2021
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. What is meant by unit matrix?   **1**

3. Define the term discounted value of a bill.   **1**

4. What is meant by joint stock company?   **1**

5. Write the meaning of linear programming problem.   **1**

6.   Define objective function.   **1**

7. Show that $(A \cup B)^c = A^c \cap B^c$ **4**

8. Let *R* be a relation "is less than" from $A = \{2,4,6\} to B = \{1,5,7\}$
    i) Write down the Cartesian product corresponding to *R*
    ii) Write down the domain and range.
    iii) Find $R^{-1}, Dom(R^{-1}), \text{Range}(R^{-1})$ **4**

9. Evaluate (without expanding) $\begin{vmatrix} 12 & 16 & 20 \\ 5 & -6 & 3 \\ 3 & 4 & 5 \end{vmatrix}$ **4**

10. If $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} and\ B = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$
    show that $(aA + bB).(aA - bB) = (a^2 + b^2)A$

                                                                                                    4

11. If $A = \begin{bmatrix} 5 & 6 \\ 7 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$ verify that $(AB)^{-1} = B^{-1}A^{-1}$ **4**

12. *A, B* and *C* are partners in a partnership firm, *A* gives ₹3,000 more than *B* and *B* give ₹4,000 more than *C*. A's contribution was ₹12,000. But *A* had contributed only for 2 months, *B* for 6 months and *C* for 7 months. The profit made by the firm was ₹22,600. Find their respective shares if the profit was to be distributed on the basis of their contributions.   **4**

13. **a.** The true discount of ₹1,147.50 due after some time is ₹22.50 at 3% per annum. When is the sum due?
                                    Or   **4**
    b. The difference between the bankers' discount and the true discount on a bill due after $7\frac{1}{2}$ months at 5% is ₹9. Find the
       i) True discount
       ii) Bankers' discount
       iii) Amount of the bill.

14. **a.** Which is the better investment of the following?
       i) 2% stock at 90,
       ii) 3% stock at 95,
       iii) 4% stock at 120.
                                    Or   **4**
    b. A person sells ₹8,000, 5% stock at 98 and invest the proceeds in 6% stock at 105. Find the change in his income.

15. **a**. Write any four advantages of linear programming.
                                    Or   **4**
    b. Write any four applications of linear programming.

16. **a**. Graph the system of in equation. Name the geometric figure so formed and
                                                    $x + y \leq 200$
       find the ordered pairs representing the vertices $y - 4x \geq 0$
                                                    $x \geq 20$
                                    Or   **4**
    b. Exhibit graphically the solution of the linear constraints
       $3x + 2y \leq 6$
       $y + 4x \leq 4$
       $x, y \geq 0$

17. **a.** In what ratio must a grocer mix tea at ₹72 per kg with tea at ₹48 per kg so that by selling the mixture at ₹63 per kg, he may gain $\frac{1}{6}^{th}$ of his outlay?

<div align="center">Or</div>   **4**

    b. A fruit seller buys two kinds of oranges at ₹60 and ₹40 per hundred. He mixes them and sells them at ₹60 for 120 and thereby realizes a profit of 10%. In what proportion does he mixes them?

18. **a.** In a class of 40 students, 27 students have taken Economics, 21students have taken Economics but not Education. All the students have taken at least one of the two subjects. Find the number of students who have taken
i) Economics and Education
ii) Education but not Economics.

<div align="center">Or</div>   **5**

    b. In a survey of college students, it was found that 40% use their own books, 50% use library books, 30% use borrowed books, 20% use both their own books and library books, 15% use their own books and borrowed books, 10 % use library books and borrowed books and 4% use their own books, library books and borrowed books. Calculate the percentage of students who do not use any book at all.

19. **a.** If $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$ then prove by mathematical induction that $A^n = \begin{bmatrix} 1+2n & -4n \\ n & 1-2n \end{bmatrix}$ where n is a positive integer.

<div align="center">Or</div>   **5**

    b. *A, B, C* and *X* are four matrices given that

$$A = \begin{bmatrix} 1 & 2 & -3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 & -2 & 7 \\ 0 & 1 & -2 \\ 0 & 0 & 1 \end{bmatrix} and \ C = \begin{bmatrix} 0 \\ 11 \\ 5 \end{bmatrix} and \ X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

i)Verify $AB = BA = I_3$ *(I is a unit matrix of order3)*
ii) If $X = BC$, find x_1, x_2 and x_3

20. **a.** A bill due 7 months hence was accepted on 12th August, 2014. By discounting it at 5%, the banker gained ₹10 and it is $\frac{1}{50}$ of the true discount at the same rate. Find the date on which it was discounted and the amount of the bill.

<div align="center">Or</div>   **5**

    b. A bill for ₹28,050 is drawn on 22-04-1950 at 11 months and is discounted on 11-1-1951. If the rate of interest is 10% per annum, find the banker's gain. Verify the result by finding the true discount and the banker's discount.

21. **a.** 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 $\frac{2}{3}$ of it in the first and rest in the second, his annual income would have been ₹2.50 more. How much did he invest?

Or 5

b. A man who holds ₹3,900 of 4% stock and ₹2,400 of 7 % stock wants to sell out the former at 82 and the latter at 118 and reinvest the proceeds partly in a 5% stock at 96 and the rest in 6% stock at 108 so as to get exactly the same income as before. How much of each stock must he buy?

22. **a.** Let R be the relation in N x N which is defined by $(a,b) R (x,y)$ iff $a+y=b+x$, Prove that R is an equivalence relation.

Or 6

b. If R is an equivalence relation on a set A. Verify that R^{-1} is also an equivalence relation on the set A.

23. **a.** Food *I* has 5units of A, 7 units of B and 2 units of C. Food *II* has 0, 4 and 6 units respectively and Food *III* has 4, 0 and 6 units respectively. Find by determinant method, how much amount of the three foods will be exactly required if we need 39 units of A, 37 units of B and 66 units of C?

Or 6

b. National income determination model is given by

$Y = C + I + G$
$C = a + b (Y - T)$
$T = d + tY$

Where Y = National income
C = Consumption expenditure
T = Tax collection
t = Income tax rate

Find using Cramer's rule method, the value of Y, C and T in terms of the rest of the variables and constants.

24. **a.** Find the inverse of $\begin{bmatrix} 2 & 1 & 4 \\ 1 & 4 & 2 \\ 2 & 3 & 1 \end{bmatrix}$ also show that the product of the matrix and its inverse is an identity matrix.

Or 6

b. Find a matrix X such that $X. \begin{bmatrix} 3 & 4 \\ 6 & 2 \end{bmatrix} = \begin{bmatrix} 2 & 8 \\ 9 & 4 \end{bmatrix}$

25. **a.** *A*, *B* and *C* were partners, they had contributed toward the capital of the firm ₹12,000, ₹9,000 and ₹6,000 respectively on which they were entitled to get interest at 5% per annum. They shared profit or loss in the proportion of 5:4:2. If in 1 year *A* received ₹2,772 more than what *C* got, what was the total profit in the business and what amount did each receive?

<div align="center">**Or**</div>   **6**

   b. The gross profit of a business are divided as follows: 10% for depreciation, 7% for reserve, 5% as interest on capital invested and the remainder is divided among three partners in the proportion of 2 parts to *A*, 3 parts to *B* and $\frac{5}{3}$ parts to *C*.

   Suppose, if the gross profits was ₹35,000 and the capitals invested by *A*, *B* and *C* respectively was ₹50,000, ₹70,000 and ₹80,000, how much does each of the partners receive?

26. **a.** A shopkeeper wishes to mix teas at ₹80, ₹90, ₹110, ₹120 per Kg respectively. How will he mix them using the first two kinds in the proportion of 2:1 and last two in the proportion of 3:2 so that by selling the mixture at ₹100 per Kg, he may earn $\frac{1}{20}$ of the receipts as his clear profit.

<div align="center">**Or**</div>   **6**

   b. 200Kgs of vegetable ghee was mixed with pure ghee to make 80% pure. A dealer tries to improve the quality by putting a further 30Kgs of pure ghee into the mixture. What is the percentage of pure ghee in the new mixture?

<div align="center">***************</div>