

2018
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 complement of a set. 1
2. Define an orthogonal matrix. 1
3. What is inverse of a matrix? 1
4. What is meant by discounted value of a bill? 1
5. What is meant by average due date? 1
6. Write one difference between yield and dividend. 1
7. Show that $A - (B \cup C) = (A - B) \cap (A - C)$ with the help of Venn diagram. 4
8. Show that the relation R defined by "is congruent to" on the set of all triangles in a plane is an equivalence relation. 4
9. Using properties of determinants, prove that 4

$$\begin{vmatrix} b+c & c+a & a+b \\ q+r & r+p & p+q \\ y+z & z+x & x+y \end{vmatrix} = 2 \begin{vmatrix} a & b & c \\ p & q & r \\ x & y & z \end{vmatrix}$$
10. If $A = \begin{bmatrix} 3 & -5 \\ -4 & 2 \end{bmatrix}$ and $A^2 = 5A + KI$ then find the value of K. 4

11. If $A = \begin{bmatrix} 5 & 6 \\ 9 & 7 \end{bmatrix}$, show that $A - A'$ is a skew-symmetric matrix and $A + A'$ is a symmetric matrix. 4
12. P, Q and R are three partners of a firm. The total of their capital contribution is ₹ 10,000. P's capital is ₹ 800 more than that of Q and ₹ 1,200 more than that of R. The profit made is ₹ 4,000. How will they share the profit if the profits are proportional to the capitals? 4
13. a. The true discount and banker's discount on a bill due in three months hence are ₹ 50 and ₹ 51 respectively. Find the amount of the bill and the rate of interest. 4
- Or**
- b. A man owes ₹ 27,489 and desires to pay in 73 days. The creditors demands a bill at 73 days for an amount that if immediately discounted at 10% would yield the same amount due. For how much should the bill be drawn?
14. a. The average due date of four bills was June 26. Of these the first three bills were for ₹ 100, ₹ 200 and ₹ 80 due respectively on June 2, June 18 and July 3. The 4th bill was due on July 16. Find the amount of the 4th bill. 4
- Or**
- b. Mr. Konjoj purchased a calculator with cash down ₹ 600. If he buys it on installment basis, then he pays ₹ 50 cash down and 13 monthly installments of ₹ 50. Calculate the rate of interest in the second case.
15. a. Which is the better investment:
i) 4% stock at 95 or ii) 5% stock at 120 4
- Or**
- b. How much stock are to be sold to realize ₹ 43,960 by selling at premium of ₹ 10, brokerage being $\frac{1}{10}\%$ and stamp duty 3%?
16. a. Sketch the graph of the following system of inequations:
 $x + y \geq 2$
 $x \leq 2$
 $y \leq 1$ 4
- Or**
- b. Write any four limitations of LPP.
17. a. A fruit seller buys two kinds of oranges ₹ 600 and ₹ 400 per hundred. He mixes them and sells them at ₹ 600 for 120 and thereby realizes a profit of 10%. In what proportion does he mix them?

Or**4**

- b. 120kg of vegetable ghee was mixed with pure ghee to make it 70% pure. A shopkeeper tries to improve the quality by putting a further 80 kg of pure ghee into the mixture. What is the percentage of pure ghee in the new mixture?

18. a. In a survey of 200 students, it was found that 21 students take 3 drinks- milk, coffee and tea, 40 take milk and coffee, 60 take coffee and tea, 52 take milk and tea, 20 take milk only, 10 take coffee only and 15 take tea only. Using venn diagram, find how many do not take any of the three drinks.

Or**5**

- b. In a group of 100 persons, 70 watch football, 50 watch both football and basketball and all the person watch at least one of the two games. By using Venn diagram, find how many person watch i) only basketball ii)only football.

19. a. Prove that the matrix A given by $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ satisfies the relation

$$A^2 - A(a+d) + (ad - bc)I = 0 \text{ Where, } I \text{ is a unit matrix of order 2.}$$

Or**5**

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

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

20. a. The equilibrium condition for 3 related markets is given by

$$11P_1 - P_2 - P_3 = 31$$

$$-P_1 + 6P_2 - 2P_3 = 26$$

$$-P_1 - 2P_2 + 7P_3 = 24$$

Using matrix inversion, find the equilibrium price for each market.

Or**5**

- b. Let $A = \begin{bmatrix} 5 & 3 \\ 12 & 7 \end{bmatrix}$, verify that $A^2 - 12A - I_2 = 0$ and hence obtain A^{-1} .

21. a. A man finds that if he invest his money in 4% at 120, his income will be `90 more than what he would get by investing his money in 5% at 160. How much did he invest?

Or**5**

- b. Having a certain sum to invest, a man puts half of it in 5% stock at 105 and the other half in 4% stock at par, the price in each case being inclusive of brokerage. If he had invested 2/3 of it in the first and rest in the second, his annual income would have been ` 2.50 more. How much did he invest?

22. a. Show that the relation R in the set $A\{2,3,4,5,6\}$ given by $R = \{(x, y) : |x - y| \text{ is an even number}\}$ is an equivalence relation.

Or

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- b. 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.

23. a. An amount of ₹ 10,000 is put into three investment at the rate of 10%, 12% and 15% per annum. The combined income is ₹ 1,310 and the combined income of the first and second investment is ₹ 190 short of the income from the third. Find the investment in each, using determinant method (Cramer's Rule).

Or

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- b. The total cost C for a manufacturer producing two items x and y is given as

$$C = l + mx + ny$$

Data for three months are as follows:

Months	Cost (₹)	No. of items produced	
		x	y
1	5,800	30	20
2	5,400	40	10
3	6,200	50	20

Determine l , m and n using determinant method. Also obtain the cost in the next month for producing item $x=45$ units and $y=15$ units.

24. a. The gross profit of a business are divided as follows:
15% for depreciation, 10% for reserve, 5% as interest on capital invested and the remaining is divided among three partners in the proportion of 3 parts to A, 2 parts to B and $\frac{3}{2}$ parts to C. Suppose the gross profit is ₹ 25,000 and the capital invested by A, B and C respectively to be ₹ 40,000, ₹ 35,000 and ₹ 25,000, how much does each of the three partners receive?

Or

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- b. A, B, C and D formed a partnership and contributed ₹ 50,000, ₹ 45,000, ₹ 30,000 and ₹ 35,000 respectively. They agreed to set aside 15% of profit in a year as reserve and distribute $47\frac{1}{17}\%$ of the balance of profit equally among them. The remaining profit is divided as interest on respective capitals. If B

receives in all ₹ 4,500 more than D in a year, find the total profit earned in that year. Find also the shares of profit distributed to A and B.

25. a. Solve graphically the following LPP.

$$\text{Minimize } Z = 5x_1 + 6x_2$$

Subject to the constraints

$$x_1 + x_2 \leq 1$$

$$2x_1 + x_2 \geq 4$$

$$2x_1 + 3x_2 \geq 6$$

$$x_1, x_2 \geq 0$$

Or

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- b. Solve graphically the following LPP

$$\text{Maximize } Z = 4x + 6y$$

Subject to the constraints

$$x + y \leq 5$$

$$x \leq 2$$

$$y \leq 4$$

$$x, y \geq 0$$

26. a. In mixing tea, 1kg of every 100 kg is wasted. In what proportion must a dealer mix teas which cost him ₹ 42 and ₹ 32 per kg respectively so as to gain 10% by selling the mixture at ₹ 40 per kg?

Or

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- b. A grocer wishes to mix teas at ₹ 120, ₹ 130, ₹ 140 and ₹ 170 per kg respectively; how much he mixes them (using the first two kinds in the proportion of 3:2 and the last two in the proportion of 2:3) so that by selling the mixture at ₹ 150 per kg, he may earn $\frac{1}{10}^{\text{th}}$ of the receipts as his clear profit?
