

2020**FUNDAMENTALS OF BUSINESS MATHEMATICS**

Full marks : 100

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 26 questions. All questions are compulsory.

iii) Marks are indicated against each question.

iv) Internal choice has been provided in some questions.

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

1. Define equivalent sets. 1
2. What is meant by minor of an element? 1
3. Write the meaning of scalar matrix. 1
4. Define orthogonal matrix. 1
5. Write the meaning of present value. 1
6. What is meant by stock value? 1
7. For any two sets A and B , prove that $(A \cap B)^c = A^c \cup B^c$ 4
8. If A , B and C be any 3 sets, prove that $(A-B) \times C = (A \times C) - (B \times C)$ 4
9. Prove that
$$\begin{vmatrix} 1 & 1 & 1 \\ x & y & z \\ x^3 & y^3 & z^3 \end{vmatrix} = (y-z)(z-x)(x-y)(x+y+z)$$
 4
10. Show that $A^2 - 3A + 2I_3$ is a null matrix if $A = \begin{bmatrix} 1 & 0 & -2 \\ 2 & 2 & 4 \\ 0 & 0 & 2 \end{bmatrix}$ and I is a unit matrix of order 3. 4

11. Show that $\begin{bmatrix} 1/6 & -1/3 & 1/6 \\ -1/3 & 2/3 & -1/3 \\ 1/6 & -1/3 & 1/6 \end{bmatrix}$ is an idempotent matrix. 4

12. If $A = \begin{bmatrix} 4 & -3 \\ 3 & 7 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 2 \\ 11 & -4 \end{bmatrix}$ prove that $\text{adj}[AB] = [\text{adj}B][\text{adj}A]$ 4

13. a. A and B jointly started a business with a capital of ₹ 80,000 and ₹ 90,000 respectively. They agreed to divide 40% of the profit equally between them. The remaining profit would be treated as interest on capital. If at the end of a certain year the share of one partner exceeded that of the other by ₹ 6,000, find the share of each.

Or 4

- b. X and Y are partners sharing profits of the firm in the ratio of 4:5. They admitted Z as a new partner and have given $1/6^{\text{th}}$ share of profit. Find new profit sharing ratio. Z brings ₹ 54,000 as goodwill. Show how this amount will be distributed between X and Y.

14. a. A bill for ₹ 1,224 is due in 6 months. Find the difference between true discount and bankers discount, the rate of interest being 4% per annum.

Or 4

- b. Find the actual rate of interest which a banker earns when it discounts a bill nominally due after 102 days at 5% per annum.

15. a. A person invests equal sums in the 4% and in $4\frac{1}{2}\%$ and obtains equal incomes. If the 4% are at a discount of 4, find the quoted price of the $4\frac{1}{2}\%$.

Or 4

- b. Mr. X wishes to purchase ₹ 40,000, 5% stock at 110. How much will he have to invest? What will be his annual income?

16. a. A milkman mixes 44 pints of water with 356 pints of milk which he buys for ₹ 123. At what price should he sell so as to make one third profit on his outlay?

Or 4

- b. A mixture of 80 litres of milk and water contains 10% water. How much water should be added to it to increase the percentage of water to 20%?

17. a. Graph the solution set of the following system of inequalities

$$-2x + y \leq 10$$

$$3x - 4y \geq -24$$

$$y \leq 4$$

Or**4**

- b. Write any four limitations of linear programming.

18. a. In a survey of a certain school, it was found that 80 students are either egg eaters or meat eater, 30 are egg eaters but not fish, 20 are egg eaters and meat eaters, 18 are egg eaters but not meat eaters and fish eaters and 60 are meat eaters. How many students eat all three items [using algebra of sets]?

Or**5**

- b. A school awarded 10 medals in badminton, 15 medals in carom and 12 medals in table tennis. If these medals went to a total of 25 students and only 2 students get medal in all the three sports, how many received medals in exactly two of the three sports [using algebra of sets]?

19. a. Solve the following system of equations by Cramer's rule

$$2y - 3z = 0$$

$$x + 3y = -4$$

$$3x + 4y = 3$$

Or**5**

- b. Given two goods market model:

Market I

$$D_1 = S_1$$

$$D_1 = 25 - 2P_1 + P_2$$

$$S_1 = -5 + 4P_1$$

Market II

$$D_2 = S_2$$

$$D_2 = 20 + 2P_1 - 2P_2$$

$$S_2 = -10 + 5P_2$$

Obtain equilibrium price $\bar{P}_1$ and $\bar{P}_2$, using Cramer's rule.

20. a. The average due date of four bills was 10th June. Three of the bills were payable as follows:

` 418 on 29th April

` 551 on 3rd June

` 1,007 on 8th July

The 4th bill was for ` 323, on what date was it due?

Or**5**

- b. A merchant's 'goods purchased' and 'payment made' was as follows;

Goods Purchased	Payment Made
August 6 - ` 2,000	August 25 - ` 1,500
September 15 - ` 5,000	September 20 - ` 4,000
October 9 - ` 3,000	

Find out the date on which the balance should be paid to close the account.

21. a. A man invests ₹ 11,600 partly in 4% stock at ₹ 88 and partly in 6% stock at ₹ 120. What is his holding in each, his total income from the investment being ₹ 560?

Or

5

- b. Out of two stocks A and B at ₹ 136.5 and ₹ 125, the former paying 5.5% dividend and the latter 5%, a person purchases ₹ 1,82,000 of the less profitable stock initially and then sells it to invest the proceeds in the other, paying $\frac{1}{8}\%$ brokerage on the stock sold. What is his gain in the return by the change in investment?

22. a. Let R be the set of real numbers and $A = R - \{3\}$ and $B = R - \{1\}$

Let the function $f : A \rightarrow B$ be defined by $f(x) = \frac{x-1}{x-3}$, show that the function f is bijective.

Or

6

- b. i) Let R be the set of real numbers and the function $f : R \rightarrow R$ defined by, $f(x) = x^2$ for all $x \in R$. Show that f is many one into.
 ii) Let N be the set of natural numbers and the function $f : N \rightarrow N$ defined by $f(x) = 7x + 5$ for all $x \in N$. Show that f is one – one into. (3+3=6)

23. a. Mr. Tom invested a total of ₹ 1,500 in three different savings account with annual rates of 5%, 2% and 1%. The total amount yield from this investment is ₹ 38. If he invested equal amounts in the 5% and 1% account. How much amount would be yield from each investment? Use matrix algebra.

Or

6

- b. Food X has 1 unit of vitamin A, 3 units of B and 5 units of C. Food Y has 2 units, 3 units and 5 units respectively and food Z has 3 units of each of vitamin A and C none of B. We need 14 units of A, 9 units of B and 24 units of C. Find by matrix method how much amount of the three foods will exactly feed this requirement .

24. a. A firm is engaged in breeding pigs. The pigs are fed on various products grown on the farm because of the need to ensure certain nutrient constituents, it is necessary to buy additional one or two products which we shall call A and B.

The nutrient constituent (vitamins and proteins) in each unit of the products are given below:

Nutrient	Nutrient Contents of the products		Minimum Amount of nutrient
	A	B	
1	36	6	108
2	3	12	36
3	20	10	100

Product A cost ₹ 20 per unit and product B cost ₹ 40 per unit. How much of products A and B should be purchased at the lowest possible cost so as to provide the pigs nutrients not less than that the minimum required as given in the table?

Or

6

- b. A small scale manufacturer has production facilities for producing two different products P and Q. Each of the product needs three different operations: grinding, assembling and testing. Product P needs 1, 3 and 4 minutes to grind, assemble and test respectively whereas product Q needs 4, 1 and 3 minutes for grinding, assembling and testing respectively. The production run calls for at least 40 minutes of grinding time, at least 30 minutes of assembling time and at least 60 minutes of testing time. If product P cost ₹ 20 and product Q cost ₹ 10 to manufacturer, using graphic method, determine the number of units of each product the firm should produce in order to minimize the cost operations.

25. a. A grocer sells one kind of tea at ₹ 2.16 per kg and losses 10% and another at ₹ 3.24 per kg and gain 12.5%. How should they be mixed so that the mixture may be sold at ₹ 3.15 per kg at a profit of 25%?

Or

6

- b. Two grades A and B of oil are mixed in the proportion of 2:5. After 20% of this has been sold from stock, a sufficient quantity of A is mixed with the remainder to raise the proportion to 4:7. If the stock is now 1100 gallons, what was the quantity of the original mixture and how much of grade A was added to make the new mixture?

26. a. Three men A, B and C go into a business, A contributing ₹ 5,000, B ₹ 3,000 and C ₹ 2,500 of the capital, on the understanding that after allowing $\frac{1}{8}$ of the profit to C as manager, the remainder should be divided among them in proportion to the amount of capital contributed by each. At the end of the year, C received ₹ 280. What were the total profits of the business and how much did A and B received respectively?

Or

6

- b. L, M and N invested ₹ 50,000, ₹ 35,000 and ₹ 25,000 to form a partnership firm. It is agreed that L and M will get 20% and 10% of the profit as remuneration for supervising the firm. The balance will be distributed among the partners in the ratio of the capital invested. In a year, if L gets ₹ 1,290 more than M, find the share of each partner.
