Calculate the change in his income, brokerage being $\frac{1}{8}\%$ in each case. 4
 23. Graph the system of linear in-equations. Name the geometric figure so formed and find the order pair representing the vertices of the figure. 4

$$\begin{aligned} 2x + 3y &\leq 9 \\ x + 4y &\leq 4 \\ x, y &\geq 0 \end{aligned}$$
 24. **a.** Out of 300 students in a college, 30 students speak all the three languages, English, Nagamese and Hindi, 60 speak English and Nagamese, 90 speak Nagamese and Hindi, 75 speak English and Hindi, 36 speak English only, 15 speak Nagamese only and 24 speak Hindi only. How many students does not speak any of the three languages? (Using algebra of sets method) 6
- Or**
- b.** A school awarded 10 medals in badminton, 15 medals in carrom and 12 medals in table tennis. If these medals went to a total of 25 students and only 2 students get medals in all the three sports. How many received medals in exactly two of the three sports?

25.a. Find a matrix X such that $X \begin{bmatrix} 1 & -2 & 3 \\ 0 & 2 & -1 \\ -4 & 5 & 2 \end{bmatrix} = \begin{bmatrix} 1 & -2 & 3 \\ -4 & 5 & 2 \\ 0 & 2 & -1 \end{bmatrix}$

Or

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b. Given the National Income Determination Model

$$Y = C + I + G$$

$$C = a + b[Y - T]$$

$$T = d + tY$$

Where Y, C and T are endogenous variables and I, G are exogenous variables, a, b, d and t are constants. Write down the above system of equations in matrix form and solve for the endogenous variables.

26. a. Three vats A, B and C are filled with a mixture of spirit and water, the ratio of their volumes is 6:3:1. The ratio of spirit and water in vat A, B and C are 3:1, 4:1 and 5:2. If $\frac{2}{3}$ of the mixture of A, $\frac{1}{2}$ of the mixture of B and $\frac{1}{3}$ of the mixture of C are mix together, then find the ratio of spirit and water in the new mixture thus formed.

Or

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b. A shopkeeper wishes to mix tea at ₹ 80, ₹ 90, ₹ 110 and ₹ 120 per Kg respectively, how must he mixed them using the 1st two kinds in the proportion of 2:1 and the last two kinds in the proportion of 3:2 so that by selling the mixture at ₹ 100 per Kg he may earn $\frac{1}{20}$ of the receipt as his clear profit.

27.a. i) Write Crammer's Rule.

ii) The sum of three numbers is 6. By adding the first and third and subtracting the second we get 2. If we multiply the first number by 2, add the second number and subtract the third number we get 1. Find the number (using Crammer's Rule).

Or

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b. i) Evaluate without expanding $\begin{vmatrix} 1 & bc & a(b+c) \\ 1 & ca & b(c+a) \\ 1 & ab & c(a+b) \end{vmatrix}$

ii) The equilibrium conditions for three related markets are given by

$$3P_1 + P_2 + P_3 = 32$$

$$\text{the equations } -15P_1 + 6P_2 - 5P_3 = 5.$$

$$5P_1 - 2P_2 + P_3 = 1$$

Find the equilibrium price for each market using determinants method.

28. a. In a development plan of a military cantonment, a contractor has taken a contract to build 10 houses of class I and 20 houses of class II. The matrix below shows the amount of each raw materials in truck to be used in each class of house.

	Sand	Bricks	Stone
Class I	7	8	4
Class II	10	7	5

- i) Find how many trucks of each raw materials the contractor should order. (Use matrix algebra)
- ii) If sand ₹ 3,300 per truck, bricks cost ₹ 5,500 per truck and stone cost ₹ 2,000 per truck. Find
 - a) The cost of raw material for each type of house.
 - b) The total cost of raw materials for all the houses.

Or

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- b. i) If $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$ then prove by mathematical induction that

$$A^n = \begin{bmatrix} 1+2n & -4n \\ n & 1-n \end{bmatrix} \text{ where } n \text{ is positive integer.}$$

- ii) A shopkeeper has in stock 40 dozen notebooks, 30 dozen pens and 12 dozen pencils. If the selling price are ₹ 20 per note book, ₹ 10 per pen and ₹ 5 per pencil, Find the total amount, the shopkeeper will get after selling all the items in the stock. (Use matrix algebra)
